USING CRITERION REFERENCED ASSESSMENT IN A LIVING ENVIRONMENT

CURRICULUM

by

Shane H. Turybury

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CERTIFICATION OF PROJECT WORK

We, the undersigned, certify that this project entitled Using Criterion Referenced Assessment in a Living Environment Curriculum by Shane H. Turybury, Candidate for the Degree of Master of Science in Education, Inclusive Curriculum and Instruction, is acceptable in form and content and demonstrates a satisfactory knowledge of the field covered by this project.

Master’s Project Advisor
EDU 691 Janeil C. Rey, Ph.D.
Department of Language, Learning and Leadership

Mira Tetkowski Berkley, Ph.D.
Department of Curriculum and Instruction

Dean Christine Givner, Ph.D
College of Education
At SUNY Fredonia

5/2/12
Date

5/11/12
Date

5/22/12
Date
Abstract

This purpose of this curriculum project was to design Criterion Referenced Assessment’s (CRA’s) that to be implemented into a New York State (NYS) Living Environment Curriculum to provide an ongoing means of formative assessment. All CRA’s within the project are aligned with the NYS Living Environment curriculum objectives and standards. CRA data can provide teachers with information that can influence their future instructional decisions. For the project, twenty-four daily CRA’s were made and four units were developed in connection to the four Living Environment units of Ecology, Mitosis, Meiosis, and DNA/RNA. By design, answers for each CRA are provided, as well as, two scoring matrices to link CRA scores to re-teaching strategies based on student group and test question scores. The data obtained from the CRA’s will then be utilized by the teachers to influence future instructional decisions as well as help students recognize what more is needed to be learned in order to meet criterion mastery.

Limitations of this project are developing CRA’s for a partial amount of the NYS Living Environment curriculum (four units) and just two scoring matrices. Therefore, further research can be conducted to investigate whether or not the creation of CRA’s for the complete Living Environment curriculum and additional scoring matrices further enhanced the feedback mechanism of the project. Furthermore, an empirical study on the effectiveness of this tool on student state tests scores and implementing this tool into other content areas can be conducted.
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**Introduction**

Since the implementation of No Child Left Behind (NCLB 2002), classroom teachers have become increasingly accountable for their student’s achievement and test scores. Consequently teachers need tools to be able to monitor student progress and make future instructional decisions. Standardized tests and summative assessments have become the prominent form of assessment used to indicate student achievement, gage students’ progression of learning, and provide data for instructional decisions. Summative assessments only measure a student’s knowledge on one day at one time the moment the test is given. They also measure a student’s knowledge after the learning has occurred. Another type of assessment, formative assessments measure a student’s progress throughout the course of the year using various assessment formats such as Portfolios, Criterion Referenced Assessments (CRAs), Curriculum Based Assessments (CBA’s) and Naturalistic assessment. The purpose of this curriculum project is to design a curriculum that incorporates CRA’s into the New York State (NYS) Living Environment Curriculum to provide a means of formative assessment and feedback mechanism for re-teaching content and making future instructional decisions. Incorporating CRA’s into the curriculum will also allow teachers to monitor student progress more efficiently.

Student achievement has always been an important goal of education. Over the past two decades student test scores has come to the forefront of educational politics, with the implementation of No Child Left Behind (NCLB). Classroom teachers continue to become more accountable for their student’s achievement, and standardized and summative tests are currently the prominent method of testing used to make instructional decisions and measure student knowledge. As I pursue my Masters of Science in Curriculum and Instruction and my professional certification in Biology, I want to be able to assess my students in a manner that
allows me to make the most effective instructional decisions for the benefit of my student’s learning. Incorporating CRA’s into the Living Environment curriculum will allow for the use of an assessment tool that provides the instructor knowledge of student learning as it is occurring. This will allow the instructor to make more effective instructional decisions and help the students get reinforcement more quickly in the areas they don’t understand. Scoring matrices will also be incorporated to be used with the CRA’s and provide useful instructional strategies to re-teach material based on student CRA scores.

Criterion Referenced Assessment’s (CRA’s) are very effective tools for assessing student achievement and making instructional decisions. CRA’s use numerous items per area to test a limited knowledge domain and are designed specifically to measure student’s performance on learning tasks (Taylor, 2010). The goal of using CRA’s is to check if students have learned the material just as in any other assessment tool. CRA’s focus on the objective of the lesson or unit and the assessment is created from this objective. For example if the lesson objective is “The student will be able to describe the process of photosynthesis”, then the assessment will be created to test the student’s knowledge and understanding of the objective. The differences between CRA’s as opposed to summative and standardized tests are the ability to make more effective instructional decisions, gain student performance results quicker and more often, and use measures that are directly related to the content being taught. Norm-referenced assessments compare student’s scores to the “norm”, mean or average of other student’s scores on the same test. The raw scores are put into a standard bell curve to create a normalized set of scores that compare student’s test to the average score of their peers. Criterion-Referenced Assessments do not normalize student data; rather they test how well students understand the predetermined criteria. It is very important to link instruction and assessment (Blakenship, 1985). CRA’s are
designed to help link the assessment of students to the curriculum and instruction and allow for better instructional decisions and hopefully increased student learning of the curriculum being taught. With the use of the scoring matrices with the CRAs teachers can change their future instruction using data-based intervention strategies to help increase student learning and create more effective lessons.

The goal of this curriculum project to design CRA’s for the NYS Living Environment curriculum and scoring matrices to be used with the CRA’s in order to provide a tool for teachers to increase student learning, make effective instructional choices and appropriately use formative assessment. Traditional summative assessments are similar to CRA’s but are lacking in their ability to return useful feedback to the instructor and to the students in a timely manner. A formative assessment checks the student’s knowledge compared to the objective of the lesson and is administered throughout the learning process. Summative assessments measure the student’s learning after it has occurred while CRA’s measure it while it is still occurring. CRA’s allow some of the following questions to be answered when used correctly: What do students know? Where are they going? What did they learn? What did the students know before the unit started (Moxley Jr., 1972)? By being able to answer these questions with the data received from CRA’s, a teacher can then make a more accurate measure of student’s knowledge and what areas need to be re-taught.

For this curriculum project, CRA’s will be designed and integrated into the NYS Living Environment units of Ecology (population interactions, ecosystems, and human impact), Meiosis and sexual reproduction (production of gametes, fertilization, human and mammal development), Mitosis (cell cycles, cell division, and cancer), and DNA and RNA (structure, replication, transcription, translation and the genetic code). The individual lessons within each unit will be
designed for an 80-minute block class. A CRA will be designed to be administered every lesson and will also serve as a replacement to the typical unit summative exam. The assessments designed will average 2-6 questions per day and will be aligned with the objectives stated in the lessons for each day and with NYS Living Environment standards. The end of unit assessments will address all the objectives for all lessons in the unit to create a comprehensive assessment that focuses on the criterion students were expected to learn. Guidelines, in the form of two scoring matrices will be designed to help teachers interpret results from the assessments and select appropriate intervention and future teaching strategies that address the student’s needs based on their CRA scores.

According to Moxley (1972) “the usefulness of criterion-referenced tests is determined by the consequences of the feedback from such tests.” (p.61) It is not only important to design the assessment correctly but adequate feedback is needed for CRA’s to be useful. Without proper feedback these assessments in essence act the same way as a summative/standardized test. The difference between summative and formative assessments lies in formative assessments ability to provide continuous feedback to students to aid them in the learning process. This allows the teachers to better understand student knowledge of content, for example, determining what areas need more support and allows students to understand their level of learning more thoroughly as well. Thus it is the purpose of this curriculum project to design a curriculum that incorporates CRA’s into the Living Environment Curriculum to provide a formative style of assessment. By incorporating CRA’s into the curriculum it will allow teachers to monitor student progress more efficiently and to make more effective instructional decisions in guiding future instruction. It will also allow teachers and students to have a better understanding of the student learning process and level of understanding of the content.
Literature Review

All articles included in this review were obtained through the online EBSCO Host search engine provided using the specific databases of ERIC, Education Research Complete, and Academic Search Complete. Search terms included “NCLB”, “effective formative assessments”, “uses of summative assessments”, “CRA”, “using formative assessments to make instructional decisions”, and “NYS Living Environment curriculum”. Only those articles with close relevance to the curriculum projects goals were included. The research articles must have met the following criteria to be considered relevant and significant to the research question:

1) Contained novel research in the article.

2) Included topics discussing NCLB, testing, using testing to make instructional choices, the values of formative assessments in making instructional choices, the benefits of CRA’s or incorporating CRA’s into curriculum to help make better instructional choices and to increase student learning in the abstract.

3) Revealed that the topic being researched was pertinent to the design of this curriculum and supported the implementation of CRA into a curriculum in the findings and discussion sections.

4) Selected only after it was found to be relevant and of quality research.

Literature that will be reviewed will focus on the curriculum project problem. The purpose of this curriculum project is to design a curriculum that incorporates CRA’s into the New York State (NYS) Living Environment Curriculum to provide a means of formative assessment. Incorporating CRA’s into the curriculum will allow teachers to monitor student progress more efficiently and to make more effective instructional decisions in guiding future instruction. The literature will be broken up into four sub-categories of No Child Left Behind
(NCLB), Criterion Referenced Assessments (CRA’s), NYS Living Environment Curriculums, and incorporating CRA’s into curriculums. Some of these topics will be broken down further to create a more organized discussion of the literature and to provide a clearer of what the current ideas are in these fields of research. A review of the literature begins with an analysis of the federal No Child Left Behind Legislation adopted in 2001.

**NCLB and the Effects on Testing**

No Child Left Behind (NCLB) is a bi-partisan supported federal law that focuses on accountability, the need for highly qualified teachers, expanded parental involvement, and the use of scientifically based research methods (Simpson, LaCava & Graner, 2004). It is the most significant educational law enacted in the past few decades. “NCLB was largely the product of frustration. It was crafted by Washington policy makers fed up with the seeming refusal of educators to accept responsibility for mediocre performance or to concede the need to address schools that were massively failing black, Latino, and poor children.” (Hess & Rotherham, 2007, p. 347) The primary goal of NCLB is to get students to perform at a proficient level (accountability) according to the state goals set in accordance to NCLB and to reduce the achievement gap between middle class white students and minority students, poor students, and students with disabilities (Simpson, LaCava & Graner, 2004). Although the goal of NCLB was to help students in the above categories and to help all students perform at higher levels the law has a one-size fits all approach that doesn’t take into consideration student’s different abilities and needs (Weaver, 2007).

Since the implementation of No Child Left Behind (NCLB, 2001) there has been an increased focus on high stakes testing to help measure adequate yearly progress. The goal of NCLB was to make learning available to all students including those with intellectual
disabilities, hence the name of “No Child Left Behind”. What it has done in reality is place an extraordinary pressure on students to pass state tests every year. As noted above many critics agree that NCLB has hindered the progress of students in minority groups and students with disabilities. NCLB requirement that school demonstrate Adequate Yearly Progress (AYP) is similar to a reward and punishment system for a classroom where schools and students are extrinsically motivated to perform. In this type of classroom program students are rewarded with stickers, movement up a behavior chart or with erasers, pencils, and other tangible desirable items for behaving well, following directions, or performing well on activities and assignments. Punishments include absence of the rewards or movement down behavior charts in consequences of poor behavior, not following directions or refusing to do work. Research in the field of rewards and punishments has shown extrinsic motivation (a reward, or a punishment) to be less effective than intrinsic motivation (students learning for praise, approval or because they enjoy it) (Bracey, 1994). In the scheme of NCLB the results of the state tests act as extrinsic motivators as students are in the majority only learning the material to achieve high test scores (test mastery) or to pass the state test. This creates a situation where students only learn material for the test and forget it shortly after. The schools are treated the same way, if they meet AYP they get a reward of continued or more federal money, if not they are punished with less federal money and even at times state intervention and take over of the entire school (Simpson, LaCava & Graner, 2004; Weaver, 2007). Thus the schools use programs suggested by NCLB advocates to get more rewards and teach to the tests so as to avoid punishment.

The emphasis on testing places time constraints on schools and has caused many schools to eliminate other programs such as the arts to spend more time on preparing students for the statewide exams at the end of the year (Weaver, 2007). According to Hess and Rotherham
(2007), another initiative that was implemented in 2007, called “American Competiveness Initiative” (ACI) focuses on preparing students in the fields of math, science and technology so that America can better compete in this new global economy where we are failing. The ACI and NCLB have similar goals in increasing student achievement but seem to be on a collision course because of ACI’s call to boost Americas “competiveness” in the global community, and NCLB goal to create educational equality (Hess & Rotherham, 2007). The ACI calls for competiveness among students which would leave many students behind as the white middle class students or students who are more affluent and better at learning in the American school system would excel while other students of differing learning styles and backgrounds would be left behind. The goals of NCLB are extremely difficult to meet, as some of the top schools in the country have not met the goals because each state has different criteria to meet (Weaver, 2007). Not meeting the NCLB goals gives schools a bad image and thus schools focus on the test and trying to prepare their students the best they can for the end of the year state exam.

Some of the more positive aspects of NCLB include its focus on teacher accountability, reducing the learning gap between minority students and majority students and a national set of guidelines to focus content standards. Schools and states across the country have been working hard to fulfill the requirements of NCLB (Peterson, 2005). Providing guidelines to states for academic achievement has caused every state to be accountable for student achievement, create standards for most classes and provide assessments that measure students learning of these standards. This has helped to reduce learning gaps and to hold everyone in the school system including the student accountable for student learning.

Adequate Yearly Progress (AYP) is the measurement used to determine whether or not schools are meeting NCLB mandates. To keep track of AYP states have implemented summative
assessments to show student improvement. Summative assessments are given periodically to
determine a student’s level of knowledge in a particular category and include: state assessments,
district benchmark or interim assessments, end-of-unit chapter tests, end-of-term or semester
exams and scores that are used for accountability of schools and students (Garrison &
Ehringhaus, 2007). Just as with literacy programs suggested by NCLB there were no alternative
suggestions on how to measure AYP (Whitfield, 2005). NCLB focuses on summative
assessments, however it remains to be seen if this style of assessment adequately measures
student’s knowledge and if it is useful to teachers in making future instructional choices.

The NYS Regents exams are standardized tests used to determine student’s advancement
and knowledge level. According to answer provided to What is the purpose of NYS regents
exams? (2010) the NYS regents are used to help distribute funds to school, measure student
progress and knowledge, and if passed provide Regents credits students need to get a regents
diploma. The University of the State of New York (2012) provides teachers with a scoring guide
to each edition of the regents that is created. From this scoring guide it is seen that the regents
has a raw score and a scale score. The scale score is out of 100 allowing the state of New York to
report percentages. According to DeMauro (2002) “0 represents no performance, 100 represents
highest possible performance, 65 represents achievement of the standards, and 85 represents
achievement of the standards with distinction.” In the development of the Regents exam the
questions included undergo field testing. During field testing the questions are given to
thousands of students and the results help the creators of the Regents make changes based on
statistical evaluations (DeMauro, 2002). “These statistics describe the test questions in terms of
their difficulty and the degree of relationship between performance on each question and
performance on whole sets of questions designed to measure the same learning standards.” (DeMauro, 2002).

As far as scaling goes this is how it is accomplished: “Student scores are put on the same scale as item difficulty, using what is called IRT, or item response theory models. These models work as follows: Student performance is located on a scale with item difficulties. If the student is higher on that scale than an item is difficult, it means that a student performing at that level has a greater than 50 percent chance of answering that item correctly. If a student is lower on the scale than an item is difficult, than a student performing at that level has less than a 50 percent chance of answering the item correctly. Remember, the questions are screened to have these scale properties, so that these determinations of probabilities are accurate for any given set of questions. The further the distance between a student’s performance and an item’s difficulty, the greater the probability for the student to answer correctly or incorrectly.” (DeMauro, 2002). Thus the raw score students receive on the Regents is converted into a scaled score which is scaled based on the difficulty of the question and this scale score is the score that is reported as the students score on the Regents. The Regents exam is considered a summative exam. Moving forward the literature on summative assessments will be reviewed.

**Summative assessments**

A summative exam is an assessment that tests student knowledge after the learning has taken place and has the goal of gauging students learning relative to content standards at a particular point in time (Garrison & Ehringhaus, 2007). An example of this type of assessment would be a state exam needed to show adequate yearly progress as mandated by NCLB. This tends to cause teachers to teach to the test and for students to learn only for the test. “On the first day of school, a sixth-grader at a California middle school raised his hand and asked the teacher,
‘Is there anything we will be learning this year that we need to remember for longer than the test?’ (Weaver, 2007, p. 45) The aforementioned quote is an example of a student’s view of the purpose of learning. If we continue on this track, students will be learning just to pass tests and will retain no information after the test. The current use of summative testing puts the test too far down the path of learning which makes it difficult to gain classroom level information from the test and to use the test to make instructional adjustments (Garrison & Ehringhaus, 2007). If used correctly summative assessments can be useful in determining student knowledge and viewing student progress. Under the current law of NCLB however summative testing is not being used correctly and is harming the progress of many students.

One group that is harmed by the mandates of NCLB is English Language Learners (ELL’s). NCLB requires that ELL’s take all state assessments in English after they have been in a United States school for at least one year (Menken, 2010). Instead of measuring student knowledge throughout the year in the ELL’s native language and in the English language to measure progress, ELL’s are expected to take and pass the same content tests as native English speaking students. The use of summative testing and the laws of NCLB were meant to benefit ELL’s but instead may have worsened their quality of schooling (Menken, 2010). The difficulties for ELL’s come in the language of the content tests. These tests focus on a specific content but since they are in English the test is also testing one’s language proficiency (Menken, 2010). The formatting of content tests have effects on other groups targeted by NCLB as well, such as students with disabilities, students from low SES areas, and students from minority groups. The language within state assessments makes it difficult for some groups who do not have the same English proficiency as other groups. However there is a group of research and
opinions that support and believe summative testing and assessment can in fact raise student’s achievement (Harlen, 2003).

The viewpoint of summative testing being beneficial to student’s achievement largely comes from politician and parents. This claim is supported by the increase in tests scores after implementation of tests (Harlen, 2003). The purpose of state testing is to act as a summary of learning (Harlen, 2005). However the way it is currently being used is detrimental to student learning. There seems to be a couple flaws in using increased test scores to claim increased student learning. These flaws are that an increase in test scores does not necessarily mean an increase in achievement and that when summative assessment is used to make educational decisions, such as judging student’s knowledge of content, formative assessments tends to be driven out (Harlen, 2003). Two forms of student achievement, progress throughout the year toward the mastery of state standards and overall academic improvement, cannot be measured by summative assessments.

As to the second flaw of summative testing, many may ask why it is important if formative assessment is present or not if test scores keep rising. According to Harlen (2005), summative and formative assessments are not really different types or forms of assessment, the differences lie in how the assessment is used. The assessment data can be gathered using the same “test”; however, if the data is used to help learning and teaching it would be formative and if the data were used to summarize, report, or record student learning (as represented by the test score) it would be considered summative. The next section will discuss the benefits of formative assessment, the affects NCLB has had on formative assessment and why summative and formative assessment should be used together.

**Formative assessments**
Formative assessment is a key component of the educational process and provides teachers with information that allows them to make adjustments in their teaching and the students learning while these processes are occurring (Garrison & Ehringhaus, 2007; Stiggins & Chappuis, 2005; Keeley, 2011; Kaftman, Buck & Haack, 2006). The adjustments that are made help students achieve target standards or pass state tests (often based on standards). A formative assessment is also used to help teachers to determine the next steps during the learning process as the instruction process nears the summative assessment portion of learning (Garrison & Ehringhaus, 2007; Harlen, 2005). “Your final driving test, or summative assessment, would be the accountability measure that establishes whether or not you have the driving skills necessary for a driver’s license—not a reflection of all the driving practice that leads to it. The same holds true for classroom instruction, learning and assessment.” (Garrison & Ehringhaus, 2007)

Summative and formative assessment should be used together to accurately determine students’ knowledge of a subject area. However with implementation of NCLB the focus has been shifted solely to summative assessments and formative assessments have been eliminated or pushed aside and used sparingly (Harlen, 2003).

Even though summative assessment has come to the forefront of the assessment scene with the implementation of NCLB and its AYP requirement, formative assessment has many benefits as well especially when used alongside summative assessments. Assessments can be used in summative and formative ways; it is only considered formative when the data from the assessment is used in a way to improve teaching and learning (Keeley, 2011). To improve teaching and learning the teacher uses the assessment data to inform themselves of possible ways to improve student’s learning and to provide feedback to students so that they can see what is left for them to learn to reach their goal or to achieve a higher grade. The feedback provided from
formative assessments can increase self-efficacy, encourage a focus on how to achieve higher grades, and aide teachers in making future instructional choices (Harlen, 2003; Garrison & Ehringhaus, 2007). Summative assessments can be used in formative ways, such as administering small tests more frequently, and using the test scores to provide students’ feedback and affect instructional choices (Stiggins & Chappuis, 2005). There are many types of formative assessments that have been proven effective in helping student learning and in aiding teacher’s future instructional decisions. Some will be discussed henceforth.

In a study of student’s prior knowledge and conceptions of ideas that form during instruction of distance formative assessments were used to determine student knowledge of distance and the units used to measure distance (Keeley, 2011). The formative assessments indicated that students need opportunities with measuring distance to grasp an understanding that distance does change with starting point and explicit instruction in science and mathematics is needed about starting and ending points when using linear measurement tools (Keeley, 2011). This research demonstrates a formative assessment tool that can help teachers gain an understanding of student’s current knowledge of an area and make future instructional choices that will help students in the areas in which they are struggling. Research conducted by Kaftman, Buck, and Haack (2006) used quizzes to help teachers see that their perceptions of student learning did not match up to actual student learning. The quizzes simply had students match pictures to words, which did not mean the student had true understanding of the content material. The newly implemented formative assessment worksheet helped gauge student learning more accurately and also aided the teachers in making further instructional choices to fill in the gaps in student knowledge of the content area (Kaftman, Buck & Haack, 2006). A third type of formative assessment that is often used as a summative assessment is Criterion Referenced
Assessments. When used in a formative manner a CRA can be used to provide useful feedback to students that will help them with their understanding of the content, this feedback will also aid the teacher in making future instructional decisions (Moxley, 1972).

**Differentiated assessment: A brief overview**

With the advent of No Child Left Behind (NCLB) and the renewal of the Individuals with Disabilities Education Act (IDEA) in 2002 and 2004 respectively, pressure has been put on teachers to ensue the education of all students. To reach all the many different students with varying learning styles as indicated by Howard Gardner’s multiple intelligence theory, the teaching method of differentiated instruction has been embraced. The goal of differentiated instruction is to reduce the over-representation of culturally and linguistically diverse students in special education settings (Walker-Dalhouse & Risko, 2009). The process of differentiating instruction uses assessments and strategies that individualize instructions to the student’s level of readiness, interest and learning style (King-Shaver, 2009). By differentiating instruction teachers can better meet each child where they are when they enter the class and move them forward in the educational path more effectively and efficiently (Levy, 2008). Students do not learn the same, thus it is important that we do not teach them the same way. However differentiation should not just be to instruction but to assessment as well. Since students need different levels of support teachers need varying assessment tools, most importantly formative assessment tools to determine the varying levels of student understanding (Levy, 2008).

A wide range of assessment should be used to determine a student’s understanding of content. However one of the more commonly used assessments for measuring ongoing student progress and for aiding in differentiating instruction are formative assessments. The formative assessment that is the focus of this curriculum project is Criterion Referenced Assessments
(CRA’s) and these will be discussed in detail in the next section of this literature review. To identify the most appropriate method of instruction, a comprehensive assessment tool is needed such as the formative assessment: *Classroom Assessment Based on Standards* which focuses on providing feedback to students to engage them in the learning process (Walker-Dalhouse & Risko, 2009). One of the major student groups that was focused on in NCLB was students with disabilities who can have co-morbid test anxiety and struggle on traditional style assessments. Assessments need to be differentiated and teachers need to use assessment-guided instruction (such as the feedback provided from formative assessments) to help meet the needs of diverse students (Ferreri, 2009). The risk of the standards mandated by the implementation of NCLB is that teaching shifts towards the standards and away from the students. The tools of differentiated instruction and the process of using varying assessment tools and differentiating these assessment tools to meet students needs keeps the focus on the students, helps them engage in the learning process, helps teachers engage in better future instructional choices and helps students achieve mastery of the standards (Levy, 2008).

**Criterion Referenced Assessment**

A Criterion Referenced Assessment is an assessment tool that is created using the lesson’s objectives. From a review of the literature, this type of assessment is either called a Criterion Referenced Test when being used as a summative assessment or a Criterion Referenced Assessment when being used as a formative assessment. For the purposes of this curriculum project the assessment will be referred to as a Criterion Referenced Assessment because of the focus on utilizing a formative assessment in a curriculum to aide student learning and teacher instructional decisions.
There is often confusion between Norm Referenced Tests (NRT) and Criterion Referenced Assessments (CRA’s). Some similarities between these assessments include measurement of the achievement domain, representative test items, rules for item writing, validity and reliability judgment, usefulness in educational assessment and ability to measure students’ achievement of curriculum-based skills (Notar, Herring, & Restauri, 2008). Although there are many similarities there are key differences among these assessment types. NRT’s are used to rank students with respect to the achievement of others in areas of knowledge and are used to discriminate between high and low achievers (Notar, Herring, & Restauri, 2008). CRA’s are used to determine if each student has achieved the specific skill of concept noted in the class’s criteria and to find out how much students know before and after instruction (Notar, Herring, & Restauri, 2008). Most of the state assessments that have been put into place to meet Adequate Yearly Progress as mandated by No Child Left Behind are NRT’s, which have limited ability to indicate actual student progress. Since the assessments are “normed”, hence the comparison to other students test scores, these exams are not actually measuring student’s knowledge of content but comparing their scores to other student’s scores. It is possible for a student’s test score to receive a failing grade one year, whereas in a different year with lower peer performance the grade could be a passing grade. In contrast CRA’s assess a student based on preset criteria and that is generally considered a more valid indicator of student performance and progress (Klecan-Aker & Colson, 2009).

When implemented correctly a CRA can help students gain a higher level of understanding or mastery of a concept. According to Lalley and Gentile (2009) a proper CRA should have clearly stated objectives that aide in the transfer of prior learning to current and future competencies and a standard for passing mastery tests sufficiently high (e.g. 75% or
better) to assure that if initial learning is forgotten it can be relearned quickly. Lalley and Gentile (2009) also suggest the use of multiple forms of CRA’s with corrective exercises and retesting as needed to meet initial mastery and grading incentive to encourage students to go beyond mastery level learning. Research conducted by MacQuarrie, Applegate and Lacefield (2008) demonstrated that CRA’s are useful in making group or individual level decisions for instruction and to gauge student understanding of material. CRA scores can be used summatively; however, they are most useful when scores are used in a formative manner to aide students in acquisition of knowledge. The next section will discuss literature that looks at how to use CRA scores in a formative manner.

How to use scores collected from CRA’s.

The most useful characteristic of a formative assessment is its ability to measure student learning continually to check for student mastery and to provide feedback to students and teachers as to what students are lacking in and what needs to be revisited. CRA’s provide teachers with the ability to retest students until mastery is reached. When developed a CRA will have several test questions for each mastery objective and several parallel forms of the test should be written in case students need to retest later to meet mastery (Lalley & Gentile, 2009). Lalley and Gentile (2009) suggest that parallel tests should be created before initial instruction because after the first test if students fail and the teacher needs to provide feedback they may adjust the second test to meet the students needs. This prevents the second test from being an accurate measurement of the student’s ability to pass the criteria objective. “By providing these two elements-that of consistent corrective feedback that is immediately available during practice with the material, and real-life examples or models to learn from, students are better able to comprehend, apply, and extend the knowledge of norm-referenced and criterion-referenced
testing distinctions to their everyday environments.” (Notar, Herring, & Restauri, 2008, p. 122-123)

One of the most important uses of Criterion Referenced Assessments (CRA) is the ability to provide students feedback based off of their initial test scores. When providing feedback the goal is to provide rewarding consequences and feedback that helps students meet mastery criteria (Moxley, 1972). The feedback provided does not compare students’ scores to one another but helps the students understand criteria they still have left to learn and helps guide the teacher to make instructional choices that will help students learn this criteria. By providing students and teachers feedback on a daily basis if desired, CRA’s help students obtain mastery, go beyond mastery with enrichment objectives and create a long term process in which students retain more of the information for a longer period of time (Lalley & Gentile, 2009). The teacher can also determine if the criteria presented to the students are not adequately described for the students to understand what is needed of them to meet that particular criterion. The feedback will help the teacher see a link between performance and criteria description if a common criterion is missed by many students (Lingard, Minasian-Batmanian, Vella, Cathers, & Gonzalez, 2009). By matching students scores on CRA’s to the criteria set and other assessments, CRA feedback can be used to measure the validity of the CRA itself (Hartman & Looney, 2003). Being able to develop a valid and reliable CRA is an important part of assessing students formatively and being able to obtain effective feedback. The next section will discuss literature that deals with developing CRA’s.

**Effective ways of developing Criterion Referenced Assessments**

When deciding how to develop an effective CRA, “effective” must first be defined. The CRA should be designed to accurately measure the student’s understanding of the intended
criteria. The goals of the assessment and what is necessary of the students to obtain mastery on the CRA should be stated clearly and feedback should be provided to encourage student’s future learning (McNamara, & Burton, 2009). The criteria created for the CRA should be as detailed as possible to help guide student participation and contribution to discussion during the feedback process (McNamara, & Burton, 2009). If open-ended questions are included in the CRA, rubrics should be created to fairly assess the student’s responses and should be provided to students prior to the assessment process so they have an understanding and expectation as to how their response will be graded.

Each lesson plan that is created within a NYS Living Environment Curriculum includes a set of objectives that are in line with the NYS Living Environment core curriculum standards. These objectives for each lesson should be used to create the criteria list for both daily and unit CRA’s. These criteria should be given to the students in advance of any CRA so they have an understanding of what they need to learn to achieve mastery. These criteria should be revisited if students do not get them correct requiring students to learn and relearn the criteria until they have mastered the criteria (Lalley & Gentile, 2009). Enrichment criteria should be added to aid students in going beyond initial mastery and to expand, organize, and apply their newly acquired knowledge (Lalley & Gentile, 2009). Using CRA’s allows students to become active participants in their own learning and have a better understanding of what they know and what they need to learn to achieve mastery. This important process of understanding one’s own learning process is called meta-cognition.

**Importance of CRA’s in developing meta-cognition**

Meta-cognition is the process of thinking about ones thought process. Through the process of meta-cognition an individual is able to figure out what is known about a subject and
what is left to learn. Formative assessments such as Criterion Referenced Assessments (CRA’s) bring the discussion of assessment, along with feedback and performance expectations to students in a manner that allows for meta-cognitive processes to occur and for the learning process to become more student centered. Formative assessments help to create a feedback loop that aids in the learner’s ability to think about his/her own cognitive processes (Romova, & Andrew, 2011). To encourage meta-cognition, feedback from assessments should be provided to students and they should be engaged in reflective questions allowing them to think about their performance on the assessment and in what areas they are weak or strong (McNamara & Burton, 2009). Sharing criteria with students, having students self-assess, using descriptive feedback, and discussing assessment results using reflective questioning are all effective ways of teaching students about and engaging them in the meta-cognitive process (Oxenford O’Brien, Nocon & Sands, 2010).

It is important for students to be able to think about what they know and what they have left to learn when trying to obtain mastery on CRA’s and other formative assessments so that they can continue to make progress with their learning. If there is no understanding of what is learned and what is left to learn, not only will the student struggle in obtaining the remaining knowledge, but the teacher will not know what areas need to be re-taught or enriched with a more differentiated approach. Teacher-feedback and revision is a key process in process-based methods and in engaging students in meta-cognition (Romova, & Andrew, 2011). The use of CRA’s, in particular encourage cooperative learning and the sharing of ideas which are both key components in the meta-cognitive process (McNamara & Burton, 2009). The sharing of ideas becomes most effective during data-driven dialogue that focuses around the meta-cognitive processes of self-assessment, self-reflection and goal setting (Oxenford O’Brien, Nocon &
Sands, 2010). Many current NYS Living Environment curriculums do not encourage the use of meta-cognition and use limited formative assessments. The common curriculum uses many quizzes and unit tests that are employed in a summative manner with little teacher feedback to students. This limits the amount of student meta-cognition and inhibits the teacher from making future instructional choices that will aid the students in achieving mastery of the subject matter on the Regents exam.

**Overview of current NYS Living Environment curriculum**

Most current NYS high school curriculums include a state test at the end of the year. In most school districts to pass the class the student must pass the exam. This sets up a situation where a majority of the year the teacher is “teaching to the test”. This also creates an environment where the students are “learning for the test” and are unlikely to retain any of the information for more than a few months after the test (Wisegeek, 2012). It is no different in the NYS Living Environments curriculum. This course has a NYS Regents exam that students have to take at the end of the year. Therefore, based off of personal experience, most NYS Living Environment curriculum includes a large amount of summative assessments in the course including quizzes, tests, and practice Regents exams. Teaching in this manner, “to the test” doesn’t help students retain information about the subject area for a long period of time. The Regents exam is given once at the end of each year. This makes it difficult to use for teachers to improve their instructional techniques throughout the course of the year and to provide feedback to students so they have an awareness of information they still need to learn to pass or meet mastery of the Regents exam.

NYS Living Environment curriculums are designed around the NYS Living Environment core curriculum standards because of the end of the year state Regents exam (NYS Department
of Education, 2011). The Regents exam in this content area is designed from these standards and is similar to the development of a Criterion Referenced Assessment (CRA). The Regents is graded using a scale score based off field testing that creates difficulty of question making more difficult questions worth more (DeMauro, 2002). Since teachers are not psycho-matricians, it makes it difficult for them to tell what questions are difficult and which ones are not; thus, making it hard for them to know what content to focus on. Also this could create a situation where one student gets a raw score of 57 but gets a lot of difficult question correct and another student gets a raw score of 60 with no difficult questions correct leading to the lower raw score receiving a higher scaled score. With so much pressure on students to score highly on the NYS Living Environment Regents creates a situation where the majority of instruction is focused on “teaching to the test”.

Since implementation of NCLB there has been a shift in reforming science curriculum to include more inquiry-based standards (Finn, Julian, & Petrilli, 2006). Science itself is based around hands-on experimentation with the goal of answering research questions with a lot of ongoing communication between researchers to ensue validity of the conducted experiments. Currently most scientific concepts are presented as known facts that students are required to memorize. Exposing students to a view of science as just memorization presents them with an inaccurate view of how science is actually conducted (Cross, Taasoobshirazi, Hendricks, & Hickey, 2008). Not only are there issues with current instructional methods in science but also with the assessment methods. Inquiry is a large part of science classrooms especially in lab classes; however, large-scale assessments, including state-exams fail to assess anything other than a student’s ability to memorize scientific facts (Day & Matthews, 2008). According to research conducted by Day and Matthews (2008) the Living Environment Regents Exam
provides an inadequate measure of inquiry behaviors called for by the NYS Living Environment Standard 1. Although students have to document completions of a certain amount of labs to take the NYS Living Environment Regents there is no lab portion on the Regents exam itself. With the lack of adequately designed assessments new efforts need to be made to design effective assessments and teaching methods that better reach the learning needs of the students.

Although many curriculums continue to feature traditional styles of teaching, such as lecture, some are implementing new styles of assessment and teaching styles. Some curriculums have begun to include scientific argumentation to help students engage in discussions of ideas or claims that include scientific theory, data, and evidence (Cross et. al., 2008). While testing the effectiveness of the argumentative teaching method Cross et al. (2008) used multiple levels of formative assessments including curriculum based assessments which helped provide students with feedback. Other curriculums have implemented performance assessments that tests student’s ability to perform inquiry-based tasks, which are important to science as it is inquiry-based as a practice (Day & Matthews, 2008). The advent of technology-based teaching programs such as SmartBoard, and clicker systems have caused many teachers to implement these programs into their curriculums. Some curriculums have even been created as lecture-free classrooms using technology such as the Qwizdom Q5 radio frequency remotes, which have students input answers to questions as they work collaboratively through their textbook with a small group. The Qwizdom Q5 remote returns instant responses to whether or not the student’s response was correct and allows students to discuss the answer choices within their group to stimulate higher order thinking (Barnes, 2008).

There has been much research in the effectiveness of alternative assessment tools at measuring student’s knowledge and their effectiveness in providing teachers with useful
feedback to guide future instructional decisions and to engage students in the assessment process. The formative assessment chosen for this curriculum project is the Criterion Referenced Assessment. Creating effective formative assessments and then implementing them into the curriculum among a variety of other assessment types including high-stakes state tests is a time consuming task.

**Incorporating Criterion Referenced Assessments into curriculum**

Curriculums are very complicated compilations of lesson plans, activities, and assessment tools. Embedding assessments and activities is a difficult process as each one needs to be aligned with state standards to ensure students are learning the necessary content knowledge for the state tests and aligned to the lesson plan objectives. Many teachers tend to use unit tests and quizzes in a summative manner to collect data on the student’s current knowledge of content. Assessments used in a summative manner take a snapshot of student learning on a specific day and provide no feedback to the student on what is left for them to learn nor do they help guide teacher’s future instructional choices. Assessments used in a formative manner are ongoing allowing a continuous measurement of student learning that provides feedback to students to guide them in achieving mastery of content knowledge and feedback to influence teachers in making future instructional choices.

Criterion Referenced Assessment’s (CRA’s) provide a formative assessment tool that is easy to design, align with standards and lesson objectives, implement and use to provide feedback to students and teachers. Research conducted by Carlson, MacDonald, Gorely, Hanrahan, and Burgess-Limerock (2000) looked at the difficulties and benefits of implementing CRA’s into a multi-disciplinary university department. The research looked at the process of change instead of the effectiveness of the CRA’s themselves. The shift required an understanding
of the differences between norm-referenced assessments and CRA’s with the main difficulties being a shared understanding of criteria and standards between all participants in the assessment process (Carlson et. al., 2000). The benefits of implementing CRA’s into the university included the encouragement of collaboration, diversity, and ongoing reflection, and allowing the department to use more authentic assessment practices that better measured ongoing student learning (Carlson et. al, 2000). Although difficulties lie in implementing CRA’s into a curriculum, the benefits of doing so will greatly increase student-teacher interaction and overall student learning of content by providing them with ongoing feedback.

**Using CRA’s to provide feedback to students**

Criterion Referenced Assessments help students by providing them feedback to help them achieve mastery of state learning standards within each content area. State standards and teacher’s expectations of students as far as the knowledge they need to learn is often mysterious and unknown to the students. The Comprehensive Application of Behavior Analysis to Schooling (CABAS) is a cybernetic system, which operates like a CRA and aligns the questions to standards and criteria (Singer-Dudek, Speckman, & Nuzzolo, 2010). Being able to align the CRA’s to state standards and criteria reduces the time teachers have to spend doing this, will help students better understand the goals of each CRA and will create more effective CRA’s as demonstrated by the research conducted by Singer-Dudek et. al. (2010). Making CRA’s that are effective and are aligned with state standards will allow the teacher to better explain what is expected of students to reach mastery of content. This makes the standards known to students and allows students to be aware of what they need to know to succeed on the CRA’s.

**Using CRA’s to provide feedback to teachers**
Teachers need to be able to receive feedback from the assessment they use, so they can analyze what is left for students to learn to achieve mastery of criteria, and so they can better their instructional practices to better meet student’s diverse learning needs. Criterion Referenced Assessments (CRA’s) provide teachers with a formative assessment tool that provides ongoing measurement of student achievement and provides the teacher with valuable feedback. CRA’s that are aligned to the course’s standards and the curriculum’s objectives will provide the teacher with information that will help them make instructional choices that will better meet student’s learning needs and get students closer to achieving mastery of the criteria and objectives (Hughes & Cappa, 2007). Students can only learn as fast as their teacher is capable of teaching them. CRA’s provide teachers with an assessment tool that is tied directly to state standards, provides useful feedback and allows teachers to teach “faster” and more adequately (Singer-Dudek, Speckman, & Nuzzolo, 2010).

To accurately measure student’s content knowledge the assessment being used needs to be valid and reliable. CRA’s provide a reliable and valid assessment tool for measuring student’s knowledge and in helping students improve their skills and knowledge of content (Klecan-Aker & Colson, 2009). Being valid and reliable ensures that the data collected by the CRA’s is accurate and allows the teacher to fairly judge the student’s progress towards achieving mastery of criteria and to make effective instructional decisions on what students need to be re-taught and how the instruction method should be changed to allow for better knowledge acquisition.

After an analysis of current literature it is evident that CRA’s are an effective formative assessment tool. Although there are benefits in summative assessments the way they are currently used does not test the student’s knowledge of content. Current state exams are norm-referenced assessments which compare student’s test scores against other students’ test scores to
determine student knowledge and level of achievement. Criterion-referenced assessments measure student’s knowledge compared to the criterion which are created from the state standards and directly measure the student’s level of knowledge of content. CRA’s can be used both summatively and formatively. A summative CRA measures the end product of student knowledge in a certain class. A formative CRA measures a student’s ongoing learning process providing feedback along the way to help them reach mastery level learning of criteria.

Current NYS Living Environment curriculums tend to “teach to the test”. Teaching this way has teachers rushing through material using only summative assessments to gauge student understanding with little feedback used and little revisititation of materials students do not understand. Implementing CRA’s into curriculums allows teachers to have an effective formative assessment tool that measures student’s ongoing learning and gives teachers useful feedback that can be used to help them make future instructional choices and let students know what is left for them to learn to meet mastery level learning of the material. This curriculum project will implement CRA’s into four units of the NYS Living Environment curriculum. The goals of this project are to align CRA’s with NYS Living Environment state standards, create CRA’s capable of providing effective feedback, and develop a guide of how to use the data of CRA’s to give feedback to both the students and teachers.

**Methods**

The purpose of this curriculum project was to implement Criterion Referenced Assessment’s (CRA’s) into the NYS Living Environment curriculum. The goal of including these assessments was to provide teachers with an assessment tool that can be used formatively to better track student progress and to inform their future teaching decisions. The Living Environment Regents is typically the first science Regents students have to take. Having a
method that can readily assess students, provide students and teachers with feedback about student learning and help prepare students for the regents will benefit them in future science courses. High school science is more in depth then intermediate level science classes. High school science teachers expect students to learn a lot more content than in intermediate courses. The use of CRA’s along with the feedback scoring matrices helps teachers track students’ progress to understanding the NYS standards. This section discusses the intended audience, standards and units that CRA’s were made for, how they were made and limitations of the project. Templates for the lesson plans, providing feedback and creating CRA’s are provided in the Appendices A and B. Standards that are covered in the units and the lesson plans are included in appendices C and D.

**Intended Audience**

This curriculum project is intended for any person associated with the NYS Living Environment course. The typical student takes the NYS Living Environment in ninth or tenth grade; however, there are students in the eighth, eleventh and twelfth grades that may also be enrolled in this course as it is required to achieve a NYS Regents diploma. Students are from a wide variety of backgrounds with some main groups being Caucasians, African Americans, Hispanics, English Language Learners, and Student’s with Disabilities. As of the 2004-2005 school years 2,880,411 students were enrolled in NYS public schools with 7.2% of students being American Indian, Alaskan, Asian, or Pacific Islander; 19.9% of students being Black (not Hispanic); 19.7% of students being Hispanic; and 53.2% of students being White (not Hispanic) (NYS Education Department, 2002-2005). During the same time period 7.2% of students were Limited English Proficient and 36.6% of students were eligible for Free Lunch (NYS Education Department, 2002-2005). During the 2004-2005 school years 143,202 students graduated with
only 11,436 being students with disabilities (NYS Education Department, 2002-2005). Teachers who teach the NYS Living Environment curriculum will also be included as participants in this project. In the fall of 2004 only 15% of teachers were Black or Hispanic with the other 85% of teachers being White (The University of the State of New York, 2008). In 2006-2007 only 6% of new certificates were given to teachers who were Black or Hispanic (The University of the State of New York, 2008).

**Setting**

The setting of this project is New York State public high schools in all school districts that are required by the state to implement the NYS Living Environments curriculum. Specifically the units of Ecology (population interactions, ecosystems, and human impact), Meiosis and sexual reproduction, Mitosis (asexual reproduction, cell cycles, cell division, and cancer), and DNA and RNA (structure, replication, transcription, translation, the genetic code, and mutations) were used. Lessons were prepared for eighty-minute block classes.

There were seven CRA’s in the Ecology unit, six daily CRA’s and 1 unit CRA. There were twenty-four total objectives in the unit with an average of three objectives per lesson. The original Ecology unit lessons were created for forty-five minute periods and will be adapted to meet the eighty minutes block lessons that will be used for this curriculum project. From these objectives sixteen criteria were created. The Meiosis and sexual reproduction unit consisted of six CRA’s, five daily CRA’s and one unit CRA. This unit consists of fourteen objectives and ten criteria with about two objectives per lesson. There were six CRA’s in the Mitosis unit with five daily CRA’s and one unit CRA. This unit consisted of fifteen objectives and nine criteria with about two objectives per lesson. There were nine CRA’s in the DNA and RNA unit with eight daily CRA’s and one unit CRA. This unit consists of twenty-four objectives and sixteen criteria
with about two objectives per lesson. All of the objectives for these units met several of the NYS Living Environment core curriculum standards, which can be found in Appendix C and the objective of meeting mastery on the unit CRA (NYS Living Environment Standards, 2009).

**Design**

Two types of CRA’s were designed: those given every day to track daily progress and those given by unit to track each student’s progress towards mastery within that unit. Feedback from the daily CRA’s was used to guide the teacher’s review for the next day’s lesson. Feedback from the CRA’s will notify the teacher of concepts the students are struggling with and need to be re-taught. A general feedback guide and scoring matrices were created to help teachers select feedback and re-teaching strategies according to CRA score and student grouping and CRA question type. These assessments helped inform students about areas they are struggling in and what criteria they still have left to learn. A major goal of using formative assessment is to include the students in the process and this feedback allows for that. Students were also prepared to use the feedback given and to understand the process of being assessed with CRA’s. Criteria would be discussed with students so they would understand what they have to know to achieve mastery, or a particular grade that they want to achieve.

Students would be graded based on knowledge of established criteria not based on how well they do compare to the other students. Mastery would be measured by students achieving 85% on the unit CRA based on achievement of meeting the criterion (the objectives). Criteria were created to match objectives and standards. The criteria were designed to be specific and descriptive to inform students of what information they were expected to know on the CRA’s. Not all objectives were turned into criterion as some objectives were combined or did not translate well into criterion/question form such as objectives dealing with labs. Short answer or
essay questions were graded using a scoring rubric that students will be aware of before they take any CRA. This rubric explained what students have to do to meet the criterion and receive points for the free response questions and can be found in Appendix B. Short answer or essay questions were worth two points and the objective style questions were worth one point. Daily CRA’s were not scored to measure students mastery; however, unit CRA’s were. For each CRA 85% was to be considered mastery.

While the unit CRA’s provided the teacher and students the information of whether or not they have achieved mastery knowledge on the content, the daily CRA’s were used to provide daily feedback to the teacher and students about student progress in achieving mastery. A feedback manual and scoring matrices linked to feedback strategies were created to aid the teacher in providing feedback to the students based on daily CRA’s scores and to aid them in guiding their future instructional choices as to what topics need to be revisited.

The majority of the lesson plans for the units being used have already been created using the template provided in Appendix A with a sample lesson plan provided. Some lesson plans were modified to meet the 80 minutes block lesson and to incorporate the NYS Living Environment standards. Lessons were designed around NYS Living Environment Standards and include multiple activities and teaching methods to differentiate instruction. Current assessment practices within these units are summative assessments created from past NYS regents questions.

**Limitations**

Although using Criterion Referenced Assessments in a curriculum provided many benefits there still are some limitations. One main limitation is that the CRA’s will not be implemented in all NYS Living Environment units. Limitations will also occur because using one source of assessment is detrimental to student progress. The CRA’s being implemented offer
a formative assessment to help teachers track student progress and aid future teacher instructional decisions. The unit CRA’s can very well be used as a summative form of assessment. Creating a manual to help teachers in providing feedback will also provide limitations. There are only so many examples that can be provided since each situation will be unique. This manual provided suggestions of what teachers can due in the future if topics need to be revisited on a whole class scale or on an individual needs basis.

**Findings**

This section contains objectives and criteria of the lesson plans, CRA’s and feedback guides for the curriculum project. Full lesson plans are available in the appendix. The units that these items have been completed for include Ecology, Meiosis, Mitosis, and DNA and RNA. The goal of this curriculum project is to provide teachers with a set of CRA’s for the above units and provide them with a way to give students feedback about the CRA and options for interventions and strategies to re-teach topics if needed. A general feedback guide and scoring matrices are provided to help teachers use research proven strategies to assist students in better understanding the content *(Scoring Matrices)*. The first scoring matrix will separate the CRA scores into five categories and then split the students into categories. The second matrix will again separate the CRA scores into five categories but split the questions into types. From here the teacher can locate numbers within the matrix that will match up to specific interventions or strategies related to the student grouping category and their score on the overall CRA or the type of question and the percentage of students who got the question wrong. This will help give the teacher particular interventions and strategies to re-teach material specific to student learning needs (ELL, SWD, GAT, etc).
The units will be provided as follows. The lesson objectives, criteria and standards will be provided in the units under this section (findings section). The full lessons will be provided in Appendix D. The CRA’s for each lesson will be provided with answers under each unit heading. The specific content feedback for difficult areas will be provided in feedback sections after the CRA for which it is for. This will also include the question type to help teachers save time in locating the strategies to use in the scoring matrices already provided. The purpose of creating a general feedback mechanism with multiple strategies is to allow teachers to select a strategy that focuses on the area they need it. The higher percentage of students that miss a question type or category of students who score poorly on the CRA the more detailed and time consuming the strategy. This was done in hopes of following the logic that the more students who miss the question the more reinforcement needed. Following are a list of strategies selected and summaries for the strategies. These strategies are also provided in a separate document that is linked to the scoring matrices to ease teacher use.

Summary of strategies

Provided below is a list of suggested strategies that can be used when providing feedback to students when CRA scores suggest re-teaching is needed. Strategies are provided even for the category of 81-100% correct on a specific CRA. This list is also included in another document called “Strategies” that is hyperlinked into the scoring matrices excel document in which the teacher can choose the student grouping or question type, the CRA score and then be taken to a list of strategies that match the category and score. From here the teacher can click the summary link and be taken to the summary of that particular strategy.

Scoring Matrix one
This matrix is broken up by student category and by the percent correct on the overall CRA. The strategies chosen for this scoring matrix are aimed at increasing the student’s ability at learning and understanding content material. Besides re-teaching the content with different activities teachers need an arsenal of strategies they can teach to students to aid the students in understanding, retaining and applying content that is learned.

**English language learner (ELL) strategies.**

These strategies were selected to aid English Language Learner’s. Some of the strategies may also help with vocabulary, comparing and contrasting, and critical thinking. These are specific for students who are ELL’s. The strategies in the question type scoring matrix are broader and are for the general student body.

1. **Realias, photos, and illustrations:** Realia are objects from real-life that are used in the classroom to improve students understanding of more abstract concepts. The purpose of this strategy is to enable English learners to develop an understanding of an unknown word or concept (Vogt & Echevarria, p.25, 2008). Realia are real life items and are used to make key content and vocabulary “come alive” (Vogt & Echevarria, p.25, 2008). This is very easy to implement and can be done with vocabulary words as follows: A list of key vocabulary words are created and posted on a word wall. After introducing the new terms, realia, illustration or photos are given to students in partners. Partners take turns, one reading a sentence with a blank that the other partner fills in using a realia, illustration or photo that represents the vocabulary word (Vogt & Echevarria, p.25, 2008).

2. **4-Corners Vocabulary:** This strategy can be used in small group or whole class settings and focuses on vocabulary acquisition (Vogt & Echevarria, p.40, 2008). This
strategy helps students to contextualize words by creating a chart. This chart includes an illustration, a definition, a sentence and the actual word (Vogt & Echevarria, p.40, 2008).

3. Personal Dictionaries: This strategy helps to support students in learning key vocabulary (Vogt & Echevarria, p.35, 2008). When the teacher comes across a vocabulary word in the lesson students write this vocabulary word down into their own personal dictionary (hence the name of the strategy). They can now use this dictionary as a vocabulary and spelling resource. The words can be categorized alphabetically, by subject or by content and topic (Vogt & Echevarria, p.35, 2008).

4. Move It!: Most instruction lacks a kinesthetic approach to teaching. This lesson allows students to move their bodies, to the lesson (or part of the lesson). The teacher uses hands, facial expression or whole body movements to illustrate key points in the lesson and has the students repeat these actions to make meaning of the new words or concepts (Vogt & Echevarria, p.53, 2008). Using signals for yes/no, true/false and similar style questions will help teachers monitor progress of ELL’s during the lesson (Vogt & Echevarria, p.53, 2008).

5. KWL Chart: This is one of the best known ways to activate prior knowledge and build background information. Creating the KWL chart assesses students’ knowledge of the topic, their misconceptions and allows them to have input about what they would like to learn about the topic (Vogt & Echevarria, p.27 2008). The first two boxes in the chart, “what I know?” and “what I want to know” are filled out by students prior to the lesson, reading or activity (Vogt & Echevarria, p.27, 2008). Then the final step of filling in “what I learned” is completed after the lesson, reading or activity (Vogt & Echevarria, p.27, 2008).
6. Identifying Levels of Second Language Acquisition: This strategy can be time consuming which is why it is down further on the scoring chart. Understanding the levels of English language acquisition of your students is very important (Vogt & Echevarria, p.51, 2008). This strategy places students in three levels of English acquisition to help them receive instruction at their comprehension level. Beginning level are learners that have little comprehension of oral and written English and are unable to produce much English (Vogt & Echevarria, p.51, 2008). Ample listening opportunities, the use of physical gestures and movements to convey meaning, and context should be used to aid these students (Vogt & Echevarria, p.51, 2008). There are two other Beginning level types provided in the book by Vogt and Echevarria (2008); however for the sake of this summary are left out. Intermediate level ELL’s need explicit instruction in figurative language, making predictions, using text features and grammar (Vogt & Echevarria, p.51, 2008). Advanced ELL’s are capable of leading group discussions, providing presentations and producing oral and written forms of English; however they should still receive explicit instruction to further their English learning (Vogt & Echevarria, p.51, 2008).

7. Framed Outline: This strategy has the teacher create an outline of a reading or a lesson leaving out some key content (Vogt & Echevarria, p.62, 2008). Then the students complete the outline as they read the text or go through the lesson. Creating this outline allows ELL’s to refer to it during subsequent lessons and similar learning activities (Vogt & Echevarria, p.62, 2008).

8. Questioning Prompts for Different Levels of Language Acquisition: Questioning prompts will be based off the different levels of language acquisition represented in the
classroom (Vogt & Echevarria, p.62, 2008). It is important to remember that lower level language proficiency does not mean lower level cognitive ability. Vogt and Echervarria (2008) provide groupings for language acquisition that correlate with scaffolding of questions for the students. Depending on language level students are expected the respond differently to the questions ranging from touching the answer to explaining the process verbally in detail (Vogt & Echevarria, p.62, 2008).

9. Canned Questions: The teacher is to write on strips of paper a variety of questions related to the topic being studied. Questions should be ranged from lower to higher levels of thinking according to Bloom’s Taxonomy (Vogt & Echevarria, p.77, 2008). The strips are placed in a can and the students are placed in small groups. The teacher selects strips one-by-one and the groups work together to answer the questions (Vogt & Echevarria, p.77, 2008). Students can also submit questions to the can (Vogt & Echevarria, p.77, 2008).

10. You Are the Teacher!: Students will require direct instruction in how to move around the classroom in this activity. This strategy encourages students to learn important information and then re-teach it to their peers (Vogt & Echevarria, p.92, 2008). Students should research their topic in a small group and then create a poster or chart using words and graphics to arrange the learned information. One member of the group stays at the poster to teach the material while the other group members go around to other posters and learn about the other topics (Vogt & Echevarria, p.92, 2008). Throughout the process students will switch who is presenting the poster so every student gets a chance to learn the information of the other posters.

Students with disabilities strategies.
All of these strategies should be taught to the students using a scaffolding method with first doing the strategy with the students and then gradually giving them more freedom until they can do the strategy on their own.

11. BRAVE: This strategy is to help individuals overcome test nervousness and occurs in five steps: breathe deeply, relax, attitude is important, visualize yourself in your favorite place and end is in sight (Minskoff & Allsopp, p.112, 2003). This strategy is a self-monitoring strategy that has students take deep breaths, relax their tightened muscles and try to maintain a positive attitude throughout the CRA. The last two steps of visualizing oneself in a favorite place and remembering that the test will be over soon and will not take forever are methods to keep the student calm (Minskoff & Allsopp, p.112, 2003).

12. CRAM: If students are struggling with multiple-choice tests this strategy has four steps to aid them. First the students should cover the answers, then read the question carefully, next answer the question without looking at the choices and finally match their answer to a choice (Minskoff & Allsopp, p.119, 2003).

13. RULE-WE: This strategy is a six step strategy to help students with disabilities with taking essay style tests. First the student should read the question, underline keywords and list the major points of the question (Minskoff & Allsopp, p.122, 2003). Next students should focus on the details of each point and then write the answer. Once the answer is written students should evaluate the quality of the lesson (Minskoff & Allsopp, p.119, 2003).

14. SPORT: Say to yourself-where?, Picture in your head, Organize in your mind, Remember to “dump” all the information, and Tell yourself that you need to go back.
This strategy is to help students remember what they studied when they are taking a test. Students are to first think where and then picture the information in their head (Minskoff & Allsopp, p.124, 2003). Next the students should organize the information in their mind and “dump” all of the information onto a piece of paper. Finally the student should go back to the “dumped” information and use this information to answer the question (Minskoff & Allsopp, p.124, 2003).

15. **WORRY**: This strategy is to help students organize information from books and notes. The strategy is called WORRY and stands for “Work with note cards from reading and lecture notes, Outline main ideas covered in reading and lectures, Read note cards from reading for facts, Read lecture notes for facts, Yes, you’re ready after one more reading of your outline.” (Minskoff & Allsopp, p.140, 2003).

16. **BREAK**: This strategy is to help students remember information for tests. The acronym is as follows: “Break memorizing into short time periods, Recite the information aloud as you write it, Establish mnemonics, Always try to visualize information in your mind, Keywords help.” (Minskoff & Allsopp, p.143, 2003). This strategy helps students learn how to study more effectively, learn memorization techniques, and visualize information in the mind ahead of the test for easier recall.

17. **Cornell Method**: The focus of this strategy is in aiding students in taking organized notes. The paper should be split into three sections: one for note taking, one for questions and one for summarizing the notes (Minskoff & Allsopp, p.153, 2003). Students should take notes during class skipping lines between ideas and topics and using shorthand writing (no complete sentences). Students should then later summarize the
notes in the bottom section and write questions that they have about the notes in the right hand side of the page to ask the teacher the next class (Minskoff & Allsopp, p.153, 2003).

18. **POWER**: The strategy stands for: Plan, Organize, Write, Edit, and Revise and is used to help students with writing research papers and short answer or essay style questions on exams (Minskoff & Allsopp, p.210, 2003). First students should identify a clear topic and organize their ideas into an outline. Then they should use the outline to write a response to the test or research question, edit their response and revise as needed (Minskoff & Allsopp, p.210, 2003).

19. **LID**: This strategy will be used twice for this curriculum project occurring here for students with disabilities and again under the section for the comparing and contrasting question types. The strategy occurs in three steps: “List the items to be compared, Identify the similarities and differences, Draw a graphic representation of the relationship” (LID) (Minskoff & Allsopp, p.285, 2003). This helps students visually organize the items to be compared and contrasted and then organize the similarities and differences among the items with a graphic representation (Minskoff & Allsopp, p.285, 2003).

20. **IFF 2**: The strategy is designed to help students determine cause-and-effect relationships by following these steps: “Identify an event, Find one cause, Find other cause, Identify an event, Find one effect, Find other effects.” (Minskoff & Allsopp, p.289, 2003). The strategy occurs in two parts, one to identify the causes and one to identify the effects. This will help students be able to identify the cause and effect relationships dealing with the event/s (Minskoff & Allsopp, p.289, 2003).

**Gifted and talented strategies**
These strategies are geared specifically toward students who are gifted and talented. As there has not been much research in this area of specific strategies developed for students who are gifted and talented most of these strategies are general theories that can be modified easily to meet the students’ and teachers’ needs.

21. Descriptive Patterns: Graphic organizers are the most common way to help students create nonlinguistic representations. (Marzano, Pickering & Pollock, p. 75, 2001)

Descriptive patterns is one of the simpler graphic organizers as it has students place the topic in a central circle and then place smaller circles around it containing key ideas and facts about the topic (Marzano et al, p.75, 2001).

22. The flow of instruction: This strategy is the process of repeated rhythm class-preparation, review and time for group and individual sharing and discussion (Kondor, 2007). The strategy allows for a consistent way of providing feedback to students and discussing with them the difficulties they are experiencing. Small group discussions can help students gain understanding of topics from one another and by working their way through a problem together.

23. Explicit cues: In trying to activate prior knowledge using explicit cues is a straightforward way of doing so (Marzano et al, p.114, 2001). By using cues teachers are able to generate a preview of the material that is to be learned for the students (Marzano et al, p.114, 2001). These cues will help students think about their prior experiences with the content and get them ready to expand their knowledge in the area.

24. This method uses a choice board that looks like a Tic-Tac-Toe board. (Kondor, 2007). On the board are choices for student activities. These activities are broken into three categories: visual, oral/auditory, and kinesthetic (Kondor, 2007). The teacher can
determine the number of activities the student has to choose and the time they have to
complete them. This method gives students choice and allows them to work on
assignments that are interesting to them.

25. Exemplars: This strategy includes problem-solving questions that help students to think
critically and develop questioning skills (Kondor, 2007). This strategy is most common
with math problems but can be adapting to the sciences. The questions should have multi-
step answers that make the students “think outside of the box” and develop their own
questions to help solve the problem. An example would be: develop a comprehensive
solution to slowing down climate change using the knowledge you have gained from this
class. Include four methods, design a law to enforce and provide three ideas for
alternative energy plans.

26. Questioning: Complex concepts that demand cognitive effort can help build positive
attitudes towards learning in individuals who are gifted and talented (Intel Corporation,
2012). Open ended questions that have students analyze, synthesize and evaluate can help
them apply new knowledge to other situations (Intel Corporation, 2012). Asking open-
ended questions that have students perform these tasks in class can help the teacher and
students understand what they know and what is left to learn. They also will prepare
students for exams and further the depth of understanding on a topic.

27. Cognitive organizers: This tool can be used as a self-regulated learning strategy for
students who are gifted and talented (Tan, Dawson, & Venville, 2008). By becoming
self-regulated a gifted and talented student is aware of self efficacy of learning and is
committed to academic goals. The cognitive organizer is a visual tool that helps learners
represent facts, ideas, concepts and the connections between them (Tan, et. al., 2008).
They also aid in the organization and transformation of information. A cognitive organizer can take the form of a semantic web or other style of graphic organizer; however, in this strategy the student has control over the design of the organizer.

28. Explicit Modeling: Gifted and talented students use higher-order thinking skills and often need ways to describe their thinking strategies (Intel Corporation, 2012). Asking students pertinent questions and listening to students interact, teachers can observe how students are thinking as they are working on projects. Once the teacher understands how the students are thinking they should provide appropriate instruction and support, hence modeling to students how to use higher-order thinking processes and encouraging them to go above and beyond what is expected of other students to know.

29. Cooperative Learning: Group work can exploit gifted and talented students making them feel added responsibility and making it more difficult for them to collaborate successfully with other students (Intel Corporation, 2012). Rules should be set as to group interaction and how the project will be scored to help minimize one student doing all of the work. In a cooperative learning situation the gifted and talented students could be provided opportunities to tutor their peers. This will help them test their knowledge of the content and benefit in collaborative learning situations.

30. Making Physical Models: Physical models are concrete examples of what is being learned. These models are commonly used within the sciences and mathematics. The act of generating a physical representation of the concept being learned establishes an “image” of the knowledge in the student’s mind (Marzano et al, p.78 2001). For example, if students are learning about volcanoes the teacher could have the students create a
vinegar and baking soda volcano or challenge the student to come up with an idea of their own to simulate an erupting volcano.

**Other.**

The strategies in this section are for the general student population. Other implies students who don’t fall into one of the previous three categories and have “normal” functioning behaviors and academic skills.

31. Concept patterns: This Strategy helps organize information around a word or a phrase that is representative of an entire class or category (Marzano *et al*., p.77 2001). The pattern of the graphics can occur in any manner as long as the main concept is in the middle and the concept characteristics branch off from this point.

32. Metacognition: This tool is considered a macro-strategy and is typically defined as thinking about thinking (Appalachia Educational Laboratory, 2005). The teacher should guide and scaffold students in thinking about their thinking and learning process. Once students can think about their own thinking they have control over the factors that affect learning such as the self, the current task and the strategies that are needed to be employed to learn the most effectively (Appalachia Educational Laboratory, 2005).

33. Active Student Engagement: Another macro-strategy is active student engagement which is rooted in cognitive learning theories and involves the teacher engaging students in hands-on lessons that have students use multiple learning skills and higher order thinking skills (Appalachia Educational Laboratory, 2005). To get students to become active learners teachers can provide differentiated instruction by adjusting content, process, required products or the learning environment to match up with student interests or their learning profile (Appalachia Educational Laboratory, 2005). This can be
accomplished by giving students and interest survey and a learning style survey to see what interests they have that relate to the content and how they learn.

34. Higher order thinking: This approach is commonly called critical or strategic thinking and can be described as “the ability to use information to solve problems, analyze arguments, negotiate issues, or make predictions” (Appalachia Educational Laboratory, 2005). To help students generate higher order thinking, teachers need effective question techniques such as asking good questions, allowing wait time, and providing feedback (Appalachia Educational Laboratory, 2005). Teachers should also guide students through examining assumptions and values, evaluating the evidence and assessing the conclusions.

35. Independent practice: This idea usually implies homework; however, it is anytime in which students have the opportunity to practice their newly learned concepts and knowledge (Appalachia Educational Laboratory, 2005). Any kind of independent practice has been shown to increase student achievement. Independent practice that is regular, short, aligned with new skills and knowledge recently targeted in instruction is particularly effective (Appalachia Educational Laboratory, 2005). Thus whether it is homework or an in-class assignment the assignment should focus on what was taught recently, give students opportunity to practice newly learned skills/concepts/ideas and have ample teacher feedback.

36. Case Method: An effective way for disseminating and integrating knowledge that students have just learned is by applying it to real-life experiences (George Mason University, 2010). The case method engages students in active discussion about issues and problems that are involved with practical application of the content. It provides a
format for role playing ambiguous or controversial scenarios as well as discussing fundamental critical issues (George Mason University, 2010). The teacher can transform a current event or problem that deals with the current unit being taught into a critical learning experience that helps students understand the complexity of finding solutions to social problems (George Mason University, 2010). An example would be the invasive species known as the zebra mussel in the Great Lakes. The teacher can have students find out what problems this is causing and what the possible solutions are.

37. The Expository Advance organizer is a way to describe new content to students (Marzano et al, p.118, 2001). The organizer should focus on what is important not what is unusual, should produce deeper level learning and are most useful when presenting information that is generally not well organized (Marzano et al, p.118, 2001). The organizer can take the form of a Venn diagram, a T-chart, a Semantic web or any other form of graphic organizer. The one selected should be used to best organize the new information to ease the learning process for students.

38. Discussion: Teachers can stimulate discussion in a variety of ways such as discussing the reading as a review, listing critical talking points or emerging issues and generating a set of questions stemmed from a reading or lecture (George Mason University, 2010). All of these can also be used in helping to focus large or small group discussions. Planning by the instructor and preparation on the part of the students will help lead to successful discussions (George Mason University, 2010).

39. Graphic Advance Organizers: Graphic organizers have already served as a few strategies in this guide and are great visual tools for students to learn from. However creating advance organizers helps in activating prior knowledge and organizer material
for students when they are preparing to learn a new subject (Marzano et al, p.119-120, 2001). For example when teaching a unit on DNA/RNA the teacher could create a graphic organizer highlighting the key scientists and experiments to get students familiar with terminology and some of the names to be used in the unit. This will also activate prior knowledge if students have been taught some of these ideas or names before such as Watson and Crick.

40. Integrating Technology: Living in the technological age that we do, it is necessary for students to become computer literate. By integrating technology into the curriculum the learning experience becomes enhanced (George Mason University, 2010). Smartboard activities, webquests, and other technological strategies can provide students with engaging learning opportunities. PowerPoints, on-line notes used to extend topic discussion and content specific software can help increase student understanding of difficult concepts (George Mason University, 2010).

**Scoring matrix two**

This matrix is based on question type and percentage of students answering that type of question incorrectly. There are five categories: Multiple choice and true/false, Short answer, Vocabulary, Compare and Contrast, and Critical Thinking. This matrix is included to help teachers prepare students for the Regents exam at the end of the year. Many students do not have test taking skills and acquiring these skills will help them achieve higher on exams or exam like assessments. Although the focus of this project is to help teachers’ in future instructional choices, aid them in measuring student’s knowledge of content, and increase student’s knowledge of content through CRAs, this matrix is useful in preparing students for summative exams and testing situations which have become an important part of today’s
educational system. The goal of the CRAs is to create fair questions that measure student knowledge; however, even with fair questions some students will struggle and the Regents exam may have difficult questions.

This matrix is meant to provide feedback to students and help them better take test to eliminate the factor of the test design impacting the student’s score. Also there are only five strategies for each category in this matrix opposed to ten in the previous matrix. The reasoning is the first matrix focuses on increase student content knowledge while this primarily focuses on test taking strategies. The later three categories of vocabulary, compare and contrast, and critical thinking provide strategies that can aid students on exams as well as while learning content.

**Multiple choice and true/false.**

These strategies are designed to aid students in answering multiple choice or true/false questions.

1. ASC-General Process: General approaches to answering multiple choice questions should begin with separating the question into the core (stem) and alternative information (The George Washington University, 2012). The core (stem) information in the question is the part that is being answered. The alternative information is information to confuse the reader or supplement the core (stem) information. The question should be read several times and key terms and the core information (Stem) should be underlined (The George Washington University, 2012). If there is vague terminology create your own terms and then select a correct answer and compare it to the alternative choices (The George Washington University, 2012)
2. ASC-Comprehensive Process: A process of elimination should be used to select the correct answer even if students believe they automatically know the correct choice (The George Washington University, 2012). Students should read all alternative choices and compare them to one another. Obviously wrong response should be eliminated and the remaining response should be related back to the question (The George Washington University, 2012). The remaining two choices should be compared and related back to class discussion and book readings. The choice the most closely relates to these sources of knowledge should be selected as the correct choice (The George Washington University, 2012).

3. ASC-When You Don’t Know the Answer: When you don’t know the answer students should make sure they are not wasting time trying to figure it out (The George Washington University, 2012). Students should mark the question in the margin and move on and come back to the question if time allows it. This can be helpful because sometimes the test provides information later on in other questions that is helpful in answering previous questions (The George Washington University, 2012).

4. The True/False Test: Even though the title of this strategy says there are five tips there are indeed a few more than five. Students should make sure every part of the sentence is true for a true statement and pay close attention to negatives, qualifiers, absolutes and long statements (Landsberger, 1996). If there is a negative, drop the negative and determine if the statement is true or false then reverse that answer to get your choice (the negative that was removed flips the answer choice) (Landsberger, 1996). Qualifiers can restrict or open up general statements and absolutes restrict possibilities (no, never, always, entirely mean the statement must be 100% true and the statement is generally
false). Long sentences include punctuation that break up the sentence, each portion of the sentence needs to be true for the entire statement to be true (Landsberger, 1996).

5. **MCT-Answering Difficult Questions:** A majority of NYS testing has a good percentage of multiple choice questions. These questions can be wordy in difficult ways and cause problems for students. When approaching a difficult question students should first eliminate incorrect answers, then give remaining options the true/false test to see if they match up with known correct statements about the topic (Landsberger, 1996). Options should then be checked to see if the match the sentence grammatically, if it is unfamiliar, and obtains that contains negative or absolute words. If there are “all of the above options” make sure all choices are correct or if one can be eliminated. For number options eliminate the high and low value and go somewhere in the middle (Landsberger, 1996). “Look alike questions”, echo questions and questions that are alternative answers should have the two choices compared and contrasted to the questions to help select the response with the most similarities to the question (Landsberger, 1996). This list of options can be taught to students in a scaffolded process slowly releasing the strategy over to the students for their independent use.

**Short answer**

These strategies are for short answer responses or essay style questions. They will aid the student in organizing their key ideas and answering the question fully.

6. **Short Answer Tests:** When preparing for a short answer question or test students should develop summary sheets, focus on key words, events, concepts, and organize the material before reviewing it (Landsberger, 1996). During the test students should respond directly to the question by using the key words and ideas called for and by responding in concise
answers. If there is the possibility of several answers inform the teacher for clarification and if you need to guess use common sense (better possibility of getting points for a logical guessed answer than if left blank) (Landsberger, 1996).

7. **STS-Short Answer:** Most short answer questions are testing for knowledge, not understanding, thus use flashcards to study the key ideas and terminology (University of Alabama at Birmingham, 2009). Make sure all parts of the question are answered in sufficient detail and pay attention to grammar, it does count in the overall grade of the question. Use formal words or words the teacher used and write in short concise statements (University of Alabama at Birmingham, 2009).

8. **STS-Essay Tests:** Some short answer questions are asking for understanding and the response should be designed more like a short essay response. Make sure to read the question carefully, jot done the key ideas it is looking for and design an outline to guide your response (University of Alabama at Birmingham, 2009). The outline will also help to make sure you answer the question. Try to include two to three main points with some explanations and details (University of Alabama at Birmingham, 2009). It you are not sure about a specific date or piece of information, generalize that statement to avoid being wrong (University of Alabama at Birmingham, 2009). For example if the amount of nitrogen in the air is 78.09%, say that it is around 80% or 75%, both of these estimates are correct whereas a statement of 77.5% would be wrong.

9. This strategy was developed by a teacher in Kentucky and deals with responding to short answer questions based off of reading, but it can be modified into other situations. Always make sure to restate the question in your answer (Read Naturally, 2012). First the topic, reading, or concept should be read or discussed to students. Then the teacher
should state the question and go over the key words and cross out the ones not needed in
the answer (Read Naturally, 2012). As group, answer the question making sure to include
the question. Repeat this process as needed to help students understand how to phrase the
answer in this think-aloud exercise (Read Naturally, 2012). After a few tries have the
students try some on their own and talk about their answers. After the students have
developed some confidence using this technique have them try one for grading purposes.
Make sure to provide feedback to students as to where the strengths and weaknesses are
in their answer and what could strengthen their responses in the future (Read Naturally,
2012).

10. The Essay Exam: Essay responses and short answer response can be similar. Here an
essay response strategy will be adapted for a short answer response. Write down all key
words and ideas that pertain to the question and design an outline to make sure all parts
of the question are going to be answered (Landsberger, 1996). When there is more than
one short answer question focus on the questions worth more if they are weighted. Put the
question in your own words, see if you have a choice in your answer, and when you
begin to answer get right to the point (Landsberger, 1996). Make sure your central idea is
well stated and it is made clear as to why it is important (Landsberger, 1996).

Vocabulary

These strategies focus on student’s ability to acquire, comprehend and generalize vocabulary.
The strategies will also focus on breadth of vocabulary.

11. Embedded vocabulary instruction is similar to direct vocabulary instruction in that the
goal is to introduce students to as many new words as possible (Coyne, McCoach, Loftus,
Zipoli Jr., & Kapp, 2009). When introducing a new word the word is briefly described
within the context of oral language such as lecture notes or book readings. Some of the benefits of this strategy are that it is time efficient as the words are already embedded into instruction and the descriptions are brief (Coyne, et al, 2009). It allows students to gain a basic understanding of target words and allows the introduction of many words in a short time. One of the limitations is the minimal instructional time for each word as research shows that multiple and repeated exposure is critical in effective vocabulary instruction (Coyne, et al, 2009).

12. Extended Instruction: “Depth of word knowledge has important implications for listening or reading comprehensions. How well, or deeply, a word is known determines whether or not it can be discriminated from other words and understood in novel contexts or in different morphosyntactic (linguistic unit that cannot be broken down into any smaller meaningful parts) forms (Coyne, et al, 2009). To focus on the development of depth of vocabulary knowledge students should have extended opportunities to discuss and interact with the words outside of initial description/interaction (Coyne, et al, 2009). Rich instruction of words includes explanations of word meanings, presentation of the words in context and in new contexts and having students discriminate among potential examples of word meaning and provide their own word meaning. Extended vocabulary instruction provides students with interactions with words outside of story/lecture constraints, repeated exposure to target words and a deeper, refined knowledge of word meanings (Coyne, et al, 2009).

13. Synthesized comprehension instruction uses vocabulary development, explicit strategy instruction, and responsive engagement within a lesson construct (Dougherty Stahl, 2009). This type of instruction falls under the term transactional strategy instruction,
which focuses on readers linking text to prior knowledge, constructing meaning from group and personal interpretations and determining responses based on the dynamics of the group. This is a general strategy theory that focuses on vocabulary comprehension through defining vocabulary, linking vocabulary instruction to prior knowledge, helping students develop word meaning from their experiences and the class’s experiences and using repeated exposure and discussion to deepen word comprehension (Dougherty Stahl, 2009).

14. eVoc strategy 2: This strategy takes the original vocabulary field trip and modifies it to a digital vocabulary field trip. Instead of beginning with a large poster of a topic and discussing terms the students already know teachers create a digital version of this on a free online program called TrackStar (trackstar.4teachers.org) (Dalton, & Grisham, 2011). This internet tool allows the teacher to collect a group of websites and organize them to allow students to take an online journey in exploring the content vocabulary. Questions are developed to focus students to specific vocabulary on each website and are provided on the page to left. The teacher can also connect the ideas of the websites together to get students to interconnect the various vocabulary terms and major concepts (Dalton, & Grisham, 2011). The students thus gain multiple exposures in various contexts and through different media.

15. eVoc strategy 3: This strategy uses online vocabulary games to connect learning with fun (Dalton, & Grisham, 2011). Two recommended sites to do this are www.vocabulary.co.il and www.vocabulary.com (Dalton, & Grisham, 2011). Some of the games included on these sites include crosswords, picture-word matches, word scrambles, and 8 letters in search of a word (word creation from 8 letters). The games are supplemented with word
list (to focus what words you want the students to be exposed to) and test preparation items (Dalton, & Grisham, 2011). The sites can also be bookmarked so students can independently use at home or during their spare time.

**Compare and contrast**

These strategies focus on helping students compare and contrast concepts, vocabulary terms or items.

16. LID: This strategy will be used twice for this curriculum project occurring here for the comparing and contrasting question types and earlier for the students with disabilities category. The strategy occurs in three steps: “List the items to be compared, Identify the similarities and differences, Draw a graphic representation of the relationship” (LID) (Minskoff & Allsopp, p.285, 2003). This helps students visually organize the items to be compared and contrasted and then organize the similarities and differences among the items with a graphic representation (Minskoff & Allsopp, p.285, 2003).

17. Teacher Direct Comparison Tasks: If students are having difficulties with comparing items then the teacher should introduce the process of comparison by involving students in highly structured tasks (Marzano et al, p. 17 2001). This process has the teacher identify objects that the students are to compare and the qualities of the object they are comparing. This helps focus the conclusion that students will reach (Marzano et al, p.17 2001). To place this task in student’s hands the teacher should slowly scaffold the process until students are able to compare two or more items and select important qualities to compare.

18. Analogies are great tools to helps students see similarities and differences among new information (Marzano et al, p.26 2001). There are two-types: Teacher-directed and
Student-directed analogies. The Teacher-directed analogies have a lot of structure provided and the teacher gives the student the analogy and has them explain how the objects are similar and different. The Student-directed analogies have students produce more elements of the analogy and explain the similarities and differences (Marzano et al., p.26-27 2001).

19. Venn Diagram: Graphic organizers can have varying uses depending on the type and who is creating it, the teacher or the student. The graphic organizer called the Venn diagram is used for comparison of two objects (Marzano et al., p.18 2001). A Venn diagram is comprised of two circles intertwined with one another. One object is written over one circle and another over the other circle. The middle, where the two circles are combined is where similarities of the objects are written and in the individual areas of each circle is where the characteristics that are unique to that object are written (Marzano et al., p.18 2001).

20. Comparison Matrix: Another graphic organizer commonly used for comparing multiple objects is the Comparison Matrix (Marzano et al., p.18-19 2001). A Comparison Matrix is like a T-chart, the objects being compared are written across the top and on the left hand side characteristics of the objects are written. Then on the right hand side the characteristic row is split into two sections, similarities and differences. This allows more than two items to be compared and contrasted and helps students see the similarities and differences among the characteristics of the objects Marzano et al, p.18-19 2001).

**Critical Thinking**

These strategies are to help students prepare for questions that focus on critical thinking.
21. This strategy, the “Rule-Based” Strategy follows a set of rules to help students produce a summary from either notes, reading or lecture (Marzano et al, p.32 2001). First students should delete trivial material and redundant material. Then superordinate terms should be substituted in for lists and finally students should select or create a topic sentence (Marzano et al, p.32 2001).

22. Students Teaching Students: When trying to expand students ability to critically think the teacher should encourage them to assess their speaking. One strategy to do this is Students Teaching Students (Paul, & Elder, 2009). One of the best ways to learn is by trying to teach someone else. Students should be partnered together each with a concept they are to teach to the other student. If they are having difficulties explaining certain areas of the concept they will now know that these are areas of the concept they need to learn in more depth and with more clarity (Paul, & Elder, 2009).

23. Group Problem Solving: Another strategy to help students with critical thinking is Group Problem Solving. By placing students into groups and having them solve a problem together with help them think better through mutual articulation and exchanges (Paul, & Elder, 2009). When one student is wrong others will often correct them and this will help the students learn to “correct” themselves when they are going down an illogical solution path. The teacher should make sure students are applying intellectual standards to their thinking process are they are discussing issues within the group (Paul, & Elder, 2009).

24. Practice Thinking within Content: When trying to teach students how to think biologically the following suggestions can be used (Elder, & Paul, 2009). Every class should be approached with a clear sense of relevant thinking appropriate for student activities. Modeling or dramatizing in-front of students can produce the desired thinking.
Activities should be designed to have students generate and assess their thinking. This requires thinking aloud and having students practice this strategy to aid them in thinking about what they are writing (Elder, & Paul, 2009).

25. Understanding Content as Interconnected Ideas: The teacher should explain to students the every system of thought is used to ask questions, gather data/information, make inferences, trace implications, and transform thinking about the dimension of the world that the subject represents (Elder, & Paul, 2009). Each idea should be explained in the terms of other ideas and the connections should be made apparent to help students understand the connections. These ideas of each concept or idea form an interrelated system (Elder, & Paul, 2009). This system should be modeled by thinking aloud slowly and deliberately in front of the students to explain the connections between each concept, term, and idea (Elder, & Paul, 2009). This should be scaffold so that students can replicate this strategy and do it another concept topic such as DNA replication. Students should be able to connect all of the major experiments, events and terms in this concept to one another in a coherent flow chart, semantic web, or written explanation.

Units

This curriculum project was designed around the four Living Environment units of Ecology, Mitosis, Meiosis, and DNA/RNA. Provided here are the lesson plan names, objective, criteria and standards the objectives are aligned with (full lessons are provided in Appendix D). Also there is a CRA for each lesson with answers to questions provided in a different color text. The unit CRA is a part of the lesson as the lesson includes a review session and the unit CRA. For content that is generally difficult, feedback suggestions will be provided in a brief feedback section for guidelines on difficult concepts and ideas to enhance the lesson if all students struggle
on CRA. For all other feedback, teachers should consult the general feedback section provided at the beginning of the findings section and use the scoring matrices to obtain helpful strategies for re-teaching misunderstood questions or concepts.

**Ecology unit.**

This unit covers the basic information dealing with Ecology. Topics within the unit include: behavior, population interactions, energy pyramids, and human impacts.

**Teacher____________**

**80 minute period of Living Environment’s**

**Unit: Ecology: Behavior, and population interactions**

**Lesson one: Overview of Learned and Innate behavior**

I. **Objectives:** 1) Students will be able to describe what learning is and what a learned behavior is. 2) Students will be able to describe what innate behavior is. 3) Students will be able to describe the difference among the learned and innate behavior and describe each one’s role in population interactions.

II. **Criteria:** 1) Understanding of what learning is, being able to define learned behavior and giving three examples of learned behavior. 2) Understanding of what innate behavior is, and being able to list three examples of innate behavior. 3) Description of the similarities and differences among learned and innate behaviors. Students will be able to list three of each.

**Name________________** **Date____________________**

**CRA for Lesson 1**

Criteria covered by this CRA:
• Understanding of what learning is, being able to define learned behavior and giving three examples of learned behavior.

• Understanding of what innate behavior is, and being able to list three examples of innate behavior.

• Description of the similarities and differences among learned and innate behaviors.
  
  Students will be able to list three of each.

1) Which of the following is an example of a learned behavior?

   a) Being able to grow hair       b) Having blue eyes
   c) A wolf hunting its prey      d) Lacewing songs used to attract males

2) Write two sentences, one being an explanation of learning and the other an example of a learned behavior not stated in the above question.

   Learning is the process of being able to enact a certain behavior by watching a parent or peer in order to survive. An example of learning is dolphin being taught how to catch its food source (fish).

3) Which of the following is an example of an innate behavior?

   a) Being able to grow hair       b) Having blue eyes
   c) A wolf hunting its prey      d) Lacewing songs used to attract males

4) In your own words and in less than three sentences describe what an innate behavior is. You can support your answer with examples.

   An innate behavior is a behavior that an organism is born with such as birds ability to fly or a rabbit's ability to know which organisms are their predators and run from them.

5) Which of the following is a difference between innate and learned behavior?

   a) A learned behavior is taught   b) An innate behavior deals with population interactions
6) In three sentences compare and contrast innate and learned behaviors.

Innate behaviors are behaviors that organisms can perform from the moment they are born such as breathing or mating rituals of some organisms. Learned behaviors have to be taught to an organism after birth such as a human learning to dress oneself. Both types of behaviors are similar in that they are population interactions.

Feedback guide for Ecology unit daily CRA one

See general feedback section and scoring matrices. Provide ample examples of both types of behavior and explanations as to how both operate as population interactions.

Teacher_______________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson two: Population interactions, ecological niches, invasive species, and introduction to ecosystems.

I. **Objectives:** 1) Students will be able to understand what population interactions are more fully and what an ecological niche is. 2) Students will be able to define what an invasive species is and how it causes competition. 3) Students will be able to define the basic vocabulary of an ecosystem.

II. **Criteria:** 1) Students will be able to give at least three examples and define what an ecological niche is. 2) Students will be able to explain how an invasive species leads to competition, define competition and give at least two examples of an invasive species. 3) Students will be able to define the words organism, population, community, and ecosystem.
CRA for Lesson two

Criteria covered in this CRA:

- Students will be able to give at least three examples and define what an ecological niche is.

- Students will be able to explain how an invasive species leads to competition, define competition and give at least two examples of an invasive species.

- Students will be able to define the words organism, population, community, and ecosystem.

1) Which of the following is an example of an organism?
   a) a rock  
   b) Lake Erie  
   c) a horse  
   d) an eraser

2) In one sentence define what a community is.

   **A community is an area including all of the various populations and their interactions with each other.**

3) An organism’s job within an ecosystem in which no other organism can fill without competition is called a(an)
   a) biosphere  
   b) community  
   c) predator  
   d) ecological niche

4) Give an example of an ecological niche using a complete sentence.

   **An example would be a robin occupying a particular maple tree within the ecosystem.**

5) Which of the following is an example of competition?
   a) a deer eating grass  
   b) a rose and a dandelion growing very close together
c) a whale in a wide open ocean  d) a human eating whenever they are hungry

6) In three sentences or less describe what an invasive species is and how it leads to competition?

**An invasive species is an organism that is not native to the ecosystem that it becomes introduced to.** Most invasive species have no natural predators in the new ecosystem and compete with the natural organism because they have the same niche. Since the invasive species and native species have the same niche they compete for it.

**Feedback guide for Ecology unit daily CRA one**

See general feedback section and scoring matrices. Provide amble examples of ecological niches and invasive species. Use the examples to explain how invasive species causes competition with the native species.

**Teacher____________**

80 minute period of Living Environment’s

**Unit: Ecology: Behavior, and population interactions**

**Lesson three: Ecosystem vocabulary and ecosystem interactions**

I. **Objectives:** 1) Students will be able to describe key vocabulary terms that deal with population interactions and ecosystems. 2) Students will be able to place organisms and inorganic items into the correct categories of predator, prey, producer, consumer, biotic and abiotic. 3) Students will be able to describe the terms for food chains, draw a food chain and understand different trophic levels.

II. **Criteria:** 1) Students will be able to define the words population interaction, predator, prey, producer, consumer, biotic, abiotic, food chain, biosphere and trophic level. 2) Students will be able to draw a food chain and provide explanations for the different trophic levels.
CRA for Lesson 3

Criteria covered in this CRA:

- Students will be able to define the words population interaction, predator, prey, producer, consumer, biotic, abiotic, food chain, biopshere and trophic level.
- Students will be able to draw a food chain and provide explanations for the different trophic levels.

1) Which of the following selections contains an example of something that is abiotic, biotic and a producer?

   a) rock, steel, lion
   b) grass, apple tree, whale
   c) water, robin, grass
   d) eagle, fox, deer

2) Describe two of the characteristics in complete sentences of one of the following biospheres: tundra, taiga, desert, tropical rainforest, or temperate deciduous forest.

   A desert has low precipitation and hot temperatures. A tundra has cold temperatures, low precipitation and no trees. A taiga has cold temperatures, moderate precipitation and some trees. A tropical rainforest has high temperatures and high precipitation with a lot of organisms. A temperate deciduous forest has moderate temperature and precipitation.

3) Which of the following selections contains the correct order of trophic levels?

   a) tertiary consumer, producer, primary consumer, secondary consumer
   b) producer, primary consumer, secondary consumer, tertiary consumer
   c) secondary consumer, tertiary consumer, primary consumer, producer
   d) primary consumer, secondary consumer, producer, tertiary consumer

4) Using the following organisms create a food chain: hawk, grass, snake, mouse, decomposer.
Grass-mouse-snake-hawk-decomposer

Feedback guide for Ecology unit daily CRA three

Use general feedback guide and scoring matrices. Provide students with multiple opportunities to practice drawing food chains and labeling organisms to their trophic levels.

Teacher______________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson four: Food webs, lab on ecosystem in a bottle

I. Objectives: 1) Students will be able to draw a food web when given a list of organisms. 2) Students will be able to understand how a food web and food chain are different. 3) Students will be able to create an ecosystem in a bottle and answer questions about food webs pertaining to the ecosystem they created.

II. Criteria: 1) Students will be able to draw a food web from a list of organisms. 2) Students will be able to list at least three differences between food webs and chains.

Name____________________________             Date______________________

CRA for Lesson 4

Criteria for this CRA:

• Students will be able to draw a food web from a list of organisms.
• Students will be able to list at least three differences between food webs and chains.

1) From the following list of organisms draw a food web: grass, deer, rabbit, fox, mouse, snake, small bush, hawk, bobcat, human, and a decomposer.
2) Which of the following is a difference between food webs and chains?

   a) a food chain shows population interactions
   
   b) a food web shows energy flow
   
   c) a food chain shows who eats whom
   
   d) a food web is a complex representation of organisms feeding relationships within an ecosystem

3) In two to three sentences compare and contrast food webs and chains.

   A food web represents the population interactions among all of the organisms in an ecosystem. A food chain is a linear representation of trophic level energy movement. A food web show the complex energy flow within an ecosystem by visually representing it in a web.

Feedback guide for Ecology unit daily CRA four

Use general feedback guide and scoring matrices. Provide students with opportunity to draw food webs. Use visual representations and organizers to demonstrate differences between food webs and chains.

Teacher____________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson five: Energy flow and environmental limitations
I. **Objectives:** 1) Students will be able to draw an energy pyramid and describe how materials are recycled in an ecosystem. 2) Students will be able to define competition, limiting factors, and carrying capacity. 3) Students will be able to describe how limiting factors limit the carrying capacity, limit the amount of organisms there can be in a particular habitat and why there cannot be an infinite population.

II. **Criteria:** 1) Students will be able to draw energy pyramids and explain the 10% rule. 2) Students will be able to describe the interactions of competition to limiting factors and carrying capacity and define limiting factors and carrying capacity. 3) Students will be able to describe how limiting factors and carrying capacity are interrelated.

Name____________________________             Date______________________

CRA for Lesson 5

Criteria for this CRA:

- Students will be able to draw energy pyramids and explain the 10% rule.
- Students will be able to describe the interactions of competition to limiting factors and carrying capacity and define limiting factors and carrying capacity.
- Students will be able to describe how limiting factors and carrying capacity are interrelated.

1) How much energy is passed on from a producer to a primary consumer?
   a) 100%  
   b) 47%  
   c) 80%  
   d) 10%

2) If a producer contains 4400 calories of energy how much the original energy will a tertiary consumer gain? Show your calculations and provide a one sentences explanation as to why this happens. (Think of energy pyramids and energy flow up to the next tropic level)
4400 x .10= 440 calories to primary consumer. 440 x .10= 44 calories to secondary consumer. 44 x .10= 4.4 calories to the tertiary consumer.

3) An environmental factor that controls how large a population can become is a…

  a) limiting factor  
  b) carrying capacity  
  c) competition  
  d) food web

4) In two to three sentences explain what competition is. Provide an example.

**Competition is when two organisms are competing for a shared food source, shelter or water supply. Competition occurs when an invasive species arrives such as the zebra mussel in the great lakes.**

5) In three to four sentences explain how limiting factors and carrying capacity are connected. Discuss some limiting factors that can affect a population carrying capacity.

**A limiting factor is an environmental item that affects the size of the population such as water supply and food supply. The carrying capacity is how large the population can get given the current environmental conditions. Hence limiting factors such as the amount of available food or water and the available areas to take shelter or live in affect the carrying capacity of an organism.**

**Feedback guide for Ecology unit daily CRA five**

Use the general feedback guide and scoring matrices. Focus on connecting limiting factors to carrying capacity and give students practice with the 10% rule.

**Teacher_____________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson six: Human impact
I. **Objectives:** 1) Students will be able to describe the various impacts humans have on the environment and why these human actions impact the environment. 2) Students will be able to define bioaccumulation. 3) Students will be able to describe ways to reverse or slow down climate change and other environmental impacts humans have on the world.

II. **Criteria:** 1) Students will be able to describe at least three human impacts on the environment. 2) Students will be able to define bioaccumulation. 3) Students will be able to describe at least two methods used to slow down or reverse human impacts on the environment.

Name____________________________  Date____________________

CRA for Lesson 6

Criteria for this CRA:

- Students will be able to describe at least three human impacts on the environment.
- Students will be able to define bioaccumulation.
- Students will be able to describe at least two methods used to slow down or reverse human impacts on the environment.

1) Which of the following human actions does not have a negative impact on the environment?

   a) burning of fossil fuels  
   b) war
   c) factories  
   d) creating wildlife refugees

2) Choose one human action and in two to three sentences explain how it impacts the environment.

The burning of fossil fuels by humans releases excess CO2 and other “greenhouse” gases into the atmosphere. There gases slow the release of heat back into space (created by sun
rays) and trap the heat for longer periods creating overall global warming and localized climate change.

3) The uptake and build up of toxic substances is called…

   a) climate change
   b) bioaccumulation
   c) acid rain
   d) mass wasting

4) In two to three sentences describe what happens to methyl mercury levels in organisms as it moves up the food chain.

   The process of bioaccumulation causes toxins to increase in concentration as they move up the food chain. As the levels of methyl mercury become more concentrated they become more toxic to organism further up the food chain and cause these organisms’ health issues or death.

5) The burning of fossils fuels and release of CFC’s and green house gases into the atmosphere contribute to what environmental impact.

   a) bioaccumulation
   b) climate change
   c) mass wasting
   d) acid rain

6) The earth is on a constant cycle of warming and cooling. Explain in three to four sentences how human actions have impacted this cycle, ways to slow the human impact down, and possible consequences of this impact.

   Humans burning of fossil fuels and cutting down of forests along with the release of CFC’s have created abundant greenhouse gases in the atmosphere. This is speeding up the warming process of the earth and causing climate change at a much faster rate than naturally possible. Decreasing the burning of fossil fuels and by replenishing the forest that
we cut down can slow down our effect on the environment. Consequences of these actions are climate change, species extinctions and raising ocean levels.

Feedback guide for Ecology unit daily CRA six

Use general feedback guide and scoring matrices. Students should have readings, websites and activities to help learn the many human impacts and their causes and effects.

Teacher_______________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson seven: Review and unit CRA

I. **Objectives:** 1) Students will be able to answer review questions based on the ecology unit. 2) Students will be able to perform the best they can on the unit CRA

II. **Criteria:** 1) Understanding of what learning is, being able to define learned behavior and giving three examples of learned behavior. 2) Understanding of what innate behavior is, and being able to list three examples of innate behavior. 3) Description of the similarities and differences among learned and innate behaviors. Students will be able to list three of each. 4) Students will be able to give at least three examples and define what an ecological niche is. 5) Students will be able to explain how an invasive species leads to competition, define competition and give at least two examples of an invasive species. 6) Students will be able to define the words organism, population, community, and ecosystem. 7) Students will be able to define the words population interaction, predator, prey, producer, consumer, biotic, abiotic, food chain, biosphere and trophic level. 8) Students will be able to draw a food chain and provide explanations for the different trophic levels. 9) Students will be able to draw a food web from a list of organisms. 10)
Students will be able to list at least three differences between food webs and chains. 11) Students will be able to draw energy pyramids and explain the 10% rule. 12) Students will be able to describe the interactions of competition to limiting factors and carrying capacity and define limiting factors and carrying capacity. 13) Students will be able to describe how limiting factors and carrying capacity are interrelated. 14) Students will be able to describe at least three human impacts on the environment. 15) Students will be able to define bioaccumulation. 16) Students will be able to describe at least two methods used to slow down or reverse human impacts on the environment.

Name____________________________             Date______________________

Unit CRA for Ecology

Criteria for this CRA:

- Understanding of what learning is, being able to define learned behavior and giving three examples of learned behavior.
- Understanding of what innate behavior is, and being able to list three examples of innate behavior.
- Description of the similarities and differences among learned and innate behaviors. Students will be able to list three of each.
- Students will be able to give at least three examples and define what an ecological niche is.
- Students will be able to explain how an invasive species leads to competition, define competition and give at least two examples of an invasive species.
- Students will be able to define the words organism, population, community, and ecosystem.
• Students will be able to define the words population interaction, predator, prey, producer, consumer, biotic, abiotic, food chain, biosphere and trophic level.

• Students will be able to draw a food chain and provide explanations for the different trophic levels.

• Students will be able to draw a food web from a list of organisms.

• Students will be able to list at least three differences between food webs and chains.

• Students will be able to draw energy pyramids and explain the 10% rule.

• Students will be able to describe the interactions of competition to limiting factors and carrying capacity and define limiting factors and carrying capacity.

• Students will be able to describe how limiting factors and carrying capacity are interrelated.

• Students will be able to describe at least three human impacts on the environment.

• Students will be able to define bioaccumulation.

• Students will be able to describe at least two methods used to slow down or reverse human impacts on the environment.

1) A behavior that an organism develops from life experiences is called a (an)…

   a) population interaction  b) innate behavior  
   c) learned behavior  d) energy pyramid

2) A behavior that an organism is born with is called a (an)…

   a) population interaction  b) innate behavior  
   c) learned behavior  d) energy pyramid

3) Which of the following is a difference between learned and innate behaviors?

   a) one can be taught  b) one is needed for survival
c) one helps organisms hunt  
d) one is a population interaction

4) An ecological niche is an organism’s…
   
a) habitat
b) family

c) food source  
d) job within an ecosystem

5) When an invasive species enters a new ecosystem what does it cause?
   
a) a food chain
b) bioaccumulation

c) competition  
d) producer

6) Which of the following is an abiotic factor?
   
a) water
b) antelope

c) cat  
d) whale

7) All of the abiotic and biotic factors in one area interacting together is called a (an)…
   
a) habitat
b) ecosystem

c) biosphere  
d) population

8) An organism that creates its own energy from abiotic environmental factors is a (an)…
   
a) primary consumer
b) decomposer

c) producer  
d) secondary consumer

9) Which of the following is not a difference between food webs and chains?

   a) Diagram representation of population interactions
   
   b) Linear representation of energy flow through trophic levels
   
   c) Complex representation of predator/prey relationships in an ecosystem
   
   d) a, b and c

10) What percentage of energy is passed onto the next trophic level?
    
a) 90%  
b) 38%
c) 23%  
d) 10%

11) The maximum amount of organisms of one species that can be supported within an ecosystem is called a…
   a) carrying capacity  b) limiting factors  
c) competition  d) population interaction

12) The carrying capacity is influenced by…
   a) competition  
b) limiting factors  
c) population interactions  d) climate change

13) Which of the following is a human impact?
   a) solar eclipses  b) orange juice  
c) burning fossil fuels  
d) acid rain

14) The magnification of toxic substances as they move up trophic levels is called…
   a) competition  b) bioaccumulation  
c) energy pyramid  d) toxic flow

15) By limiting the burning of fossil fuels which human impact would be slowed down?
   a) species extinction rates  b) bioaccumulation  
c) climate change  d) abiotic factors

16) Describe how a learned behavior is a population interaction. Provide an example

* A *population interaction* is any action in which two organisms interact. A learned behavior include two organisms, the one teaching and the one learning and often has the one organism learning how to hunt such as wolves teaching their young to hunt.*

17) Explain in two to three sentences what an innate behavior is. Provide an example
An innate behavior is one that is there from birth. The organism knows how to perform an innate behavior without learning it. An example is the lacewing and their mating songs.

18) In two to three sentences compare and contrast innate and learned behaviors

Learned behaviors are not present from birth such as innate behaviors and have to be acquired by life experiences. Both behaviors are population interactions and are needed for an organism to survive.

19) Explain what an ecological niche is in two to three sentences. Provide an example

An ecological niche is an organism’s job within the ecosystem. No other organism (species) can have this job without the consequence of competition. An example would be a wolf pack occupying a specific area.

20) Describe in three to four sentences how an invasive species leads to competition.

The introduction of an invasive species causes to species to have the same niche. This is not possible with the species competing for that niche position. Usually the invasive species has the advantage because they do not have any natural predators in the area. An example is the zebra mussel which almost took over the great lakes when it was introduced to the area.

21) Provide definitions for the vocabulary terms abiotic and biotic in complete sentences.

Abiotic means the item is non-living while biotic classifies the item as living.

22) In two to three sentences explain the differences between a consumer and a producer.

A producer is capable of making its own energy from either the sun or other abiotic chemicals in the environment. A consumer needs to eat other organisms to gain its energy.

23) Using the organisms: grass, rabbit, fox, wolf, decomposer create a food chain

Grass-rabbit-fox-wolf-decomposer
24) Draw a food web from the following organisms: grass, apple tree, tulip, bee, sparrow, rabbit, mouse, snake, fox, hawk, wolf, bobcat, and decomposer.

25) In two to three sentences explain the difference between a food web and a food chain.

A food chain is a linear representation of a few organism and energy flow through trophic levels. A food web is a complex representation of energy flow of all organisms in an ecosystem.

26) Draw an energy pyramid including the following trophic levels: producer, primary consumer, secondary consumer and tertiary consumer.

27) Explain in two to three sentences how competition can act as a limiting factor.

Competition between two species or populations over a food source or water supply can affect the population’s carrying capacities. This would mean competition was acting as a limiting factor.

28) Chose an impact that humans have on the environment and explain in two to three sentences what the impact is and what the cause is.
Human impact is acid rain which is caused by the release of noxious gases into the atmosphere. Acid rain then erodes away landscapes and makes soil to acidic for most plants to grow or lakes to acidic for most fish to live in.

29) Describe two techniques or actions that can be used to slow down any of the human impact on the environment. State the two actions you are going to address and which human impacts these actions affect. Then write one sentence on each action describing how it will slow down the human impact it is focused on.

The two actions being addressed are the reduction of forest cutting and the reduction of releasing noxious gases into the atmosphere. The reduction of forest cutting will slow down climate change. The reduction of releasing noxious gases will reduce the amount of acid rain.

Feedback guide for Ecology unit: Unit CRA

Use the general feedback guide and scoring matrices.

Mitosis unit.

Lessons two through five of this unit were previously created by myself for a student teaching unit. The first lesson and lesson six were added to make the unit more cohesive and complete. Lesson five was modified to provide a more complete lesson plan. The material in this unit includes cell cycles, the phases of Mitosis, the various forms of reproduction associated with Mitosis and the benefits and cons of asexual reproduction.

Teacher______________________

80 minute period of Honors Living environments

Unit: Mitosis and cell cycles

Lesson 1: Cell cycle
I. **Objective:** 1) Students will be able to describe the cell cycle including the details of mitosis.

II. **Criteria:** 1) Students will be able to draw the cell cycle and explain the main phases. 2) Students will be able to explain the four phases of mitosis and the function of mitosis.

Name____________________________             Date______________________

**CRA for Lesson 1**

Criteria covered by this CRA:

- Students will be able to draw the cell cycle and explain the main phases.
- Students will be able to explain the four phases of mitosis and the function of mitosis.

1) Which of the following shows the correct order of the cell cycle?
   a) Mitosis, S phase, G2, cytokinesis, G1
   b) G1, S phase, G2, Mitosis, cytokinesis
   c) cytokinesis, Mitosis, G2, G1, S phase
   d) S phase, cytokinesis, Mitosis, G1, G2

2) Describe the phases that are in interphase and what happens in interphase. Use two to three sentences to provide your answer.

   **The three phases of interphase are G1, S and G2. Interphase is the period in which the cell grows, replicates the DNA and prepares for cellular replication.**

3) Which of the following contains the correct order of events in mitosis?
   a) prophase, metaphase, anaphase, telophase
   b) anaphase, prophase, telophase, metaphase
   c) prophase, telophase, anaphase, metaphase
   d) metaphase, anaphase, prophase, telophase
4) In two to three sentences explain what happens during the process of mitosis, including why this is important to cells and passing on hereditary information.

During S phase the cell replicates its DNA into two equal sets and then during Mitosis the cell divides the DNA and cytoplasm into two identical cells. The metaphase and anaphase steps of Mitosis helps divide the DNA into two equal fractions to pass on hereditary information equally to the daughter cells.

Feedback guide for Mitosis unit daily CRA one

Use the general feedback guide and scoring matrices. Provide ample diagrams and videos for students to obtain visual representations of the process of Mitosis.

Teacher__________________

80 minute period of Honors Living environments

Unit: Mitosis and cell cycles

Lesson 2: Cell cycle review and Mitosis lab

I. **Objective**: 1) Students will be able to describe the cell cycle. 2) Students will be able to explain the difference between diploid and haploid, and chromatin, chromatid and chromosome. 3) Students will be able to complete a laboratory investigation of the process of Mitosis by observing prepared slides containing onion roots.

II. **Criteria**: 1) Students will be able to define the words diploid, haploid, chromosome, chromatin and chromatid. 2) Students will be able to provide at least two real life examples of Mitosis.

Name____________________________             Date______________________

CRA for Lesson 2

Criteria covered by this CRA:
● Students will be able to define the words diploid, haploid, chromosome, chromatin and chromatid

● Students will be able to provide at least two real life examples of Mitosis.

1) A diploid cell contains…

   a) the same amount of chromosomes as a body cell (normal)
   b) half the amount of chromosomes as a body cell
   c) contains three times as many chromosomes as a body cell
   d) contains no chromosomes

2) In two to three sentences compare and contrast somatic and gamete cells.

   **Somatic cells contain a normal amount of chromosomes and can only perform asexual reproduction. Gamete cells have half the amount of normal cells and can perform sexual reproduction.**

3) Describe in three sentences what was done in the lab. Then in one to two sentences explain the importance of this lab to your understanding of the process of mitosis.

   **This lab had students’ plate onion cells on a slide. Then students viewed the slide under a microscope to see the various stages of Mitosis. Then students counted the amount of cells at each stage to determine relative length of each phase. From this lab students learned that phases of Mitosis occur at different speeds.**

**Feedback guide for Mitosis unit daily CRA two**

Use the general feedback guide and scoring matrices. Focus of the vocabulary and use vocabulary acquisition and comprehension techniques.

**Teacher____________**

**80 minute period of Honors Living environments**
Unit: Mitosis and cell cycles

Lesson 3: Asexual reproduction part one

I. Objective: 1) Students will be able to describe binary fission, budding, sporulation (pore formation), and regeneration. 2) Students will be able to explain the differences between sexual and asexual reproduction, and why asexual reproduction could be beneficial.

II. Criteria: 1) Students will be able to define the asexual reproduction terms. 2) Students will be able to describe at least three differences between sexual and asexual reproduction.

Name____________________________             Date______________________

CRA for Lesson 3

Criteria covered by this CRA:

- Students will be able to define the asexual reproduction terms
- Students will be able to describe at least three differences between sexual and asexual reproduction

1) When a cell divides its cytoplasm into two unequal parts it is called…
   a) binary fission    b) sporulation
   c) regeneration     d) budding

2) How is an organism’s ability to regenerate related to its complexity? Explain in two sentences.
   The more complex an organism is the less likely it is to have the ability to regenerate. More complexity means more differentiation and energy hence complicating the process of regenerating.

3) A reproduction process that has the same amount of chromosomes in all stages of reproduction is called
a) asexual reproduction   b) triploid reproduction

c) haploid reproduction   d) sexual reproduction

4) Provide one similarity and two differences between sexual and asexual reproduction. Use one sentence for each similarity or difference.

A similarity among the processes is that they both pass on genetic information to their daughter cells. Two differences are sexual reproduction contains a haploid phase and asexual reproduction produces identical offspring.

Feedback guide for Mitosis unit daily CRA three

Use general feedback guide and scoring matrices. Focus on providing students a variety of instructional techniques when presenting the differences between asexual and sexual reproduction.

Teacher___________

80 minute period of Honors Living environments

Unit: cell cycles, mitosis, asexual reproduction

Lesson 4: Vegetative propagation

I. **Objective**: 1) Students will be able to explain the various types of vegetative propagation. 2) Students will be able to compare and contrast the pros, and cons of sexual and asexual reproduction.

II. **Criteria**: 1) Students will be able to list and describe the various types of vegetative propagation 2) Students will be able to provide at least two pros and cons of sexual and asexual reproduction

Name_________________________  Date______________________
Criteria covered by this CRA:

- Students will be able to list and describe the various types of vegetative propagation
- Students will be able to provide at least two pros and cons of sexual and asexual reproduction

1) What are the three types of natural vegetative propagation?

   a) cutting, budding, runners
   b) layering, tuber, grafting
   c) grafting, runners, bulbs
   d) runners, tuber, bulbs

2) Explain in two to three sentences the purposes of artificial vegetative propagation. Provide at least one example.

   A purpose of vegetative propagation is to produce large populations of produce quickly. Also vegetative propagation is used to make money. An example of this is layering used to produce raspberries.

3) Describe a pro and a con for each sexual and asexual reproduction. Use complete sentences, the shortest possible answer could be in two sentences.

   A pro for sexual reproduction is genetic variety and a con is the complications of the process. A pro for asexual reproduction is identical offspring and a con is lack of genetic variation to battle changing environmental conditions.

Feedback guide for Mitosis unit daily CRA four

Use the general feedback guide and scoring matrices. Focus on providing a lot of examples for the types of vegetative propagation.

Teacher_________________

80 minute period of Honors Living environments

Unit: Mitosis
Lesson 5: Cancer

I. **Objective:** 1) Students will be able to describe cancer.

II. **Criteria:** 1) Students will be able to describe cancer and how it affects the cell cycle.

Name_________________________ Date______________________

**CRA for Lesson 5**

Criteria covered by this CRA:

- Students will be able to describe cancer and how it affects the cell cycle.

1) Explain what causes cancer in two sentences. Then in two sentences explain what items of knowledge you learned from today’s class is of interest to you.

**Cancer is cause by a mutation that causes the cell to divide uncontrollably. The mutation effects one of the checkpoints at the end of either G1 or G2 causing the cell to bypass its usually checkpoints and divide without making sure it is ready to.**

**Feedback guide for Mitosis unit daily CRA five**

Use general feedback guide and scoring matrices. Focus on providing students with a lot of videos and activities to explain what causes cancer.

**Teacher______________**

80 minute period of Honors Living environments

Unit: Mitosis and cell cycles.

**Lesson 6: Review and unit CRA**

I. **Objective:** 1) Students will be able to pass a unit CRA based on their knowledge of Mitosis and cell cycles.

II. **Criteria:**
1) Students will be able to draw the cell cycle and explain the main phases. 2) Students will be able to explain the four phases of mitosis and the function of mitosis. 3) Students will be able to define the words diploid, haploid, chromosome, chromatin and chromatid.
4) Students will be able to provide at least two real life examples of Mitosis. 5) Students will be able to define the asexual reproduction terms. 6) Students will be able to describe at least three differences between sexual and asexual reproduction. 7) Students will be able to list and describe the various types of vegetative propagation 8) Students will be able to provide at least two pros and cons of sexual and asexual reproduction. 9) Students will be able to describe cancer and how it affects the cell cycle

Name____________________________             Date______________________

CRA for Mitosis Unit

Criteria covered by this CRA:

- Students will be able to draw the cell cycle and explain the main phases.
- Students will be able to explain the four phases of mitosis and the function of mitosis.
- Students will be able to define the words diploid, haploid, chromosome, chromatin and chromatid.
- Students will be able to provide at least two real life examples of Mitosis.
- Students will be able to define the asexual reproduction terms.
- Students will be able to describe at least three differences between sexual and asexual reproduction.
- Students will be able to list and describe the various types of vegetative propagation
- Students will be able to provide at least two pros and cons of sexual and asexual reproduction.
Students will be able to describe cancer and how it affects the cell cycle

1) At which phase does DNA replicate?
   a) G0  b) G2  
   c) S  D) G1

2) During which phase of Mitosis do the chromosomes get pulled apart?
   a) prophase  b) metaphase
   c) anaphase  d) telophase

3) If a cell has 2n chromosomes what type of cell is it?
   a) diploid  b) haploid
   c) triploid  d) quadploid

4) When an organism splits its cytoplasm into unequal parts it is undergoing….
   a) grafting  b) tuber
   c) regeneration  d) budding

5) When reproducing asexual organisms undergo Mitosis. When reproducing sexually organisms undergo…
   a) cytokinesis  b) Meiosis
   c) cancer  d) haploiding

6) Which of the following is a type of vegetative reproduction? (either natural or artificial)
   a) budding  b) layering
   c) tuber  d) mutation

7) Which of the following is a cause of cancer?
   a) G0  b) regeneration
c) DNA replication
d) mutation of checkpoint in the cell cycle

8) Draw a diagram of the cell cycle. Explain two of the phases using one or two sentences for each phase.

\[ \text{G1} \rightarrow \text{S} \rightarrow \text{G2} \rightarrow \text{Mitosis} \rightarrow \text{Cytokinesis} \rightarrow \text{G1 (etc…)} \]

G1 phase is when the cell grows. S phase is when DNA is replicated. G2 is when the cell makes sure it has everything for cell division. Mitosis is where DNA is separated equally and the cytoplasm is separated equally too. Cytokinesis is the splitting of the cell membrane.

9) In two to three sentences briefly describe the four stages of Mitosis. Then in one sentence explain what mitosis is.

Prophase is where spindle fibers form and attach to chromosomes so that they can be dragged to the middle of the cell during metaphase. Anaphase separates sister chromatids and telophase starts to pinch off the cytoplasm. Mitosis is the production of two identical daughter cells.

10) Why is cytokinesis not part of the Mitosis phase? Explain in two sentences and then provide an explanation of what occurs during cytokinesis using one sentence.

Cytokinesis is the splitting of the membrane where Mitosis is the splitting of the DNA.

11) Define the following words providing one sentence for each: chromosome, chromatid, and genes.

A chromosome is condensed DNA that is ready to be separated into two cells. A chromatid is two identical copies of a chromosome. A gene is a section of a chromosome that is converted into a protein.
12) Use four to five sentences to explain what you accomplished in the Mitosis lab. Describe what you saw, explain how it help your understanding of Mitosis and one interesting piece of information you learned from the lab.

In this lab onion skin was plated and observed under microscope. Students were able to view the various stages of Mitosis. Students counted the stages to determine which stage was present most. This help students understand that the stages of Mitosis take a different amount of time.

13) Choose a form of asexual reproduction and describe it in one to three sentences.

Budding is the unequal division of the cytoplasm.

14) Write two differences about sexual and asexual reproduction in one to two sentences.

Sexual reproduction has a lot of genetic variety. Asexual reproduction produces two identical copies of the parent cell.

15) Select a type of vegetative propagation. Describe if it is natural or artificial and then explain why it is beneficial if it is natural and what purposes does it serve to humans if it is artificial. Use three to four sentences to provide your answer.

Layering is an artificial type of vegetative propagation. It helps humans to create large amounts of raspberries or strawberries. Layering involves overlapping branches to create more plants of the same plant.

16) Design a t-chart of the pros and cons of either sexual reproduction or asexual reproduction (you select one). Provide two pros and two cons.

Asexual

<table>
<thead>
<tr>
<th>Cons</th>
<th>Pros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identical copies</td>
<td>Identical copies</td>
</tr>
</tbody>
</table>
Only two cells produced | Fast reproduction time (sometimes every 30 minutes.

17) What is cancer? Explain what causes cancer at a cellular level and how it relates to the cell cycle. Do not use examples like UV rays, smoking and etc… Use three to four sentences for your answer and try to use genetic vocabulary to display your knowledge of the cell cycle and what goes wrong to cause cancer.

*Cancer is a mutation among the cell cycle checkpoints that causes uncontrollable cell division.*

Meiosis unit.

This unit of lesson plans was created during my student teaching placement. Some of the lessons were modified to better suit the CRAs. This unit includes human and animal development, the process of Meiosis, sexual reproduction, chicken egg development, and discussions about crossing over and genetic variation caused by this process.

Teacher__________

80 minute period of Honors Living environments

Unit: Meiosis and human development

Lesson 1: Meiosis 1

I. **Objective:** 1) Students will be able to explain the process of Meiosis 1. 2) Students will be able to describe crossing over, synapses, and gonads.

II. **Criteria:** 1) Students will be able to list the four stages of Meiosis I and describe each phase. 2) Students will be able to define the vocabulary terms crossing over and synapses.
CRA for Lesson 1

Criteria covered by this CRA:

- Students will be able to list the four stages of Meiosis I and describe each phase.
- Students will be able to define the vocabulary terms crossing over and synapses.

1) How many chromosomes are left after Meiosis I?
   a) n  b) 2n  c) 1/2n  d) 3n

2) In three to four sentences explain the key aspects of Meiosis I including the end products and why it is important to sexually reproduction.

   During prophase I crossing over and the exchange of genetic material occurs through synapses and tetrads. This step increases genetic variety in the offspring cells. During anaphase I and telophase I the cell’s chromosomes are reduced from diploid to haploid.

3) The pairing process when two homologous chromosomes are lined up next to each creates a…
   a) gonad  b) synapse  c) crossing over  d) cytokinesis

4) Describe what happens during crossing over and how a synapse is involved. Provide your answer in two to three sentences.

   Synapses are the connection between two sister chromatids. When the two chromatids are touching they exchange genetic material in a process known as crossing over. Crossing over increases the genetic variety of the daughter cells making them not identical.

Feedback guide for Meiosis unit daily CRA one
Use general feedback guide and scoring matrices. Provide a lot of diagrams to visually represent the process of meiosis I. Question one and two are critical thinking questions, while questions three and four are vocabulary questions.

Teacher________________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 2: Meiosis II

I. **Objective:** 1) Students will be able to describe the process of Meiosis II. 2) Students will be able to define zygote, non-disjunction and disjunction.

II. **Criteria:** 1) Students will be able to list the four phases of Meiosis II, describe each process and describe the end products. 2) Students will be able to define zygote, non-disjunction and disjunction.

Name____________________________             Date______________________

CRA for Lesson 2

Criteria covered by this CRA:

- Students will be able to list the four phases of Meiosis II, describe each process and describe the end products
- Students will be able to define zygote, non-disjunction and disjunction.

1) How many cells are created by the end of Meiosis II?

   a) 1                                      b) 2
   c) 3                                      d) 4
2) Describe the end products of Meiosis II. What are these cells called, why is this process important and how does it increase genetic diversity? Use three to four sentences to provide your answer.

At the end of Meiosis II there are four daughter cells called gametes. These cells are not identical and have genetic diversity among them. Gamete cells are haploid and when they combine in the process of sexual reproduction and fertilization they further increase genetic diversity.

3) The combination of two gametes creates a….

   a) zygote  
   b) tetrad
   c) synapse  
   d) disjunction

4) Describe the process of crossing over including the terms tetrad, non-disjunction and disjunction. Explain each of these words and how they are important to crossing over. Use four to five sentences to provide your answer.

   Crossing over is the exchange of genetic information between two sister chromatids while a synapse is formed during prophase I. A tetrad is when two sister chromatids are linked together. Non-disjunction is the failure of the chromosomes to separate after crossing over creating unequal chromosome numbers in the final products and leading to genetic mutation or cellular death. Disjunction is the normal separation of chromosomes leading to correct chromosome numbers and no mutation.

Feedback guide for Meiosis unit daily CRA two

Use general feedback guide and scoring matrices. Provide ample diagrams and videos to represent the process of Meiosis II and to differentiate this process from Meiosis I. Question one and two are critical thinking questions and questions three and four are vocabulary questions.
Teacher__________________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 3: Human development

I. Objective: 1) Students will be able to describe the basic process of human development, the importance of the placenta and fertilization.

II. Criteria: 1) Students will be able to list the steps of human development and describe them through the process of gastrulation 2) Students will be able to define and describe the importance of gastrulation.

Name____________________________             Date______________________

CRA for Lesson 3

Criteria covered by this CRA:

- Students will be able to list the steps of human development and describe them through the process of gastrulation

- Students will be able to define and describe the importance of gastrulation.

1) The fusion of an egg and a sperm cell is called…
   a) mesoderm   b) fertilization
   c) placenta   d) implantation

2) Describe the process of development from fertilization through the process of implantation. Include the names of the developing embryo and use three to four sentences to provide your answer.
Fertilization is the fusion of an egg and a sperm cell to create a zygote. The zygote divides into the 2-cell, 4-cell, 8-cell and then to the blastocyst stage. This takes about 6 to 7 days at which the blastocyst implants into the uterus lining.

3) The differentiation and specialization of cells occurs during…

   a) implantation
   b) blastocyst
   c) gastrulation
   d) embryology

4) Describe the three main cell layers that are created during gastrulation. Provide one sentences for each layer.

   During gastrulation the endoderm, mesoderm and ectoderm are formed. The endoderm turns into the linings of the internal organs. The mesoderm turns into the spaces and some internal organs. The ectoderm turns into the skin.

Feedback guide for Meiosis unit daily CRA three

Use general feedback guide and scoring matrices. Focus on diagrams, visual representations and having students organize the sequence of events. Question one is vocabulary. Question two is vocabulary and critical thinking. Question three is vocabulary. Question four is critical thinking.

Teacher____________________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 4: Human development

I. **Objective:** 1) Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation.
II. **Criteria:** 1) Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation. 2) Students will be able to describe the above processes and explain how they are related.

Name____________________________             Date______________________

CRA for Lesson 4

Criteria covered by this CRA:

- Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation.
- Students will be able to describe the above processes and explain how they are related.

1) The connection between the mother and the embryo is called the…
   a) placenta       b) notochord
   c) ectoderm       d) mesoderm

2) Many of the body’s internal structures are formed by cells from the…
   a) placenta       b) notochord
   c) ectoderm       d) mesoderm

3) Describe the process of neurulation explaining how the notochord is formed, and how the neural folds and crest are formed. Provide your answer in three to four sentences.

   **Neurulation is the formation of the neural cord and notochord. First the mesoderm differentiates into the notochord. Then the ectoderm near the notochord differentiates into the neural folds and crest. The neural folds close around the notochord and turn into the spine later in development.**

4) Define morula, blastocyst, and fetus. Use one sentence for each definition.
A morula is a solid ball of cells before it reaches the uterus. The blastocyst forms after the morula and is a hollow ball of cells that implants into the uterus lining. A fetus is the stage in development after the embryonic stage (gastrulation ends this stage) and before birth.

Feedback guide for Meiosis unit daily CRA four

Use general feedback guide and scoring matrices. Focus on diagram representations and organizing events graphically to aide student’s visual learning. Question one, two and four are vocabulary. Question three is critical thinking.

Teacher_______________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 5: Mammal development

I. Objective: 1) Students will be able to explain the differences between internal and external fertilization. 2) Students will be able to describe the development of monotremes, marsupials, birds and mammals other than humans.

II. Criteria: 1) Students will be able to least at least two differences and similarities between internal and external fertilization 2) Students will be able to describe two developmental features of: monotremes, marsupials, birds and mammals

Name____________________________             Date______________________

CRA for Lesson 5

Criteria covered by this CRA:

- Students will be able to least at least two differences and similarities between internal and external fertilization
Students will be able to describe two developmental features of: monotremes, marsupials, birds and mammals.

1) The process in which the egg and sperm meet outside the body is called.
   a) internal fertilization  b) external fertilization
   c) ectoderm            d) embryology

2) In two to three sentences explain the differences between internal and external fertilization.
   External fertilization occurs outside the body. The egg of an organism that partakes in external organization must have a protective shell to avoid drying out or be in water.

3) Mammals that lay eggs are called...
   a) marsupials  b) birds
   c) montremes  d) placentals

4) Label the internal structures of the chicken egg. Select 4 structures to label
   1. Yolk membrane
   2. Yolk
   3. Germinal disc
   4. Fetus
   5. Air pocket
   6. Embryonic sac membrane
   7. Embryonic sac
   8. Albumen
   9. Shell
Feedback guide for Meiosis unit daily CRA five

Use general feedback guide and scoring matrices. Give students opportunities to work through diagrams and give a lot of examples. Questions one and three are vocabulary. Question two is compare and contrast. Question four is critical thinking.

Teacher

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 6: Unit CRA

I. **Objective:** 1) Students will be able to apply their knowledge gained in previous lessons in an attempt to pass this exam
II. Criteria:
- Students will be able to list the four stages of Meiosis I and describe each phase.
- Students will be able to define the vocabulary terms crossing over and synapses.
- Students will be able to list the four phases of Meiosis II, describe each process and describe the end products.
- Students will be able to define zygote, non-disjunction and disjunction.
- Students will be able to list the steps of human development and describe them through the process of gastrulation.
- Students will be able to define and describe the importance of gastrulation.
- Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation.
- Students will be able to describe the above processes and explain how they are related.
- Students will be able to least at least two differences and similarities between internal and external fertilization.
- Students will be able to describe two developmental features of: monotremes, marsupials, birds and mammals.

Name____________________________             Date______________________

CRA for Meiosis and human development unit

Criteria covered by this CRA:
- Students will be able to list the four stages of Meiosis I and describe each phase.
- Students will be able to define the vocabulary terms crossing over and synapses.
• Students will be able to list the four phases of Meiosis II, describe each process and describe the end products

• Students will be able to define zygote, non-disjunction and disjunction.

• Students will be able to list the steps of human development and describe them through the process of gastrulation

• Students will be able to define and describe the importance of gastrulation.

• Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation.

• Students will be able to describe the above processes and explain how they are related.

• Students will be able to least at least two differences and similarities between internal and external fertilization

• Students will be able to describe two developmental features of: monotremes, marsupials, birds and mammals

1) This process results in the production of 4 haploid daughter cells that are genetically different from the parent cell…

   a) fertilization  
   b) mitosis  
   c) meiosis  
   d) implantation

2) Crossing over occurs during…………

   a) prophase I  
   b) prophase II  
   c) interphase  
   d) cytokinesis

3) The fusion of a sperm and an egg is called…

   a) fertilization  
   b) mitosis  
   c) meiosis  
   d) implantation
4) The ectoderm develops into…
   a) The linings of the digestive system
   b) The skin and nervous system
   c) The internal structures of the body
   d) The placenta

5) The hollow ball of cells that is formed after about 7 days after fertilization is called the…
   a) morula
   b) zygote
   c) gastrula
   d) blastocyst

6) When the sperm meets the egg inside the body it is called…
   a) external fertilization
   b) internal fertilization
   c) internal development
   d) external development

7) Organisms that give birth to babies that develop mainly in the pouch of the mother are called…
   a) mammals
   b) placental mammals
   c) monotremes
   d) marsupials

8) Male and female reproductive cells form in special organs called the…
   a) gonads
   b) gametes
   c) lymph nodes
   d) liver

9) The ectoderm, mesoderm and endoderm form from the process of…
   a) blastocytism
   b) fertilization
   c) gastrulation
   d) neuralation

10) Explain the process of Meiosis I. Include all four phases and describe each briefly.
    
    **Meiosis I occurs in the four phases of prophase I, metaphase I, anaphase I, and telophase I.**
    
    **Prophase I** is where crossing over occurs and metaphase one is when the duplicated
chromosomes align in the middle of the cell. Anaphase I and telophase I pull the chromosomes apart reducing the cell from diploid to haploid.

11) Describe the formation of a tetrad, what is formed and what process occurs. Use two to three sentences.

_Tetrad formation is the connection between two sister chromatids. This process occurs in prophase I_

12) Describe the process of Meiosis II including all phases. Use one to two sentences to describe each phase.

_Meiosis II consists of prophase II, metaphase II, anaphase II, and telophase II. Prophase II is where spindle fibers attach to chromosomes and metaphase II is where the chromosomes align in the middle of the cell. Anaphase II and telophase II split the sister chromatids apart creating four daughter cells that are haploid and genetically diverse._

13) Explain the differences between disjunction and non-disjunction. Use two to three sentences.

_Disjunction is the normal separation of chromosomes. Non-junction is when chromosomes stick together during the anaphase step causing uneven numbers of chromosomes in the product cells._

14) From fertilization to implantation use four to five sentences to explain the development process and phases the zygote undergoes. Use key vocabulary terms covered in class.

_A sperm and an egg cell meet to fertilize. This creates a zygote that divides by mitosis to form a morula. The morula develops into a blastocyst as it travels down the fallopian tubes. The blastocyst implants into the uterus lining 6 to 7 days after fertilization._

15) Why is gastrulation important? What does it provide to an organism? Explain in three to four sentences.
Gastrulation provides differentiated and specialized cells. During this process the ectoderm, mesoderm and endoderm are formed. These layers go on to form the internal linings of the digestive system, notochord, spine, internal organs, skin and the rest of the body of an organism.

16) Describe the process of development of the ectoderm, endoderm and mesoderm. What do these layers specialize into? Use three to four sentences to provide your answer.

The endoderm differentiates into the internal linings of the digestive system and into the neural crest which eventually specializes into the spine. The mesoderm differentiates into the notochord and other internal organs and spaces. The ectoderm forms the skin layer of the organism.

17) Provide two differences between internal and external fertilization using complete sentences.

Internal fertilization occurs within the organism. When an organism uses external fertilization it needs to have a protective layer around the egg or the egg needs to be in water to avoid drying out and dying.

18) Label the parts of the chicken egg.

1. Yolk membrane
2. Yolk
3. Germinal disc
4. Fetus
5. Air pocket
6. Embryonic sac membrane
7. Embryonic sac
8. Albumen
9. Shell
Internal Structure of the Chicken Egg
Feedback guide for Meiosis unit: unit CRA

Use general feedback guide and scoring matrices. Questions one through nine are vocabulary questions. Questions ten, eleven, twelve, fourteen, fifteen, sixteen, and eighteen are critical thinking. Questions thirteen and seventeen are compare and contrast.

DNA/RNA unit.

This unit contains lesson plans from an already prepared unit that I taught during student teaching. Some lessons were modified to match better to the CRA format. The unit material consists of DNA and RNA history, structure, and experiments leading to discovery and structure discovery; DNA replication, the genetic code, transcription, translation, and mutation.

Teacher_____________________

80 minute period of Honors Living environments

Unit: DNA

Lesson 1: History of DNA

I. **Objective:** 1) Students will also be able to describe the basic history behind DNA and the field of genetics.

II. **Criteria:** 1) Students will be able to describe at least three experiments that lead to the discovery of the structure of DNA.

Name________________________________ Date____________________

CRA for DNA/RNA lesson 1

Criteria covered by this CRA:

- Students will be able to describe at least three experiments that lead to the discovery of the structure of DNA.
1) Which of the following scientist pairs discovered the current model of DNA?
   a) Griffith and Mendel           b) Watson and Crick
   c) Newton and Einstein           d) Avery and Chase

2) List and explain in one sentence three experiments that lead to the discovery of the structure of DNA?

   The transformation experiment by Griffith lead to the discovery of a genetic component that could influence dead cells to change their protein composition. The Avery, Hershey and Chase experiment with radioactively labeling virus components that eject into bacteria lead to the knowledge that DNA is the genetic material. The X-rays by Franklin gave DNA a double helix structure and the base pair experiments by Chargaff gave the adenine and thymine were always paired and guanine and cytosine were always paired.

   Feedback guide for CRA one of DNA/RNA

   Use general feedback guide and scoring matrices. Focus on provide students engaging material, videos and diagrams explaining the purposes of each experiment and how it lead to the discovery of DNA as the genetic material and the structure of DNA. Question one and two are both critical thinking.

   Teacher________________

   80 minute period of Honors Living environments

   Unit: DNA/RNA

   Lesson 2: Nucleic acids, DNA and RNA

   I. **Objective:** 1) Students will be able to draw the structure of DNA. 2) Students will be able to describe the basic structure of DNA and RNA.
II. **Criteria:** 1) Students will be able to draw and label the three main components of DNA. 2) Students will be able to list two differences and two similarities between DNA and RNA.

**CRA for DNA/RNA lesson 2**

Criteria covered by this CRA:

- Students will be able to draw and label the three main components of DNA.
- Students will be able to list two differences and two similarities between DNA and RNA.

1) List the three components of DNA.

**Nitrogenous bases, deoxyribose sugar, and a phosphate group**

2) Draw a simple structure of DNA and label all components

![Diagram of DNA structure]

**P-phosphate group. S-deoxyribose sugar. T,A,C,G- Nitrogenous bases.**

3) List the three components of RNA.

**Phosphate group, nitrogenous bases, ribose sugar**

4) Describe two similarities and two differences between DNA and RNA. Use complete sentences.
DNA and RNA both have Cytosine, Guanine and Adenine as nitrogenous bases and have a phosphate group in their structure. DNA is double stranded and has Thymine while RNA is single stranded and contains Uracil.

Feedback guide for CRA two

Use general feedback guide and scoring matrices. Focus on providing model work, videos and diagrams so students understand what the structure of each DNA and RNA are and what the differences compose of. Questions one through three are vocabulary and critical thinking.

Question four is compare and contrast.

Teacher______________________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 3: DNA replication

**Objective:** 1) Students will be able to describe the process of DNA replication. 2) Students will also be able to explain the function of each enzyme that is involved in DNA replication.

**Criteria:** 1) Students will be able to describe all steps of the DNA replication process using the key vocabulary. 2) Students will be able to define the function of each enzyme in the DNA replication process and describe where it falls in the process.

Name_________________________ Date______________________

CRA for DNA/RNA lesson 3

Criteria covered by this CRA:
• Students will be able to describe all steps of the DNA replication process using the key vocabulary.

• Students will be able to define the function of each enzyme in the DNA replication process and describe where it falls in the process.

1) Describe the major events in DNA replication. You do not need to list specific enzymes here.

The double stranded DNA is separated into two single strands that are held together by the enzyme. The enzyme then reads the DNA code in order from 3’ to 5’ replicating the sequence by matching the code with its complimentary base pair. Once the sequence is replicated another enzyme comes through and seals the old strand to the new strand and likewise on the other strand of DNA creating two new strands connected to two old strands making two full replications of the DNA sequence.

2) Which of the following enzymes unzips the DNA?

a) telomerase  
   b) protease
   
   c) lactase  
   d) DNA polymerase

3) Describe the function of Telomerase using two to three sentences and explaining the importance of telomeres.

Telomerase adds DNA to the end of the DNA strand so that the gene portion of the DNA is not degraded. Telomeres are non-sense DNA at the end of the strand that are in place to protect the DNA that is coded into proteins.

Feedback guide for CRA 3.

Use general feedback guide and scoring matrices. Focus on using videos and analogies to describe the DNA replication process. Question one is critical thinking. Question two is vocabulary. Question three is vocabulary and critical thinking.
Shane Turybury

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 4: Lab on DNA replication

**Objective:** 1) Students will be able to construct double helix models of DNA and demonstrate their knowledge of DNA replication by showing this model undergoing replication.

**Criteria:** 1) Students will be able to label structures of DNA and label diagrams of DNA replication. 2) Students will be able to fill out a complementary strand of DNA from the original strand.

Name____________________________             Date_________________

CRA for DNA/RNA lesson 4

Criteria covered by this CRA:

- Students will be able to label structures of DNA and label diagrams of DNA replication.
- Students will be able to fill out a complementary strand of DNA from the original strand.

1) Fill in the following diagram of DNA replication. Include DNA polymerase, helicase, and label the three major DNA structures.

**DNA polymerase and helicase should both be at the junction of the two strands. The three major parts to be labeled are the sugar, the phosphate group, and the nitrogenous bases.**
2) Fill in the complimentary sequence.

AATTCGGCCTAGATCTCGATAATACGCTAGCTAGCTCAAG
TTAAGCCGGATCTAGAGCTATTATGCGATCGATCGAGTTC

Feedback guide for CRA lesson 4.

Use general feedback guide and scoring matrices. Provide students with ample diagrams and worksheet activities so they can practice base pairing. The lab should provide a good visual base. Question one and two are critical thinking.

Teacher______________

80 minute period of Honors Living environments

Unit: DNA

Lesson 5: RNA

Objective: 1) Students will be able to describe the different types of RNA and their functions. 2) Students will be able to explain the process of RNA editing

Criteria: 1) Students will be able to list at least three types of RNA and describe their functions. 2) Students will be able to explain the steps of RNA editing and explain two reasons as to why this is important.

Name____________________________             Date______________________

CRA for DNA/RNA lesson 5

Criteria covered by this CRA:

• Students will be able to list at least three types of RNA and describe their functions.

• Students will be able to explain the steps of RNA editing and explain two reasons as to why this is important.
1) List the three types of RNA and describe two of them.

**tRNA, mRNA, and rRNA.** mRNA is where the m stands for messenger and helps translate the DNA code into protein. The rRNA is ribosomal RNA and is a component of the ribosomes and helps in translating the mRNA into amino acid sequences.

2) The RNA type that carries amino acids on it is called…

   a) tRNA  
   b) snRNA  
   c) rRNA  
   d) mRNA

3) During RNA editing what are cut out

   a) introns  
   b) uracils  
   c) adenines  
   d) exons

4) Explain two reasons why RNA editing is important.

**RNA editing gets rids of exons and connects introns. The exons would lead to faulty proteins. The introns when combined create proteins that are necessary for cell functions.**

**Feedback guide for CRA 5**

Use general feedback guide and scoring matrices. Provide examples of the types of DNA, visual structures and opportunity for students to differentiate among the types using graphic charts.

Question two and three are vocabulary. Question one is vocabulary and critical thinking.

Question four is critical thinking.

Teacher________

**80 minute period of Honors Living environments**

**Unit: DNA/RNA**

**Lesson 6: Transcription**
Objective: 1) Students will be able to describe the process of transcription. 2) Students will be able to explain the process of RNA editing and promoters.

Criteria: 1) Students will be able to explain each step of the transcription and list the enzymes used. 2) Students will be able to list a least one promoter and define what a promoter is.

Name____________________________             Date_____________________

CRA for DNA/RNA lesson 6

Criteria covered by this CRA:

- Students will be able to explain each step of the transcription and list the enzymes used.
- Students will be able to list a least one promoter and define what a promoter is.

1) The process in which DNA is made into mRNA is called…
   a) Translation         b) Transcription
   c) Fertilization       d) Implantation

2) Describe the first three steps of transcription and list any enzymes that are used.

RNA polymerase binds to the double stranded DNA and separates the two stands. Next the RNA polymerase reads the sequence from 3’ to 5’ creating a mRNA molecule. Multiple RNA polymerases can bind to one strand of DNA and make thousands of copies of mRNA from one gene.

3) List a specific promoter and define promoter.

A promoter is a DNA sequence that attracts the RNA polymerase to bind to and begin transcribing DNA into mRNA. An example of a promoter is the TATA box in Eukaryotes.

Feedback guide for CRA 6.
CRA for DNA/RNA lesson 7

Criteria covered by this CRA:

- Students will be able to use the genetic code and match mRNA sequences to amino acid sequences.
- Students will be able to list enzymes and components of translation and describe the process step by step.

1) Which of the following is the start codon?
   a) CUG          b) CCA
   c) AUG          d) UGA
2) What are the types of RNA that are in the process of translation? Describe each in one sentence.

**rRNA, tRNA and mRNA.** *rRNA* is a part of the ribosome and helps translate *mRNA* to amino acids. *tRNA* carries the amino acids and links to the *mRNA* and helps build the amino acid chain. *mRNA* carries the DNA genetic code to be translated into protein.

3) Describe the three major steps of translation in one sentence for each step.

The first step is when a ribosome attaches to a *mRNA* strand on the AUG start codon. Next is the “assembly line” that uses *tRNA* to bring in anitcodon to match the codons on the *mRNA* strand and continue building the amino acid strand. When the ribosome comes to a stop codon it disengages releasing the *mRNA* and the amino acid chain from the ribosome.

**Feedback guide for CRA 7.**

Use general feedback guide and scoring matrices. Focus on diagrams and videos to give students visual representations of the translation process. Questions one through three are all critical thinking questions.

Teacher_______

**80 minute period of Honors Living environments**

**Unit:** DNA

**Lesson 8: mutation of DNA**

**Objective:** 1) Students will be able to describe what a mutation is and how the happen. 2) Students will be able to explain the effects mutations have on genes.

**Criteria:** 1) Students will be able to define the three types of point mutations. 2) Students will be able to explain at least two effects that mutations have.
CRA for DNA/RNA lesson 8

Criteria covered by this CRA:

- Students will be able to define the three types of point mutations.
- Students will be able to explain at least two effects that mutations have.

1) A change in DNA that happens in one or a few nucleotides and occur in one spot of DNA sequence are called…

   a) point mutation    b) spot mutation
   c) change mutation   d) nucleotide mutation

2) Define the three types of point mutations.

   A substitution mutation is where one base is changed to a different base. An insertion is where an extra nucleotide is inserted into the sequence. A deletion is when a nucleotide is deleted from the sequence.

3) Explain two effects that mutations can have.

   If a mutation occurs in a gene it can affect the protein structure. If a mutation occurs elsewhere it changes the reading frame of genes and can alter protein structure in this manner. Mutations can also lead to the development of cancer.

Feedback guide for CRA 8.

Use general feedback guide and scoring matrices. Let students practice putting mutations into DNA sequences and see how it affects the amino acid output.

Teacher_______________

80 minute period of Honors Living environments

Unit: DNA/RNA
Lesson 9: lab, review, unit CRA

Objective: 1) Students will be able to complete a DNA extraction lab. 2) Students will be able to complete unit CRA

Criteria: 1) Students will complete DNA extraction lab. 2) Students will be able to describe at least three experiments that lead to the discovery of the structure of DNA. 3) Students will be able to draw and label the three main components of DNA. 4) Students will be able to list two differences and two similarities between DNA and RNA. 5) Students will be able to describe all steps of the DNA replication process using the key vocabulary. 6) Students will be able to define the function of each enzyme in the DNA replication process and describe where it falls in the process. 7) Students will be able to label structures of DNA and label diagrams of DNA replication. 8) Students will be able to fill out a complementary strand of DNA from the original strand. 9) Students will be able to list at least three types of RNA and describe their functions. 10) Students will be able to explain the steps of RNA editing and explain two reasons as to why this is important. 11) Students will be able to explain each step of the transcription and list the enzymes used. 12) Students will be able to list a least one promoter and define what a promoter is. 13) Students will be able to use the genetic code and match mRNA sequences to amino acid sequences. 14) Students will be able to list enzymes and components of translation and describe the process step by step. 15) Students will be able to define the three types of point mutations. 16) Students will be able to explain at least two effects that mutations have.

Name____________________________             Date______________________

CRA for DNA/RNA unit
Criteria covered by this CRA:

- Students will be able to describe at least three experiments that lead to the discovery of the structure of DNA.
- Students will be able to draw and label the three main components of DNA.
- Students will be able to list two differences and two similarities between DNA and RNA.
- Students will be able to describe all steps of the DNA replication process using the key vocabulary.
- Students will be able to define the function of each enzyme in the DNA replication process and describe where it falls in the process.
- Students will be able to label structures of DNA and label diagrams of DNA replication.
- Students will be able to fill out a complementary strand of DNA from the original strand.
- Students will be able to list at least three types of RNA and describe their functions.
- Students will be able to explain the steps of RNA editing and explain two reasons as to why this is important.
- Students will be able to explain each step of the transcription and list the enzymes used.
- Students will be able to list a least one promoter and define what a promoter is.
- Students will be able to use the genetic code and match mRNA sequences to amino acid sequences.
- Students will be able to list enzymes and components of translation and describe the process step by step.
- Students will be able to define the three types of point mutations.
- Students will be able to explain at least two effects that mutations have.

1) Which of the following scientist pairs discovered the current model of DNA?
2) List and explain in one sentence three experiments that lead to the discovery of the structure of DNA?

The transformation experiment by Griffith lead to the discovery of a genetic component that could influence dead cells to change their protein composition. The Avery, Hershey and Chase experiment with radioactively labeling virus components that eject into bacteria lead to the knowledge that DNA is the genetic material. The X-rays by Franklin gave DNA a double helix structure and the base pair experiments by Chargaff gave the adenine and thymine were always paired and guanine and cytosine were always paired.

3) List the three components of DNA.

Nitrogenous bases, deoxyribose sugar, and a phosphate group

4) Draw a simple structure of DNA and label all components

5) List the three components of RNA.

Phosphate group, nitrogenous bases, ribose sugar
6) Describe two similarities and two differences between DNA and RNA. Use complete sentences.

DNA and RNA both have Cytosine, Guanine and Adenine as nitrogenous bases and have a phosphate group in their structure. DNA is double stranded and has Thymine while RNA is single stranded and contains Uracil.

7) Describe the major events in DNA replication. You do not need to list specific enzymes here. The double stranded DNA is separated into two single strands that are held together by the enzyme. The enzyme then reads the DNA code in order from 3’ to 5’ replicating the sequence by matching the code with its complimentary base pair. Once the sequence is replicated another enzyme comes through and seals the old strand to the new strand and likewise on the other strand of DNA creating two new strands connected to two old strands making two full replications of the DNA sequence.

8) Which of the following enzymes unzips the DNA?

   a) telomerase  
   b) protease  
   c) lactase  
   d) DNA polymerase

9) Describe the function of Telomerase using two to three sentences and explaining the importance of telomeres.

Telomerase adds DNA to the end of the DNA strand so that the gene portion of the DNA is not degraded. Telomeres are non-sense DNA at the end of the strand that are in place to protect the DNA that is coded into proteins.

10) Fill in the following diagram of DNA replication. Include DNA polymerase, helicase, and label the three major DNA structures.
DNA polymerase and helicase should both be at the junction of the two strands. The three major parts to be labeled are the sugar, the phosphate group, and the nitrogenous bases.
11) Fill in the complimentary sequence.

AATTCGGCCTAGATCTCGATAATACGCTAGCTAGCTCAAG
TTAAGCCGGATCTAGAGCTATTATGCGATCGATCGAGTTC

12) List the three types of RNA and describe two of them.

tRNA, mRNA, and rRNA. mRNA is where the m stands for messenger and helps translate the DNA code into protein. The rRNA is ribosomal RNA and is a component of the ribosomes and helps in translating the mRNA into amino acid sequences.

13) The RNA type that carries amino acids on it is called…

   a) tRNA  b) snRNA
   c) rRNA  d) mRNA

14) During RNA editing what are cut out

   a) introns  b) uracils
   c) adenines  d) exons

15) Explain two reasons why RNA editing is important.

RNA editing gets rides of exons and connects introns. The exons would lead to faulty proteins. The introns when combined create proteins that are necessary for cell functions.

16) The process in which DNA is made into mRNA is called…

   a) Translation  b) Transcription
   c) Fertilization  d) Implantation

17) Describe the first three steps of transcription and list any enzymes that are used.

RNA polymerase binds to the double stranded DNA and separates the two stands. Next the RNA polymerase reads the sequence from 3’ to 5’ creating a mRNA molecule. Multiple
RNA polymerases can bind to one strand of DNA and make thousands of copies of mRNA from one gene.

18) List a specific promoter and define promoter.

A promoter is a DNA sequence that attracts the RNA polymerase to bind to and begin transcribing DNA into mRNA. An example of a promoter is the TATA box in Eukaryotes.

19) Which of the following is the start codon?

a) CUG   

b) CCA

c) AUG   

d) UGA

20) What are the types of RNA that are in the process of translation? Describe each in one sentence.

rRNA, tRNA and mRNA. rRNA is a part of the ribosome and helps translate mRNA to amino acids. tRNA carries the amino acids and links to the mRNA and helps build the amino acid chain. mRNA carries the DNA genetic code to be translated into protein.

21) Describe the three major steps of translation in one sentence for each step.

The first step is when a ribosome attaches to a mRNA strand on the AUG start codon. Next is the “assembly line” that uses tRNA to bring in anticodon to match the codons on the mRNA strand and continue building the amino acid strand. When the ribosome comes to a stop codon it disengages releasing the mRNA and the amino acid chain from the ribosome.

22) A change in DNA that happens in one or a few nucleotides and occur in one spot of DNA sequence are called…

a) point mutation   

b) spot mutation

c) change mutation   

d) nucleotide mutation

23) Define the three types of point mutations.
A substitution mutation is where one base is changed to a different base. An insertion is where an extra nucleotide is inserted into the sequence. A deletion is when a nucleotide is deleted from the sequence.

24) Explain two effects that mutations can have.

If a mutation occurs in a gene it can affect the protein structure. If a mutation occurs elsewhere it changes the reading frame of genes and can alter protein structure in this manner. Mutations can also lead to the development of cancer.

Feedback guide for unit CRA for DNA/RNA unit.

Use general feedback guide and scoring matrices. Questions 1, 8, 13, 14, 16, 19, 22 are vocabulary. Question 6 is compare and contrast. Questions 2-7, 9-12, 15, 17-18, 20-21, 23-24 are critical thinking.

Discussion

The purpose of this curriculum project was to design an assessment system with feedback guides to aid teacher instruction and awareness of student knowledge of content. Throughout the process of creating this curriculum some things were adjusted to make the end product more useful and less lengthy. The process produced two end products one being a scoring matrix system within Excel that allows teachers to use student grouping categories, question types and Criterion Referenced Assessment (CRA) scores to obtain strategies to re-teach and further enhance student learning in problem areas as identified by the CRA’s. The second product was a set of CRA’s with answers created for four NYS Living Environment units (Ecology, Mitosis, Meiosis, and DNA/RNA).
Creating the CRA’s

The purpose of creating CRA’s was to provide educators with a formative assessment tool that is aligned with state standards. The four units of Ecology, Mitosis, Meiosis, and DNA/RNA from the NYS Living Environment Curriculum were chosen because I am certified in the area of 7-12 Biology. Educators have an abundant supply of summative assessment tools and state exams because the current assessment requirements of how No Child Left Behind.

While creating the CRAs, I wanted to align the assessments to the lesson objectives and to the NYS standards for Living Environments. I had previously designed the lessons during student teaching and the objectives were already aligned to the state standards. However criteria were made from the objectives to create more specific expectations of the students that could easily be turned into questions and that could guide students in studying and educators in preparing lessons. The daily CRA’s were designed to be used as a formative assessment primarily to provide feedback to educators and students of students’ level of certain criteria within a subject area. The unit CRA’s were also designed as formative assessments for feedback but can be used for summative assessment purposes.

Most summative assessments are composed of multiple-choice, fill in the blank and true/false questions. The NYS Regents have a limited amount of short answer and very few of them are free response. I wanted to provide assessment that included the traditional multiple-choice questions to help students prepare for the testing styles on the NYS Regents but also wanted to include free response questions to obtain a better understanding of student knowledge of specific criteria. The free response questions were guided to lead students to reach a certain answer, but the student had freedom in how to provide this answer. The questions designed also were created in three styles that are common in state assessments: critical thinking, vocabulary,
and compare and contrast. This was done to help students prepare for these question styles and for educators to be able to provide strategies to help students with these question types, which will be discussed more in the scoring matrix design section. To fairly score the free response questions a rubric was designed to score the students’ responses. This rubric is to be provided to students so that they know how their responses will be evaluated.

**Feedback**

The primary purpose of this curriculum project was to provide assessment tools and feedback tools to educators to make future instructional decisions more effective, measure current student understanding and provide students with strategies that they can use to further their learning. Developing this was difficult and a lot of changes were made to the initial plan of the project. The feedback discussion will focus on three areas. Why was the feedback tool portion switched from specific guides for each CRA to a general scoring matrix feedback guide, why the matrices were created the way they were, and why the specific student groupings, scoring cut-lines and feedback strategies were used.

**Specific to general.**

When the feedback guides were first designed a specific feedback guide was created for each CRA. This created a project that was almost twice as long as it is now, had a lot of repeat suggestions in the feedback guides and did not provide an array of feedback tools for educators to use. It was decided that designing scoring matrices that provided feedback strategies to educators for all CRA’s would be more beneficial. This general feedback scoring matrix design can also be used across all content areas and grade levels as long as CRA’s are used. Two general feedback scoring matrices were created using five scoring categories. The first scoring matrix had four student grouping categories of Students With Disabilities, English Language
Learners, Gifted and Talented, and Other. The scoring matrix had five question type groupings of multiple choice or true/false, short answer, critical thinking, vocabulary, and compare and contrast. The general feedback scoring matrices allows all educators to select feedback strategies depending on how much students are struggling with a question type on a daily or unit CRA or how much a particular group of students are struggling on a CRA. Combined with the CRA’s these feedback matrices help teachers get an accurate measurement of student learning during assessment, provide students with useful strategies to further learning of content and help teachers change their future teaching methods to include more data-driven effective methods.

Making the matrices.

When designing the matrices it was decided to make two matrices, one for student type and one for question type to help meet the diversity within the classroom. Some lessons may not be differentiated enough to meet all students or teach student’s deeply enough for them to answer a variety of question styles. Thus the daily and unit CRA’s can be used with the matrices to identify groups of students that are having difficulties and question types that students are having problems with. The scoring categories were chosen because it splits the matrix into five categories that a pretty representative of typical understanding levels: No idea (0-20%), basic understanding (21-40%), moderate understanding (41-60%), average to good understanding (61-80%), and mastery level understanding (81-100%).

The four student groups of Students with Disabilities, Gifted and Talented, English Language Learners and Other were selected because these are typically the most common groups of students within a general education classroom. The Other student grouping represents the “normal” achieving student or a student who does not fit into the other three groupings. These groups were also selected since there are specific strategies for all groups that could be aligned
with the CRA scores to aid students re-teach material based on the student group CRA score. Easier to implement strategies were selected when the student group was achieving highly on CRAs and more in-depth and time consuming strategies were selected when students within a group where scoring poorly on the CRAs. Strategies were selected specifically to match up with the group’s characteristics. Question types were selected based on what the most common question styles were present in the CRA’s and on NYS Regents exams. The five types were aligned to student’s scores on CRAs and then linked to teaching strategies that would help increase students ability at answer that type of question. Easier to implement strategies were aligned with higher CRA scores and vice versa.

**Linking this project to the literature**

The motive for this project was the implementation of No Child Left Behind with summative style assessments. Under NCLB every state must have standards for each core area and assess students on these subjects to measure progress (AYP is only in math and ELA). Summative assessments are given periodically to determine a student’s level of knowledge in a particular content area and include: state assessments, district benchmark or interim assessments, end-of-unit chapter tests, end-of-term or semester exams and scores that are used for accountability of schools and students (Garrison & Ehringhaus, 2007). By just using summative assessments the policymakers are not being responsive to the research, which demonstrates the effectiveness of differentiating instruction and assessment, by implementing a variety of assessment styles to measure student progress. Also these summative state exams are normative in manner and measure student’s knowledge compared to other students and not compared the state standards making it unlikely to ever achieve one hundred percent adequate yearly progress. This project provides a formative style of assessment to measure student progress, the ability to
use the CRAs in a summative manner, and a way to measure student’s knowledge of content based on criterion that are aligned to state standards.

**Limitations and further implications**

This study provides educators with feedback tools, formative assessments, and re-teaching strategies. Some limitations are that not all units in the Living Environment Curriculum had CRAs created for them and that the scoring matrices do not provide content specific strategies. Also there are only two scoring matrices that deal with student grouping and question type. Other scoring matrices could be created for students short answer responses, and their model of thinking when answering questions. To create a student model of thinking in future CRAs and scoring matrices distracters can be included into the CRAs that will have students select these as answers if they are thinking in a particular model. Other future projects could develop CRAs for more Living Environment units, other content area units or even create more specific scoring matrices to relate directly to content area teaching strategies.

This curriculum project created Criterion Referenced Assessments (CRAs) for four NYS Living Environment units (Ecology, Mitosis, Meiosis, and DNA/RNA) in which the results could be inputted into two scoring matrices to receive feedback strategies based on student grouping or test question type aid teachers in re-teaching material. The CRA’s also provide students with an awareness of their own knowledge level of a particular criterion. The overall product is a formative assessment and feedback tool that will help educators guide future instructional decisions, provide an ongoing measure of student understanding, provide assessments that are aligned to state standards and provides unit CRAs that have the possibility of being used as summative assessments.
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Appendix A

Lesson Plan Template

80 minute period of Living environments
Unit:
Lesson # ___:

I. Objectives:

Standards:

II. Purpose:

III. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c. Closure
CRA Template/How CRA’s will be created

CRA criteria will be developed from the objectives. One criteria will be created for each objective. From these criteria two questions will be created, one for each criteria. One question will be in a traditional objective style and one question will be in a short answer or essay form. Some criteria will match up better with a free response question and when criteria are being created this should be kept in mind. Students will be provided with the free response scoring key prior to each CRA.

CRA free response questions rubric template

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IV. **Enrichment:**

V. **Evaluation/assessment/reflection**

**Assessment:**

Appendix B
### Appendix C

NYS Living Environment standards being covered in the 4 units

**Ecology unit:** 1.1.1a, 1.1.3a, 1.2.1, 4.1.1a-4.1.1d, 4.1.1f, 4.2.1c, 4.3.1b, 4.6.1a, 4.6.1d-4.6.1f, 4.6.3e, 4.7.1a-4.7.1c, 4.7.2a-4.7.2c, 4.7.3a, 4.7.3b

**Meiosis unit:** 1.3.1a, 4.1.2b, 4.1.2j, 4.2.1c, 4.2.1d, 4.2.1e, 4.3.1c, 4.4.1b-4.4.1f, 4.4.1h, 4.6.2a

**Mitosis unit:** 1.1.2a, 1.3.1a, 4.1.2c, 4.2.1d, 4.4.1b

**DNA and RNA unit:** 1.1.1a, 1.1.1b, 1.1.2a, 1.1.3a, 1.1.3b, 1.1.4a, 1.2.1, 1.2.2a, 1.2.3a, 1.2.3b, 1.2.4, 1.3.1a, 1.3.3, 1.3.4a, 1.3.5a, 1.3.5b, 4.1.2i, 4.1.2j, 4.2.1b, 4.2.1c, 4.2.1f, 4.2.1g, 4.2.1h, 4.2.1i, 4.2.1j, 4.2.2d, 4.3.1b, 4.3.1c, 4.3.1d, 4.3.1g, 4.5.1c, 4.5.1f, 4.5.1g, 4.5.2b

### NYS Living Environment standards being covered in the 4 units

<table>
<thead>
<tr>
<th>Standard</th>
<th>Explanation with detailed explanations</th>
<th>Is able to link key ideas together in a coherent manner.</th>
<th>Question answered completely. All parts of question are answered with sufficient information</th>
</tr>
</thead>
<tbody>
<tr>
<td>How well question was answered</td>
<td>Doesn’t answer question</td>
<td>Very little information regarding the question is provided</td>
<td>Answers part of the question, but doesn’t provide enough information to answer question fully.</td>
</tr>
<tr>
<td>Scientific Literacy</td>
<td>Unintelligible response</td>
<td>A lot of unnecessary information provided. Response is wordy and does not directly relate to the question.</td>
<td>Response is short and concise but has unneeded information and fails to completely and adequately answer the question.</td>
</tr>
</tbody>
</table>

Scientific Literacy

- Unintelligible response
- A lot of unnecessary information provided. Response is wordy and does not directly relate to the question.

**Scientific Literacy**

- Unintelligible response
- A lot of unnecessary information provided. Response is wordy and does not directly relate to the question.

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- Unintelligible response
- A lot of unnecessary information provided. Response is wordy and does not directly relate to the question.

**Scientific Literacy**

- Unintelligible response
- A lot of unnecessary information provided. Response is wordy and does not directly relate to the question.
Expanded list of standards (NYS Department of Education, 2011):

1.1.1a - Scientific explanations are built by combining evidence that can be observed with what people already know about the world.

1.1.1b - Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.

1.1.2a - Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.

1.1.3a - Scientific explanations are accepted when they are consistent with experimental and observational evidence and when they lead to accurate predictions.

1.1.3b - All scientific explanations are tentative and subject to change or improvement.

Each new bit of evidence can create more questions than it answers. This leads to increasingly better understanding of how things work in the living world.

1.1.4a - Well-accepted theories are ones that are supported by different kinds of scientific investigations often involving the contributions of individuals from different disciplines.

1.2.1 - Devise ways of making observations to test proposed explanations.

1.2.2a - Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.

1.2.3a - Hypotheses are predictions based upon both research and observation.
1.2.3b-Hypotheses are widely used in science for determining what data to collect and as a guide for interpreting the data.

1.2.4-Carry out a research plan for testing explanations, including selecting and developing techniques, acquiring and building apparatus, and recording observations as necessary.

1.3.1a-Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

1.3.3-Assess correspondence between the predicted result contained in the hypothesis and actual result, and reach a conclusion as to whether the explanation on which the prediction was based is supported.

1.3.4a-Hypotheses are valuable, even if they turn out not to be true, because they may lead to further investigation.

1.3.5a-One assumption of science is that other individuals could arrive at the same explanation if they had access to similar evidence. Scientists make the results of their investigations public; they should describe the investigations in ways that enable others to repeat the investigations.

1.3.5b-Scientists use peer review to evaluate the results of scientific investigations and the explanations proposed by other scientists. They analyze the experimental procedures, examine the evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations for the same observations.

4.1.1a-Populations can be categorized by the function they serve. Food webs identify the relationships among producers, consumers, and decomposers carrying out either autotrophic or heterotrophic nutrition.
4.1.1b - An ecosystem is shaped by the nonliving environment as well as its interacting species. The world contains a wide diversity of physical conditions, which creates a variety of environments.

4.1.1c - In all environments, organisms compete for vital resources. The linked and changing interactions of populations and the environment compose the total ecosystem.

4.1.1d - The interdependence of organisms in an established ecosystem often results in approximate stability over hundreds and thousands of years. For example, as one population increases, it is held in check by one or more environmental factors or another species.

4.1.1f - Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.

4.1.2b - Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

4.1.2c - The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.

4.1.2i - Inside the cell a variety of specialized structures, formed from many different molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus).

4.1.2j - Receptor molecules play an important role in the interactions between cells. Two primary agents of cellular communication are hormones and chemicals produced by nerve cells. If nerve
or hormone signals are blocked, cellular communication is disrupted and the organism’s stability is affected.

4.2.1b-Every organism requires a set of coded instructions for specifying its traits. For offspring to resemble their parents there must be a reliable way to transfer information from one generation to the next. Heredity is the passage of these instructions from one generation to another.

4.2.1c-Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.

4.2.1d-In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.

4.2.1e-In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

4.2.1f-In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular bases) and replicated by means of a template.

4.2.1g-Cells store and use coded information. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.
4.2.1h- Genes are segments of DNA molecules. Any alteration of the DNA sequence is a mutation. Usually, an altered gene will be passed on to every cell that develops from it.

4.2.1i- The work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino acids in a specific sequence. This sequence influences the shape of the protein. The shape of the protein, in turn, determines its function.

4.2.1j- Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions.

4.2.2d- Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it.

4.3.1b- New inheritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells.

4.3.1c- Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.

4.3.1d- Mutations occur as random chance events. Gene mutations can also be caused by such agents as radiation and chemicals. When they occur in sex cells, the mutations can be passed on to offspring; if they occur in other cells, they can be passed on to other body cells only.

4.3.1g- Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.

4.4.1b- Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.
4.4.1c-The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

4.4.1d-The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.

4.4.1e-Human reproduction and development are influenced by factors such as gene expression, hormones, and the environment. The reproductive cycle in both males and females is regulated by hormones such as testosterone, estrogen, and progesterone.

4.4.1f-The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.

4.4.1h-In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its mother’s exposure to environmental factors such as inadequate diet, use of alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy.

4.5.1c-In all organisms, organic compounds can be used to assemble other molecules such as proteins, DNA, starch, and fats. The chemical energy stored in bonds can be used as a source of energy for life processes.

4.5.1f-Biochemical processes, both breakdown and synthesis, are made possible by a large set of biological catalysts called enzymes. Enzymes can affect the rates of chemical change. The rate at
which enzymes work can be influenced by internal environmental factors such as pH and temperature.

4.5.1g-Enzymes and other molecules, such as hormones, receptor molecules, and antibodies, have specific shape

4.5.2b-Viruses, bacteria, fungi, and other parasites may infect plants and animals and interfere with normal life functions.

4.6.1a-Energy flows through ecosystems in one direction, typically from the Sun, through photosynthetic organisms including green plants and algae, to herbivores to carnivores and decomposers.

4.6.1d-The number of organisms any habitat can support (carrying capacity) is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organisms through the activities of bacteria and fungi.

4.6.1e-In any particular environment, the growth and survival of organisms depend on the physical conditions including light intensity, temperature range, mineral availability, soil/rock type, and relative acidity (pH).

4.6.1f-Living organisms have the capacity to produce populations of unlimited size, but environments and resources are finite. This has profound effects on the interactions among organisms.

4.6.2a-As a result of evolutionary processes, there is a diversity of organisms and roles in ecosystems. This diversity of species increases the chance that at least some will survive in the face of large environmental changes. Biodiversity increases the stability of the ecosystem.

4.6.3a-The interrelationships and interdependencies of organisms affect the development of stable ecosystems.
4.6.3b - Through ecological succession, all ecosystems progress through a sequence of changes during which one ecological community modifies the environment, making it more suitable for another community. These long-term gradual changes result in the community reaching a point of stability that can last for hundreds or thousands of years.

4.6.3c - A stable ecosystem can be altered, either rapidly or slowly, through the activities of organisms (including humans), or through climatic changes or natural disasters. The altered ecosystem can usually recover through gradual changes back to a point of long-term stability.

4.7.1a - The Earth has finite resources; increasing human consumption of resources places stress on the natural processes that renew some resources and deplete those resources that cannot be renewed.

4.7.1b - Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental.

4.7.1c - Human beings are part of the Earth’s ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems. Humans modify ecosystems as a result of population growth, consumption, and technology. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems may be irreversibly affected.

4.7.2a - Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water.
4.7.2b-When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.

4.7.2c-Industrialization brings an increased demand for and use of energy and other resources including fossil and nuclear fuels. This usage can have positive and negative effects on humans and ecosystems.

4.7.3a-Societies must decide on proposals which involve the introduction of new technologies. Individuals need to make decisions which will assess risks, costs, benefits, and trade-offs.

4.7.3b-The decisions of one generation both provide and limit the range of possibilities open to the next generation.

Appendix D

Ecology unit

Teacher______________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson one: Overview of Learned and Innate behavior

1. Objectives: 1) Students will be able to describe what learning is and what a learned behavior is. 2) Students will be able to describe what innate behavior is. 3) Students will be able to describe the difference among the learned and innate behavior and describe each one's role in population interactions.
II. **Criteria:** 1) Understanding of what learning is, being able to define learned behavior and giving three examples of learned behavior. 2) Understanding of what innate behavior is, and being able to list three examples of innate behavior. 3) Description of the similarities and differences among learned and innate behaviors. Students will be able to list three of each.

III. **Purpose:** The purpose of this lesson is for students to understand innate and learned behavior, how they differ from each other and how they both related to population interactions.

IV. **Standards:** NYS standard 4

Key indicators: 4.1.1f, 4.2.1c, 4.3.1b

V. **Procedures**

a. Anticipatory set (10 minutes)

<table>
<thead>
<tr>
<th><strong>Steps</strong></th>
<th><strong>Key Questions and Ideas</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>-Introduce the new unit of Ecology</td>
<td>-Cover the basic/main concepts to be discussed</td>
</tr>
<tr>
<td>-KWL of learned and innate behavior</td>
<td>-Discuss what students wrote for KWL, and fill in some ideas on the board. Complete at end of class.</td>
</tr>
<tr>
<td>-Explain basic overview of unit with graphic organizer linking content together</td>
<td>-This is to help guide the students thought process through the course of the unit</td>
</tr>
</tbody>
</table>

b. Body (60 minutes)

<table>
<thead>
<tr>
<th><strong>Steps</strong></th>
<th><strong>Key Questions and Ideas</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>-Pass out guided notes and discussion points along with the key words sheets</td>
<td>-The guided note sheet is to help students take notes on the most important information of the lesson that will come back up during later lessons on population interactions. The discussion points are to help guide students in answering teacher led questions.</td>
</tr>
<tr>
<td>-There are two types of behaviors</td>
<td>-Give 4 to 5 examples of each behavior type when discussing them.</td>
</tr>
<tr>
<td>-Discuss learning and learned behavior with examples and relate learned behavior to population interactions</td>
<td>-Learned behaviors teach organisms to stay away from other animals and how to prey on animals. Give examples such as wolves getting sprayed by porcupines (what does this teach</td>
</tr>
</tbody>
</table>
- Discuss innate behavior and how it is influenced by genes. Give examples.
- Give students some experiments that demonstrate innate behavior and discuss why.
- Give examples of how innate behavior affects population interactions.

- Discuss the differences between innate and learned behavior creating a Venn diagram in student notes and on the board to compare and contrast the two.

- Innate behavior is under genetic control.
- Explain 2-3 experiments such as the lacewing experiment and discuss how they demonstrate innate behavior.
- Examples of how innate behavior affects population interactions: alarm stimuli cause prey to react and escape a predator; if a sow bug is in a dry area it increases its movement to increase its chances of finding moisture; lacewing songs are used to attract mates.
- Innate behaviors have genetic controls that organisms are born with. Learned behaviors have to be taught or learned through experience as the organism develops.

### c. Closure (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Brief review</td>
<td>- Ask for question’s and check that students filled in guided notes.</td>
</tr>
<tr>
<td>- Have students complete KWL</td>
<td>- Ask students to fill portion of what they Learned for the KWL and post some of the student’s responses on the board.</td>
</tr>
<tr>
<td>- Pass out homework</td>
<td>- Homework is to explain innate and learned behavior and how they affect population interactions. Students will also read 1009-1110 of Biology (7th edition) by Campbell and Reece and complete the anticipation guide that was passed out.</td>
</tr>
<tr>
<td>- Remind them to bring review books to class</td>
<td>- The CRA has two questions to check for student understanding of the material covered in today’s lesson.</td>
</tr>
<tr>
<td>- Pass out Criterion Referenced Assessment (CRA)</td>
<td></td>
</tr>
</tbody>
</table>

### VI. Enrichment: Students will give two examples each of how innate and learned behavior effect or are involved in population interactions on the homework. Reading out of their textbook along with the anticipation guide that is to be completed before the reading assignment. The KWL also helps to enrich students learning.

### VII. Evaluation: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are
students responding to questions during the lesson? Did they complete the note sheet?

Were there any questions regarding the homework? How well did they perform on the CRA? What further instruction is needed if any?

Teacher________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson two: Population interactions, ecological niches, invasive species, and introduction to ecosystems.

I. Objectives: 1) Students will be able to understand what population interactions are more fully and what an ecological niche is. 2) Students will be able to define what an invasive species is and how it causes competition. 3) Students will be able to define the basic vocabulary of an ecosystem.

II. Criteria: 1) Students will be able to give at least three examples and define what an ecological niche is. 2) Students will be able to explain how an invasive species leads to competition, define competition and give at least two examples of an invasive species. 3) Students will be able to define the words organism, population, community, and ecosystem.

III. Purpose: The purpose of this lesson is to have students learn what an ecological niche is and to further comprehend population interactions. They will gain a general understanding of what a niche is and how it is involved with population interactions. They will also gain an understanding of invasive species and understand the basic vocabulary that is important to the concept of ecosystems.

IV. Standards: NYS standard 1, 4
Key indicators: 1.1.1a, 4.1.1a, 4.1.1b, 4.1.1c, 4.1.1a

V. Procedures

a. Anticipatory set (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s class, draw on students prior knowledge</td>
<td>-Go over key terms and concepts such as innate and learned behavior and how they relate to population interactions.</td>
</tr>
<tr>
<td>-Review yesterday’s CRA</td>
<td>-Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>-Review definition of population interactions.</td>
<td>-Population interactions is when two organisms interact with one another.</td>
</tr>
<tr>
<td>-Have students read page 91 in their review books.</td>
<td>-The reading will help prepare students for today’s lesson.</td>
</tr>
<tr>
<td>-Have students prepare their notebooks in the Cornell fashion for note taking.</td>
<td>-The students have experiences this before, but review what they need to do by putting an example on the board.</td>
</tr>
<tr>
<td>-Go over Yesterday’s CRA</td>
<td>-Helps student’s understanding where they are in achieving mastery of criteria and helps the teacher see what areas students are struggling with.</td>
</tr>
</tbody>
</table>

b. Body (60 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Check for students understanding of population interaction. Make sure it is concrete</td>
<td>-Go over what an ecological niche is. It is like an organism’s job in its particular area known as an ecosystem. Use abundant examples with common organisms</td>
</tr>
<tr>
<td>-Define what an ecological niche</td>
<td>-An invasive species is an organism that is not native to the area and competes with a native organism for the same niche. However the invasive species usually does not have predators and will out-compete the native organism.</td>
</tr>
<tr>
<td>-Define what an invasive species is</td>
<td>-Use an analogy to better describe the activity: two students will draw different symbols on the board (producers with two separate niches) while two students erase a specific symbol (consumer with two separate niches). Now the fifth student will draw the same shape as one of the other students but in a different color to represent an invasive species with no natural predator in the area. This will represent competition and the effects of invasive species.</td>
</tr>
<tr>
<td>-Activity with niches: Select five volunteers. Four will represent separate niches and the fifth will be an invasive species used to represent competition. Two students will be producers while two will be consumers. Students will learn more about these in the future lessons, just a basic understanding is needed now.</td>
<td></td>
</tr>
</tbody>
</table>
- Examples of invasive species
- Explain how niches and competition of niches with invasive species are population interactions.
- Handout sheet with vocabulary for ecosystems, and introduce students to the vocabulary using guided notes and examples.
- Not all terms will be covered today.

The students will draw the symbols at a rate of one per second, after 5 seconds the consumers will consume at a rate of one per second. The invasive species will outgrow the native species and gain dominance in the niche.
- Zebra mussels, purple loosestrife

- Terms to be covered today: organism, population, community, and ecosystem with examples of each that students are familiar with.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review what was learned</td>
<td>- Review population interactions, niches, invasive species</td>
</tr>
<tr>
<td>- Remind them of a quiz tomorrow</td>
<td>and vocabulary words.</td>
</tr>
<tr>
<td>- Discuss tomorrow’s class topics</td>
<td>- Quiz is on innate and learned behavior, niches, invasive</td>
</tr>
<tr>
<td>- CRA</td>
<td>species and niches. 3 questions</td>
</tr>
<tr>
<td></td>
<td>- Finishing ecosystem terms and beginning ecosystem</td>
</tr>
<tr>
<td></td>
<td>relationships</td>
</tr>
<tr>
<td></td>
<td>- Students complete two-question CRA to guide future</td>
</tr>
<tr>
<td></td>
<td>learning and instruction.</td>
</tr>
</tbody>
</table>

VI. **Enrichment**: The activity used to explain niches and invasive species. The examples used to supplement the definitions of vocabulary

VII. **Evaluation**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. How well did they perform on the CRA? What further instruction is needed if any? Was the analogy activity useful in furthering student’s understanding of niches and invasive species? Were there multiple questions or limited questions? Were students notes filled out well? Was the Cornell method helpful in guiding student’s notes?

Teacher______________

80 minute period of Living Environment’s
Unit: Ecology: Behavior, and population interactions

Lesson three: Ecosystem vocabulary and ecosystem interactions

I. Objectives: 1) Students will be able to describe key vocabulary terms that deal with population interactions and ecosystems. 2) Students will be able to place organisms and inorganic items into the correct categories of predator, prey, producer, consumer, biotic and abiotic. 3) Students will be able to describe the terms for food chains, draw a food chain and understand different trophic levels.

II. Criteria: 1) Students will be able to define the words population interaction, predator, prey, producer, consumer, biotic, abiotic, food chain, biosphere and trophic level. 2) Students will be able to draw a food chain and provide explanations for the different trophic levels.

III. Purpose: The purpose of this lesson is for students to learn vocabulary that deals with population interactions and learn how these words are incorporated into the workings of an ecosystem. This lesson will give students the ability to group organisms into their proper classifications as predator or prey, biotic or abiotic and so on. Students will also learn the structure and the importance of food chains.

IV. Standards: NYS standard 4

   Key indicators: 4.1.1a, 4.1.1b, 4.1.1c, 4.1.1f

V. Procedures
   a. Anticipatory set (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Ask students for any questions pertaining the quiz</td>
<td>-Quiz to further check for students understanding and aid the CRA’s. Also used for a grade, since the daily CRA’s are more for feedback than grades.</td>
</tr>
<tr>
<td>-Collect quizzes</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>-Review yesterday’s CRA</td>
<td></td>
</tr>
<tr>
<td>-Review terms covered already on term sheet</td>
<td></td>
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</tbody>
</table>
b. Body (60 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduce the remaining terms pertaining to ecosystems</td>
<td>- Terms: abiotic, biotic, predator, prey, producer, consumer, food chain, habitat, biosphere</td>
</tr>
<tr>
<td>- Activity- give students a bunch of organism names and other ecosystem factors. Have them get into groups of 3 or 4 students and have them place the organisms and ecosystem factors into the groups or predator or prey, consumer or producer, abiotic or biotic. Then with just the organisms have students arrange them in a food chain order representing which organism would consume which.</td>
<td></td>
</tr>
<tr>
<td>- Pass out new term sheet for food chains</td>
<td>- The students can determine the best way to organize the words into the various categories during the activity; however suggestions on how to do so will be helpful to students and quicken the process.</td>
</tr>
<tr>
<td>- Have students read p. 92-93 in their review books</td>
<td></td>
</tr>
<tr>
<td>- Give students 3 to 4 examples of food chains</td>
<td>- Have students fill in the terms individually as they read about them in the review book. Go over the terms as a class to verify accuracy with all students and give supplemental examples to fortify the terminology.</td>
</tr>
<tr>
<td>- Place an empty semantic map on the board/screen/projector and fill in using key terms and concepts.</td>
<td>- The graphic organizer will help student’s link key ideas together and develop an understanding of how the ideas in this unit flow together. The concepts should go through what was covered in today’s lesson</td>
</tr>
<tr>
<td>- Pass out finished copy of semantic web to students for notes and study material.</td>
<td></td>
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</tbody>
</table>

c. Closure (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review the activity, the purpose and what was demonstrated by it.</td>
<td>- Answer questions, was there any confusion</td>
</tr>
<tr>
<td>- Explain homework assignment</td>
<td>- Create two food chains and label the organisms with the proper terms discussed in today’s class</td>
</tr>
<tr>
<td>- CRA as a ticket out the door</td>
<td></td>
</tr>
</tbody>
</table>

VI. **Enrichment**: The homework assignment and the activity completed in class.

VII. **Evaluation**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. How well did they perform on the CRA? What further instruction is needed if any? Were all students active during the activity? How were the student’s notes? Were most terms filled
in? Did they take notes? How successful were students filling in semantic web? Do students have an understanding of how the concepts so far are linked together?

Teacher______________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson four: Food webs, lab on ecosystem in a bottle

I. **Objectives:** 1) Students will be able to draw a food web when given a list of organisms. 2) Students will be able to understand how a food web and food chain are different. 3) Students will be able to create an ecosystem in a bottle and answer questions about food webs pertaining to the ecosystem they created.

II. **Criteria:** 1) Students will be able to draw a food web from a list of organisms. 2) Students will be able to list at least three differences between food webs and chains.

III. **Purpose:** The purpose of this lesson is for students to learn what a food web is, how it is used and how to make one. Students will learn the differences among food webs and chains. Students will also create an ecosystem and understand how each organism interacts with one another.

IV. **Standards:** NYS standard 1, 4

    Key indicators: 1.1.1a, 1.1.3a, 1.2.1, 4.1.1a, 4.1.1b, 4.1.1c, 4.1.1d, 4.1.1f

V. **Procedures**
   a. Anticipatory set (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Collect homework</td>
<td></td>
</tr>
<tr>
<td>-Tell students about food webs and the lab activity for the day.</td>
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</tr>
<tr>
<td>-Outline how the lab and the lecture portion are connected.</td>
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</tr>
<tr>
<td>-Review Yesterday’s CRA</td>
<td></td>
</tr>
<tr>
<td>-Outline the days agenda to help organize the lab transition and for timing.</td>
<td></td>
</tr>
<tr>
<td>-Discussing how the lecture links to the lab helps students understand importance of variance in learning styles and making multiple connections to better understand a topic.</td>
<td></td>
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</tbody>
</table>
b. Body (60 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Explain what a food web is</td>
<td>- Food web- a diagram that shows the more complex feeding relationships between organisms. Draw an example of the board</td>
</tr>
<tr>
<td>- Explain how food webs and food chains are different. Demonstrate</td>
<td>- The activity will have each student get a card that has an organism on it. First have the students create a food chain representing who will eat whom with a string. Have the students wind the string back up. Next have the class get into a circle and create a food web. Works best with a ball of string. Students will toss the ball of string to another student who represents an organism that could eat them or be eaten by them. This will demonstrate the complexity of a food web and differences between food web and chain. Have students keep the words in mind as well</td>
</tr>
<tr>
<td>the lab. Explain the connections of the lab and the activity they</td>
<td>- Make sure students have an understanding of the lab manual before having them start on it. Help students who get stuck and aid them with questions they are struggling on.</td>
</tr>
<tr>
<td>just did.</td>
<td>- Explain to the students that they will have to keep observations of their ecosystems for a week. Observations should be taken before or after class or during the teacher’s free time. They will be graded on the notebook observations.</td>
</tr>
<tr>
<td>- Pass out lab manual and explain it</td>
<td></td>
</tr>
<tr>
<td>- Pass out worksheet that accompanies the lab and have students</td>
<td></td>
</tr>
<tr>
<td>complete questions as they come across them while doing the lab.</td>
<td></td>
</tr>
</tbody>
</table>

---

VI. **Enrichment**: The lab that had students create an ecosystem in a bottle to understand food webs and population interactions. Also the food web and food chain activity. The
students observations will help them develop observation skills, note taking skills and how to write concise scientific observations.

VII. **Evaluation**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. How well did they perform on the CRA? What further instruction is needed if any? How did students do in forming the food chain and food web? Is there an understanding of the differences between food webs and food chains? Were students on task during the lab? Did students struggle with lab questions or answer them easily? Is the process of observation and note taking over the next week understood?

Teacher____________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson five: Energy flow and environmental limitations

I. **Objectives**: 1) Students will be able to draw an energy pyramid and describe how materials are recycled in an ecosystem. 2) Students will be able to define competition, limiting factors, and carrying capacity. 3) Students will be able to describe how limiting factors limit the carrying capacity, limit the amount of organisms there can be in a particular habitat and why there cannot be an infinite population.

II. **Criteria**: 1) Students will be able to draw energy pyramids and explain the 10% rule. 2) Students will be able to describe the interactions of competition to limiting factors and carrying capacity and define limiting factors and carrying capacity. 3) Students will be able to describe how limiting factors and carrying capacity are interrelated.
III. **Purpose:** The purpose of this lesson is for students to gain an understanding of how energy flows through an ecosystem and how materials are recycled in an ecosystem. Students will also understand how biotic and abiotic factors limit the size of a population and for students to understand why there cannot be an infinitely sized population. Students will also understand that the ability of decomposers to recycle the residue of dead organism back into the ecosystem has an effect of how many organisms can live in that ecosystem.

IV. **Standards:** NYS standard 4

Key indicators: 4.1.1f, 4.6.1a, 4.6.1d, 4.6.1f, 4.6.1e,

V. **Procedures**

a. **Anticipatory set (10 minutes)**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
</table>
| -Remind students to fill in their observations for the ecosystem in a bottle lab as they come in the door  
-Review yesterday’s CRA  
-Explain the strategy that is being implemented today  
-Have students read p. 96-97 in review book | -Students should be making observations before or after class.  
- Use general feedback guide and feedback guide after CRA  
-Request is a strategy to help with reading comprehension. First everyone reads a passage then you take turns answering questions, meaning the students first ask you questions about the reading then you ask the students questions. |

b. **Body (60 minutes)**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
</table>
| -After students have read the passage go over some of the key terms before you begin Request. This eliminates the chance students will ask definition questions.  
-After the terms have been covered begin by having students ask you questions on the reading.  
-Then after 3 to 4 questions, it’s your turn to ask the students questions  
-Continue to alternate back and forth until all the material from the text is covered in detail | -Key terms to consider: Energy pyramid (Show an example of this and explain the different tiers)  
-You want the students to ask thought provoking questions that will help them learn the material and critically analyze it  
-After you have answered a student’s question ask if anyone else has something to add to your answer  
-During this activity you should be developing a list of questions that you asked, the students |
- Half way through the class transition to environmental limits
- Explain the activity being used to represent carrying capacity and limiting factors.
- Explain every time students roll less than six they cannot reproduce because a predator is limiting their population’s growth and when all the M&M’s are out of the cup their population has reached its carrying capacity.
- This activity should be used to introduce the class to the terms being defined.
- Tell students how the activity showed limiting factors and carrying capacity.
- Explain the difference between infinite and finite, and how they relate to resources.
- Discuss how predator-prey relationships limit a population.
- Discuss how decomposers effect the availability of resources within an area.

- Terms to be introduced are competition, limiting factors and carrying capacity.
- The predator was a limiting factor and the amount of M&M’s was the carrying capacity.
- There are finite resources in the world thus a population is limited by how much resources area available to it.
- Draw a curve to show predator-prey relationships.
- Give examples for everything and pass out to students an expanded note sheet.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review the class</td>
<td>Answer any questions that students still have.</td>
</tr>
<tr>
<td>Give students homework assignment</td>
<td>Homework is to read an article on human impact.</td>
</tr>
<tr>
<td>Discuss tomorrow’s class</td>
<td>Draw an energy pyramid. Tomorrow’s class will be on human impact.</td>
</tr>
<tr>
<td>CRA</td>
<td></td>
</tr>
</tbody>
</table>

**c. Closure (10 minutes)**

**Steps**
- Review the class
- Give students homework assignment
- Discuss tomorrow’s class
- CRA

**Key Questions and Ideas**
- Answer any questions that students still have.
- Homework is to read an article on human impact. Draw an energy pyramid. Tomorrow’s class will be on human impact.

VI. **Enrichment**: The activity with the dice demonstrating carrying capacity and limiting factors. The homework assignment will give students an advanced preview of tomorrow’s class and what the main discussion points will be. The drawing of energy pyramids will help students better understand energy flow. The handouts of nutrient cycles will help refresh student’s memories and help them understand the process of material recycling.
VII. **Evaluation:** The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. How well did they perform on the CRA? What further instruction is needed if any? Was the request strategy useful? Did students ask thought provoking questions? Did students feed off of each other’s answers to make answers more complete? How much of the class was engaged during this activity? Did students understand how decomposers play a role in limiting resources?

Teacher_____________________

80 minute period of Living Environment’s

Unit: Ecology: Behavior, and population interactions

Lesson six: Human impact

I. **Objectives:** 1) Students will be able to describe the various impacts humans have on the environment and why these human actions impact the environment. 2) Students will be able to define bioaccumulation. 3) Students will be able to describe ways to reverse or slow down climate change and other environmental impacts humans have on the world.

II. **Criteria:** 1) Students will be able to describe at least three human impacts on the environment. 2) Students will be able to define bioaccumulation. 3) Students will be able to describe at least two methods used to slow down or reverse human impacts on the environment.

III. **Purpose:** The purpose of this lesson is for students to understand what human actions effect the environment and why those actions have the impact that they do. Students will also learn about ways to prevent and slow down the effects humans are having on the environment.
IV. Standards: NYS standard 4

Key indicators: 4.7.12, 4.7.1b, 4.7.1c, 4.7.2a, 4.7.2b, 4.7.2c, 4.7.3a, 4.7.3b

V. Procedures

a. Anticipatory set (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
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</thead>
<tbody>
<tr>
<td>- Review yesterday’s CRA&lt;br&gt;-Students will be doing an activity called professor know it all.&lt;br&gt;-The 7 group topics will be DDT, Air pollution and acid rain, loss of biodiversity and EPA, the EPA’s pesticide program and other regulation programs, CITIES, ESA, and Animal welfare act and Clean air act.&lt;br&gt;-Describe what each group will present</td>
<td>- Use general feedback guide and feedback guide after CRA&lt;br&gt;-place students into groups of 7. Each group will be an expert on a particular topic from last night’s reading assignment. Students will also be able to use the laptop cart to look up more information on their topic (only have 20 minutes to do so)&lt;br&gt;-Students will present the key facts about their area and prevention strategies taken by their topic or against their topic</td>
</tr>
</tbody>
</table>

b. Body (60 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
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</thead>
<tbody>
<tr>
<td>-Students will have 15 minutes to prepare their presentation&lt;br&gt;-After this time students will have 2 minutes to present their information. They will turn in a copy of the information they wrote down to present to the teacher so copies can be made for the entire class.&lt;br&gt;-Get class back in seats and read for class discussion&lt;br&gt;-Discuss what bioaccumulation is&lt;br&gt;-Discuss climate change and what human actions have accelerated it and how governments are taking actions to slow it down</td>
<td>-This is an informal presentation of material and just covers key concepts.&lt;br&gt;-The presentation is so the students can teach the class about key ideas they feel are important in the topic they were assigned. Two minutes is not a lot of time to present and thus is why the sheet of group ideas is being collected to pass out to the other groups.&lt;br&gt;-Not a graded assignment.&lt;br&gt;-Give students definition bioaccumulation so they can put it on their note sheet&lt;br&gt;-Climate change- focus on the fact that temperatures fluctuate over the course of millions of years however what is happening is that humans have accelerated the warming process and temperatures are rising faster than normal</td>
</tr>
</tbody>
</table>

c. Closure (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review the class&lt;br&gt;-Remind students the unit CRA is tomorrow, there will be a review session before the unit CRA&lt;br&gt;-CRA (daily)</td>
<td>-Do students have any questions about concepts for the unit CRA?&lt;br&gt;-Review will be first half of the class period</td>
</tr>
</tbody>
</table>
VI. **Enrichment**: The expert groups of the professor know it all

VII. **Evaluation**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. How well did they perform on the CRA? What further instruction is needed if any? Are students prepared for tomorrow units CRA? How did the groups do presenting information?

**Teacher_______________________**

**80 minute period of Living Environment’s**

**Unit: Ecology: Behavior, and population interactions**

**Lesson seven: Review and unit CRA**

I. **Objectives**: 1) Students will be able to answer review questions based on the ecology unit. 2) Students will be able to perform the best they can on the unit CRA

II. **Criteria**: 1) Understanding of what learning is, being able to define learned behavior and giving three examples of learned behavior. 2) Understanding of what innate behavior is, and being able to list three examples of innate behavior. 3) Description of the similarities and differences among learned and innate behaviors. Students will be able to list three of each. 4) Students will be able to give at least three examples and define what an ecological niche is. 5) Students will be able to explain how an invasive species leads to competition, define competition and give at least two examples of an invasive species. 6) Students will be able to define the words organism, population, community, and ecosystem. 7) Students will be able to define the words population interaction, predator, prey, producer, consumer, biotic, abiotic, food chain, biosphere and trophic level. 8) Students will be able to draw a food chain and provide explanations for the different
trophic levels. 9) Students will be able to draw a food web from a list of organisms. 10) Students will be able to list at least three differences between food webs and chains. 11) Students will be able to draw energy pyramids and explain the 10% rule. 12) Students will be able to describe the interactions of competition to limiting factors and carrying capacity and define limiting factors and carrying capacity. 13) Students will be able to describe how limiting factors and carrying capacity are interrelated. 14) Students will be able to describe at least three human impacts on the environment. 15) Students will be able to define bioaccumulation. 16) Students will be able to describe at least two methods used to slow down or reverse human impacts on the environment.

III. **Purpose:** The purpose of this lesson is for students to review for their unit CRA the first half of class then measure their level of understanding of the ecology unit on the unit CRA.

IV. **Standards:** NYS standard

Key indicators: all indicators covered in previous 6 lessons

V. **Procedures**

   a. Anticipatory set (10 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>Explain game of jeopardy to students</td>
<td></td>
</tr>
<tr>
<td>Split students into 3 groups</td>
<td></td>
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</tbody>
</table>

   b. Body (60 minutes)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play jeopardy review game for until there are 45 minutes left in class</td>
<td>- When wrapping up jeopardy ask students if students have any more questions before the unit CRA</td>
</tr>
<tr>
<td>Have students go back to seats and get ready for the unit CRA</td>
<td></td>
</tr>
<tr>
<td>Pass out unit CRA</td>
<td>- Monitor students for questions and for wandering eyes.</td>
</tr>
</tbody>
</table>

   c. Closure (10 minutes)
VI. **Enrichment**: The jeopardy review game provides students with last moment recall of information and allows them to ask any last minute questions before the unit CRA.

VII. **Evaluation**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. How well did they perform on the unit CRA? What further instruction is needed if any? Are students happy with their grades? Do they understand what their marks mean? Do certain topics need to be re-taught? How will the teacher know this? The teacher will be provided with a feedback “manual” to help understand what areas students are lacking in the most and some options to re-teach these areas depending on the weaknesses of the lesson that contain the criteria students struggled with.

**Mitosis unit**

**Teacher______________________**

**80 minute period of Honors Living environments**

**Unit: Mitosis and cell cycles**

**Lesson 1: Cell cycle**

I. **Objective**: 1) Students will be able to describe the cell cycle including the details of mitosis.

**Standards:**

1.1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.
1.3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.


II. **Criteria:** 1) Students will be able to draw the cell cycle and explain the main phases. 2) Students will be able to explain the four phases of mitosis and the function of mitosis.

III. **Purpose:** The purpose of this lesson is for students to learn about the cell cycle, including the various phases of the cycle and why they are important. There is no specific standard in the NYS Living Environment standards dealing with the cell cycle; however, most high school Biology books include a section on this and it is important for students to understand as a baseline knowledge for other aspects of mitosis.

IV. **Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduction to the unit</td>
<td>- Explain to students you are starting a unit on mitosis and the cell cycle.</td>
</tr>
<tr>
<td>- Show intro video to cell cycle</td>
<td>- Video is to give students a preliminary introduction to the vocabulary they will be</td>
</tr>
<tr>
<td><a href="http://www.youtube.com/watch?v=lf9rcqifx34">http://www.youtube.com/watch?v=lf9rcqifx34</a></td>
<td>introduced to in this unit.</td>
</tr>
<tr>
<td>- Pass out note sheets</td>
<td></td>
</tr>
</tbody>
</table>

b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Give students the notes for letters A-D. These notes contain basic</td>
<td>- This includes the cell cycle, mitosis, G0, G1, G2, S phase, interphase, prophase,</td>
</tr>
<tr>
<td>definitions of each word.</td>
<td>metaphase, anaphase, telophase, and cytokinesis.</td>
</tr>
<tr>
<td>- Pass out the worksheet from biology corner.</td>
<td>- Have students work on this worksheet in pairs for 20 minutes. They should consult</td>
</tr>
<tr>
<td>- Go over the worksheet explaining what happens in G0, G1, S phase,</td>
<td>- Students should have a firma understanding of mitosis since tomorrow they will</td>
</tr>
<tr>
<td>G2, mitosis and cytokinesis</td>
<td>conduct a lab on it. Use videos, diagrams and color-in worksheets to supplement and</td>
</tr>
<tr>
<td></td>
<td>enrich student</td>
</tr>
</tbody>
</table>
c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review the class</td>
<td>- Go over any un answered questions</td>
</tr>
<tr>
<td>- Homework: page 284 questions: 1a, 2a, 2b, 3a, 4a, 4b</td>
<td>- The CRA is to test how much students learned today and what areas need reinforcement.</td>
</tr>
<tr>
<td>- Pass out CRA</td>
<td></td>
</tr>
</tbody>
</table>

V. **Enrichment**: The introduction video, the supplemental worksheets and activities.

VI. **Evaluation/assessment/reflection** (student learning): The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any? How well did they partner worksheet go? Did most groups finish the worksheet in the allotted time.

Teacher__________________

80 minute period of Honors Living environments

**Unit**: Mitosis and cell cycles

**Lesson 2**: Cell cycle review and Mitosis lab

I. **Objective**: 1) Students will be able to describe the cell cycle. 2) Students will be able to explain the difference between diploid and haploid, and chromatin, chromatid and chromosome. 3) Students will be able to complete a laboratory investigation of the process of Mitosis by observing prepared slides containing onion roots.

**Standards:**
1.1.2a Inquiry involves asking questions and locating, interpreting, and processing
information from a variety of sources.

1.3.1a Interpretation of data leads to development of additional hypotheses, the formulation of
generalizations, or explanations of natural phenomena.


II. Criteria: 1) Students will be able to define the words diploid, haploid, chromosome,
chromatin and chromatid. 2) Students will be able to provide at least two real life
examples of Mitosis.

III. Purpose: The purpose of this lesson is for students to learn about the cell cycle, and the
definitions of diploid, haploid, chromosome, chromatin, and chromatid. This lesson will
also have students use scientific inquiry to complete a lab on the process of Mitosis.

IV. Procedures (anticipatory set, body, closure)
Materials: various worksheets and PowerPoint, worksheets will be provided and
attached to this lesson plan.

A. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Any questions on homework?</td>
<td>- If not collect it</td>
</tr>
<tr>
<td>Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback</td>
</tr>
<tr>
<td>- Have students open notebooks to begin</td>
<td>guide after CRA</td>
</tr>
<tr>
<td>notes.</td>
<td>- Notes left off at letter D.</td>
</tr>
<tr>
<td>- Some fun facts about chromosomes.</td>
<td>- How many chromosomes in Human body cell</td>
</tr>
<tr>
<td></td>
<td>(46)? How many in Human sex cell (23)?</td>
</tr>
<tr>
<td></td>
<td>Then some FYI: How many in a sand</td>
</tr>
<tr>
<td></td>
<td>dollar (52)? Fern (110)? Fruitfly (8)?</td>
</tr>
<tr>
<td></td>
<td>- Purpose here is to show that chromosome</td>
</tr>
<tr>
<td></td>
<td>number doesn’t relate to complexity of the</td>
</tr>
<tr>
<td></td>
<td>organism.</td>
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B. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Continue with notes at letter E. This</td>
<td>- Diploid (2n)-normal chromosome # in body</td>
</tr>
<tr>
<td>words include: diploid, haploid, somatic</td>
<td>cell.</td>
</tr>
<tr>
<td>cell, gamete, chromatin, chromatid, and</td>
<td>- Haploid (n)-Sex cells, ½ normal #</td>
</tr>
<tr>
<td>chromosome.</td>
<td>- Somatic cell-Body cell</td>
</tr>
<tr>
<td></td>
<td>- Gamete-sex cell</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
-Ask if students have questions, if not move onto the lab. Pass out sheets, then use microscope on tv and smartboard to show them what they will be looking at.

-Students finish lab by their self, cover last question and explain what a circle graph is.

-Chromatin- NO see, present during interphase, can’t see the chromosomes.
-Chromatid- One of 2 sister pair, Do see the, present prophase-telophase.
-Chromosome- 2 chromatids joined together by a centromere.
-After you show them what they should be looking at, each student gets their own microscope, and they begin the lab. They do up to the chart (question 4???) on their own, then that part will be done as a group. Why? It saves a lot of time.

C. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-CRA</td>
<td>- Answer questions, and make sure they stay focused on their labs.</td>
</tr>
<tr>
<td>-Students finish lab on own, and ask questions about what they do not understand.</td>
<td></td>
</tr>
</tbody>
</table>

V. Enrichment: The review sheet about cell cycles, the lab on Mitosis using microscopes.

VI. Evaluation/assessment/reflection (student learning): REFLECTION: Did students get the vocab? How do you know? How did students do on the review sheet? Did students understand what they were supposed to be looking for while observing the onion root tip cells? How was time management (this is your first time teaching an 80 minute class)?

Assessment: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher_____________

80 minute period of Honors Living environments

Unit: Mitosis and cell cycles
Lesson 3: Asexual reproduction part one

I. **Objective:** 1) Students will be able to describe binary fission, budding, sporulation (pore formation), and regeneration. 2) Students will be able to explain the differences between sexual and asexual reproduction, and why asexual reproduction could be beneficial.

**Standards:**

4.1.2c The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.

4.2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.

4.4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.


II. **Criteria:** 1) Students will be able to define the asexual reproduction terms. 2) Students will be able to describe at least three differences between sexual and asexual reproduction.

III. **Purpose:** The purpose of this lesson is for students to learn about the basics of asexual reproduction, including the terms binary fission, budding, sporulation, and regeneration. This lesson will also teach students differences between sexual and asexual reproduction and why asexual reproduction could be useful.

IV. **Procedures** (anticipatory set, body, closure)
Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

### a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRAs</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>-Review of Mitosis and cell cycle</td>
<td>-Stations activities: 4 stations about 3 minutes each. 4 Groups of?? (count off by 4’s</td>
</tr>
<tr>
<td>-Students will need paper to answer some questions at the stations</td>
<td>-Stations: 1) Microscope with onion root slide. What phase is the arrow pointing at?</td>
</tr>
<tr>
<td></td>
<td>2) Draw the stages interphase, prophase and metaphase.</td>
</tr>
<tr>
<td></td>
<td>3) Draw the stages anaphase, telophase, and cytokinesis.</td>
</tr>
<tr>
<td></td>
<td>4) Difference between haploid/diploid. Difference between chromosome, chromatid, and</td>
</tr>
<tr>
<td></td>
<td>chromatin.</td>
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</tbody>
</table>

### b. Body

<table>
<thead>
<tr>
<th>Steps</th>
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</tr>
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<tbody>
<tr>
<td>-Beginning asexual reproduction. Terms to cover today will be budding, binary fission, sporulation, and regeneration.</td>
<td>-Binary fission is the simplest form of asexual reproduction. Involves the equal division of the cytoplasm. Seen in bacteria, and protists.</td>
</tr>
<tr>
<td></td>
<td>-Sketch it, simple cell division</td>
</tr>
<tr>
<td></td>
<td>-Budding- parent divides into 2 unequal parts. Unequal division of the cytoplasm.</td>
</tr>
<tr>
<td></td>
<td>Seen in yeast, and hydra. Sketch it.</td>
</tr>
<tr>
<td></td>
<td>-Sporulation=spore formation. Spore cells released from parent. Hard covering protect spore from bad environmental conditions. When good conditions, spore will develop into new organism. Examples mold, mushrooms, fungus.</td>
</tr>
<tr>
<td></td>
<td>-Fungus competition, have students set moldy bread, the need to add water but do not tell them how much they should add.</td>
</tr>
<tr>
<td></td>
<td>-Regeneration, ability to regrow lost body parts. Or grow an entire new organism from a part of the original organism. Ability to regenerate, decreases as the complexity of the organism increases.</td>
</tr>
<tr>
<td>Set up moldy bread, fungus competition</td>
<td></td>
</tr>
<tr>
<td>With leftover time students can begin getting swabs of bacteria from cheeks, ears,</td>
<td></td>
</tr>
</tbody>
</table>
railings, etc.. and plating them on agar to watch the bacteria grow.

c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review sheet</td>
<td>-finish everything except questions about</td>
</tr>
<tr>
<td>-CRA</td>
<td>vegetative propagation and benefits of</td>
</tr>
<tr>
<td>-homework: agar with bacteria</td>
<td>asexual versus sexual reproduction.</td>
</tr>
</tbody>
</table>

V. **Enrichment**: The bread fungus competition, the pictures, the review at the beginning of class.

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: Was this enough material for one class period? How did the review activity and fungus game go?

**Assessment**: homework and informal questioning of students. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher__________

80 minute period of Honors Living environments

Unit: cell cycles, mitosis, asexual reproduction

**Lesson 4: Vegetative propagation**

I. **Objective**: 1) Students will be able to explain the various types of vegetative propagation. 2) Students will be able to compare and contrast the pros, and cons of sexual and asexual reproduction.

**Standards:**
4.1.2c The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.

4.2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.

4.4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.


II. Criteria: 1) Students will be able to list and describe the various types of vegetative propagation 2) Students will be able to provide at least two pros and cons of sexual and asexual reproduction

III. Purpose: The purpose of this lesson is for students to learn about vegetative propagation, its natural occurrences, and its artificial uses. This lesson will also teach students the pros and cons of sexual versus asexual reproduction.

IV. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>- If no time in previous lesson, plate bacteria on agar.</td>
<td>- Could use review sheet here also, if not time at end of previous class.</td>
</tr>
<tr>
<td>- Vegetative propagation</td>
<td>- Introduce them to it, potatoes, apple trees</td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 2 types: natural and artificial. Types of natural are bulb, runner, and tuber, types of</td>
<td>- Natural happens in nature. Bulb: new plant grows from a bulb, example are tulips</td>
</tr>
</tbody>
</table>
artificial are cutting, grafting, and layering
- Students will take these notes from smartboard, do drawings, answer questions they have. Reason for artificially propagating is money.

- Now they have learned all forms of asexual reproduction, hand out worksheet for them to complete.

Asexual versus sexual reproduction. For this portion pass out T-charts, and Venn diagrams for students

-tuber, stem with buds called eyes. New plants develop from the eyes, example is a potato.
- Runners are horizontal stems that grow along the ground. Example are strawberries.
- Artificial VP: humans involvement in regeneration of plants.
- Cutting: stem, root, of leaf in soil, produce new plant. Example is ivy, African violets.
- Grafting, stem of a plant, attached to cut end of another plant. Example fruit trees Sketch this
- Layering, bend over stem, the stem turns into roots, sketch this, ex raspberry
- The production of genetically identical offspring from a single parent is known as asexual reproduction. PROS: This process is relatively simple, efficient, and effective, enabling populations to increase in number very quickly. Does not have to occur in single celled organisms. It can happen in multi-cellular organisms as well. CONS: every offspring has the same genes, this means there is little genetic variation among the population.
- Sexual reproduction involves the fusion of two separate parent cells. PROS: offspring produced by sexual reproduction inherit some of their genetic information from each parent, this leads to a lot of genetic variation within a population. CONS: it takes more time and energy, and you have to find a mate.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-review</td>
<td>-ask students questions</td>
</tr>
<tr>
<td>-CRA</td>
<td></td>
</tr>
<tr>
<td>Homework read 606-613</td>
<td></td>
</tr>
</tbody>
</table>

V. **Enrichment**: the worksheets, and possible plating bacteria
VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: This is a lot of information, did the worksheets help break up time? Were you able to split the lesson up into 20 min sections?

**Assessment:** informal questioning, worksheets. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher___________________

80 minute period of Honors Living environments

Unit: Mitosis

Lesson 5: Cancer

I. **Objective:** 1) Students will be able to describe cancer.

II. **Criteria:** 1) Students will be able to describe cancer and how it effects the cell cycle.

III. **Purpose:** The purpose of this lesson is to learn about cancer. This is a topic important to a lot of individual’s lives and is a good representation of what can happen when something goes wrong in the cell cycle.

IV. **Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>- Review cell cycle</td>
<td>- This is important as cancer is a result of a malfunction in the cell cycle</td>
</tr>
</tbody>
</table>

b. **Body**
<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- pass out note sheets, diagrams</td>
<td>- go through the notes with students. Explain the check-points at G1, G2 phases (the end of them) why they are important for the cell to progress. Some cells don’t need to divide, some may have not replicated all DNA and are not ready for mitosis, and some may not be large enough yet to leave G1. Go over diagram of proper cell cycle. Explain the cancer is unrestricted cell replication. There are no checks because of a genetic mutation. The cell divides uncontrollably. Go over diagram of a cancer cell - Videos are for student’s interest and for a visual understanding. - This allows students to make the topic relevant to their lives and ask questions that are interesting to them.</td>
</tr>
<tr>
<td>- show pictures of cancer and videos on cancer.</td>
<td></td>
</tr>
<tr>
<td>- With remaining time explore: <a href="http://www.macmillan.org.uk/GetInvolved/Schools/Schoolsandyoungpeople.aspx">http://www.macmillan.org.uk/GetInvolved/Schools/Schoolsandyoungpeople.aspx</a></td>
<td></td>
</tr>
<tr>
<td>- Student can also share stories if interested or ask open questions about cancer</td>
<td></td>
</tr>
<tr>
<td>c. Closure</td>
<td></td>
</tr>
<tr>
<td>Steps</td>
<td>Key Questions and ideas</td>
</tr>
<tr>
<td>- CRA</td>
<td>- Homework is to study for tomorrow’s unit CRA</td>
</tr>
<tr>
<td>- Any more questions</td>
<td></td>
</tr>
<tr>
<td>- Homework</td>
<td></td>
</tr>
</tbody>
</table>

V. **Enrichment**: The website and the open question session at the end of class.

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: Were students engaged?

**Assessment**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

**Teacher**______________
80 minute period of Honors Living environments

Unit: Mitosis and cell cycles.

Lesson 6: Review and unit CRA

I. **Objective:** 1) Students will be able to pass a unit CRA based on their knowledge of Mitosis and cell cycles.

II. **Purpose:** The purpose of this lesson is for students to challenge their knowledge by taking a unit CRA on Mitosis and cell cycles.

III. **Criteria:**

1) Students will be able to draw the cell cycle and explain the main phases. 2) Students will be able to explain the four phases of mitosis and the function of mitosis. 3) Students will be able to define the words diploid, haploid, chromosome, chromatin and chromatid.

4) Students will be able to provide at least two real life examples of Mitosis. 5) Students will be able to define the asexual reproduction terms. 6) Students will be able to describe at least three differences between sexual and asexual reproduction. 7) Students will be able to list and describe the various types of vegetative propagation 8) Students will be able to provide at least two pros and cons of sexual and asexual reproduction. 9) Students will be able to describe cancer and how it affects the cell cycle.

IV. **Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
</tbody>
</table>
b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review session for 20 mins</td>
<td>- Split class into 6 groups. Each group has two minutes to write everything they know about the topic on the sheet. Then groups rotate to the next station. At end of 12 minutes all groups should have been through each station and you can go over each page with the students. Topics on sheets: asexual reproduction, Mitosis, Cell cycle, sexual reproduction, vegetative propagation and cancer.</td>
</tr>
<tr>
<td>- Have six stations with each one having a piece of paper with a topic on it.</td>
<td>- Students have until end of class to finish.</td>
</tr>
<tr>
<td>- Pass out unit CRA after final questions from students</td>
<td></td>
</tr>
</tbody>
</table>

c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Collect CRA’s</td>
<td>-</td>
</tr>
</tbody>
</table>

V. **Enrichment**: The review activity with students writing everything they remember about each topic. They can’t repeat things that are already wrote down thus it becomes more difficult to add new things as they continue to circle around the stations until the last one.

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: How did the review go? Did students like it? Where they able to keep coming up with new information to add to the sheets?

**Assessment**: What were the results of the CRA? How many students achieved mastery? How many students passed? What topics need to be re-addressed?

**Meiosis unit**

**Teacher**______________
80 minute period of Honors Living environments

Unit: Meiosis and human development

Lesson 1: Meiosis 1

I. Objective: 1) Students will be able to explain the process of Meiosis 1. 2) Students will be able to describe crossing over, synapses, and gonads.

Standards:

1.1.1b Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.

1.3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

1.3.3 Assess correspondence between the predicted result contained in the hypothesis and actual result, and reach a conclusion as to whether the explanation on which the prediction was based is supported.

4.2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.

4.2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

4.3.1c Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.
4.4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.

4.4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

4.4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.


II. Criteria: 1) Students will be able to list the four stages of Meiosis I and describe each phase. 2) Students will be able to define the vocabulary terms crossing over and synapses.

III. Purpose: The purpose of this lesson is to teach students about Meiosis 1, and the vocabulary that encompasses this process.

IV. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Guided reading of Meiosis. This is to familiarize the students with Meiosis before we begin getting into the details.</td>
<td>- p.323 to 325</td>
</tr>
<tr>
<td>- Review Mitosis briefly</td>
<td>- Handout guided reading sheet</td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Today’s lesson will take students through the first part of Meiosis. There will be notes attached with this lesson already filled in. These will be the student’s notes.</td>
<td>- Key things: Meiosis takes place in the gonads, students may not know everyone has gonads so ask who has them. There are 8 phases. Today is Meiosis I, which include</td>
</tr>
</tbody>
</table>
While passing out notes pass out a sheet with empty Meiosis process. As you go over each stage have students fill in and color/draw the diagram for Meiosis I.

prophase I, metaphase I, anaphase I, and telophase I. Terms for prophase I include tetrad (The pairing of homologous chromosomes forms a structure, called a tetrad, which contains 4 chromatids), crossing over (When the homologous chromosomes are in a tetrad first the chromatids cross over one another. Then, the crossed sections of chromatids exchange alleles or genes producing a new combination of alleles in the cell), and synapsis (the pairing process when the two homologous chromosomes line up next to each other). Crossing over produces new variations of alleles in the cell.

Give students about ten minutes to read through this and fill it out.

-After the notes and drawings, students will fill out the Meiosis and sexual reproduction packet up until Second Meiotic Division.
-Pass out rubric and explain the project for the Meiosis posters.

**c. Closure**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Answer questions about poster</td>
<td>-Allow students to pair up if they want to and get some ideas.</td>
</tr>
<tr>
<td>-CRA</td>
<td>-CRA to test student’s understanding of today’s lesson.</td>
</tr>
<tr>
<td>-HMK: p.329: 1a, 1b, 3a</td>
<td></td>
</tr>
<tr>
<td>Poster project.</td>
<td></td>
</tr>
</tbody>
</table>

**V. Enrichment:** The poster project, the guided reading, the hmk, the drawings

**VI. Evaluation/assessment/reflection** (student learning): REFLECTION: How did this go?

Too many notes for one day? How can you kinesthetically get the students to learn Meiosis?

**Assessment:** HMK, poster project. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?
Teacher________________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 2: Meiosis II

I. **Objective:** 1) Students will be able to describe the process of Meiosis II. 2) Students will be able to define zygote, non-disjunction and disjunction.

**Standards:**

**1.1.1b** Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.

**1.3.1a** Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

**1.3.3** Assess correspondence between the predicted result contained in the hypothesis and actual result, and reach a conclusion as to whether the explanation on which the prediction was based is supported.

**4.2.1c** Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.

**4.2.1e** In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

**4.3.1c** Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.

**4.4.1b** Some organisms reproduce asexually with all the genetic information coming from
one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.

**4.4.1c** The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

**4.4.1d** The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.

**II. Criteria:** 1) Students will be able to list the four phases of Meiosis II, describe each process and describe the end products. 2) Students will be able to define zygote, nondisjunction and disjunction.

**III. Purpose:** The purpose of this lesson is for students to learn about Meiosis two and the rest of the vocabulary words associated with the process.

**IV. Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

<table>
<thead>
<tr>
<th>Steps</th>
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</tr>
</thead>
<tbody>
<tr>
<td>- Go over yesterdays CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>- Review Meiosis I</td>
<td>- just ask the students what happens in meiosis one, quick review.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Continue with note sheet on Meiosis II</td>
<td>Make sure all vocab words are covered: disjunction, crossing over, synapsis, tetrad, zygote. Have student fill in diagram with colored pencils, try to match this on smartboard. Give students 5 minutes or so to complete Mitosis vs Meiosis sheet. Then give students time to complete crossword, and review worksheet, then go over. If</td>
</tr>
<tr>
<td>Continue to have students fill in diagram as we go through the notes. Have cards with each phase of Meiosis on it. Have students arrange themselves in order of the cycle without talking. When finished with Meiosis two compare and contrast Mitosis and Meiosis with worksheet.</td>
<td></td>
</tr>
</tbody>
</table>
-Review with crossword, and this [http://www.cvsd.org/university/classpage/jgriffith/pages/9th%20gold%20items/genetics/Meiosis%20Worksheet%209th.mht](http://www.cvsd.org/university/classpage/jgriffith/pages/9th%20gold%20items/genetics/Meiosis%20Worksheet%209th.mht) 
-If extra time have them work on posters that are due next class 

there is time at end give the students time to work on posters for next class.

### c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
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</tr>
</thead>
<tbody>
<tr>
<td>-CRA</td>
<td>-CRA to measure student’s understanding of this lesson.</td>
</tr>
<tr>
<td>-Wrap-up, review material, answer any questions</td>
<td></td>
</tr>
</tbody>
</table>

V. **Enrichment**: The review, the worksheets, card order activity, crossword.

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: Enough material for the entire class? Too much review? Do students have all vocab?  

**Assessment**: the worksheets, the poster, informal questioning. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher____________________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 3: Human development

I. **Objective**: 1) Students will be able to describe the basic process of human development, the importance of the placenta and fertilization.

**Standards:**
1.3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

4.1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

4.1.2j Receptor molecules play an important role in the interactions between cells. Two primary agents of cellular communication are hormones and chemicals produced by nerve cells. If nerve or hormone signals are blocked, cellular communication is disrupted and the organism’s stability is affected.

4.2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

4.4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

4.4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.

4.4.1e Human reproduction and development are influenced by factors such as gene expression, hormones, and the environment. The reproductive cycle in both males and females is regulated by hormones such as testosterone, estrogen, and progesterone.

4.4.1f The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.
4.4.1h In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its mother’s exposure to environmental factors such as inadequate diet, use of alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy.

II. Criteria: 1) Students will be able to list the steps of human development and describe them through the process of gastrulation 2) Students will be able to define and describe the importance of gastrulation.

III. Purpose: The purpose of this lesson is for students to learn about the beginning of human development aka fertilization, implantation and gastrulation.

IV. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
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</thead>
<tbody>
<tr>
<td>-Go over yesterdays CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>-Intro to human development.</td>
<td>-Have students get out blank sheet of paper and create a</td>
</tr>
<tr>
<td>Students will create a KWL</td>
<td>chart with columns what I know, what I want to know, and</td>
</tr>
<tr>
<td>chart for fertilization and</td>
<td>what I Learned. They will have about 5 minutes or so to</td>
</tr>
<tr>
<td>development.</td>
<td>fill out the first two columns, what I know and what I</td>
</tr>
<tr>
<td>-Create a class chart on the</td>
<td>want to know.</td>
</tr>
<tr>
<td>Smartboard.</td>
<td></td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Students will take notes in</td>
<td>-Notes: I. Fertilization</td>
</tr>
<tr>
<td>notebook</td>
<td>A. Fertilization: The fusion of a sperm and egg cell. The</td>
</tr>
<tr>
<td>While going through</td>
<td>egg is surrounded by a protective layer that contains</td>
</tr>
<tr>
<td>fertilization embed a</td>
<td>binding sites to which sperm can attach. Once the 2 haploid</td>
</tr>
<tr>
<td>video into powerpoint to</td>
<td>nuclei fuse, a single diploid nucleus is formed, the</td>
</tr>
<tr>
<td>show the process</td>
<td>fertilized egg is called a zygote. A developing human at</td>
</tr>
<tr>
<td>at work.</td>
<td>this point is also called an embryo.</td>
</tr>
<tr>
<td>-Something on sextuplets etc.</td>
<td></td>
</tr>
<tr>
<td>FYI for the students.</td>
<td></td>
</tr>
</tbody>
</table>
### Development

#### B. What prevents more than one sperm from fertilizing an egg?
Egg cell contains a series of granules just beneath its outer surface. When a sperm cell enters the egg it releases these granules which coats the outside of the egg and prevents other sperm from attaching.

#### C. Multiple embryos:
- Fraternal twins, if two eggs are released during the same menstrual cycle and each is fertilized.
- Identical twins, is when a zygote splits apart and produces 2 genetically identical embryos.

#### D. Implantation:
The zygote begins to develop right after fertilization. As it grows it becomes a hollow ball known as a blastocyst. After about 6 or 7 days the blastocyst attaches to the wall of uterus and begins to grow into the tissues of the mother. This is called implantation.

### Before the embryo undergoes gastrulation and differentiation

The cells in the embryo are unspecialized or undifferentiated. These types of cells are also called stem cells. Stems are useful in many ways, they are undifferentiated so they can become any type of cell. When placed in a location in the body they develop into that type of cell. How do they know what area they are in? From the chemical signals of the surrounding cells. This is how they know what type of cell to turn into. Thus stem cells can be used to fix damaged skin, brain, nerve, and heart cells, and repair those areas of the body that previously were not repairable.
V. **Enrichment**: The images, videos, worksheets and diagrams

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: Enough material for the entire class? Too much review? Do students have all vocab?

**Assessment**: the worksheets, the poster, informal questioning. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher____________________

80 minute period of Honors Living environments

**Unit**: Meiosis and development

**Lesson 4: Human development**

I. **Objective**: 1) Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation.

**Standards:**

1.3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.
4.1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

4.1.2j Receptor molecules play an important role in the interactions between cells. Two primary agents of cellular communication are hormones and chemicals produced by nerve cells. If nerve or hormone signals are blocked, cellular communication is disrupted and the organism’s stability is affected.

4.2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

4.4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

4.4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.

4.4.1e Human reproduction and development are influenced by factors such as gene expression, hormones, and the environment. The reproductive cycle in both males and females is regulated by hormones such as testosterone, estrogen, and progesterone.

4.4.1f The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.

4.4.1h In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its mother’s exposure to environmental factors such as inadequate diet, use of
alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy.

II. Criteria: 1) Students will be able to define endoderm, mesoderm, ectoderm, fertilization, morula, blastocyst, implantation, neurulation, placenta, fetus and gastrulation. 2) Students will be able to describe the above processes and explain how they are related.

III. Purpose: The purpose of this lesson is for students to learn about the beginning of human development aka fertilization, implantation and gastrulation.

IV. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>-Review yesterday’s lesson</td>
<td>- Today is a continuation of yesterday’s lesson.</td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start day 2</td>
<td>Today’s technology is what helps use isolate stem cells. The controversy lies in taking embryonic stem cells. Some say that doing this kills a child, because after the stem cells are taken from the embryo the embryo can no longer develop. It is also a controversy because adults also have stem cells that can be taken from them without harming them, although they do not have as many they still have them. And once a very are isolated more can be created through mitosis as long as they receive no signals from differentiated cells, they will not differentiate either. A Gastrulation: during gastrulation three cell layers of the embryo are created. Those layers are called the ectoderm, mesoderm, and endoderm. END NOTES HERE</td>
</tr>
<tr>
<td>Video of neurulation.</td>
<td></td>
</tr>
<tr>
<td>FYI: spina bifida, images more info, percentages.</td>
<td></td>
</tr>
</tbody>
</table>
Images, etc…. much as they can, which is not much. Then we go through it as a class.
INFO IN BOOK that should be on sheet:
The ectoderm and endoderm form first, and the mesoderm is produced by a process of cell migration from the ectoderm. The ectoderm develops into the skin and nervous system. Mesoderm cells differentiate and form many of the body’s internal structures. Endoderm forms the linings of organs in the digestive system, respiratory, and excretory system.
OUTSIDE INFO: the ectoderm has three parts the external ectoderm, the neural crest and the neural tube, the latter two are known as neuroectoderm, or the ectoderm in which the nervous system forms from.

Back to notes
B. Neurulation: is the first step in development of the nervous system. Mesodermal tissue differentiates into the notochord. As the notochord develops the ectoderm near the notochord thickens and forms neural folds and the neural crest. The neural folds create the neural tube from which the spinal cord and brain will develop. If the neural tube does not close completely, a defect known as spina bifida can result. Studies show that folic acid (vitamin B9) can prevent most cases of spina bifida.
C. The Placenta: is the connection between the mother and embryo that acts as the embryo’s organ of respiration, nourishment, and excretion. The chronic villi and uterine lining form this organ. The exchange of gases happen at the chronic villi. The umbilical cord, which contains 2 arteries and one vein, connects the embryo to the placenta.
- GO over the sheet, should not take long.

What they don’t finish is for homework. They need rulers and maybe calculators.

Human development sheet. Students read and complete sheet
Students pair up and start Human Fetal Growth, what ever they don’t finish is for homework
c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- CRA</td>
<td>- CRA to measure student’s understanding of this lesson.</td>
</tr>
<tr>
<td>- Wrap-up, review material, answer any questions</td>
<td></td>
</tr>
</tbody>
</table>

V. Enrichment: The images, book readings, videos and review sheet at the end of lesson.


Assessment: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher______________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 5: Mammal development

I. Objective: 1) Students will be able to explain the differences between internal and external fertilization. 2) Students will be able to describe the development of monotremes, marsupials, birds and mammals other than humans.

Standards:

4.2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.

4.2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually
produced offspring often resemble, but are not identical to, either of their parents.

**4.3.1c** Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.

**4.4.1b** Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.

**4.4.1c** The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

**4.4.1f** The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.

**4.6.2a** As a result of evolutionary processes, there is a diversity of organisms and roles in ecosystems. This diversity of species increases the chance that at least some will survive in the face of large environmental changes. Biodiversity increases the stability of the ecosystem.


II. **Criteria:** 1) Students will be able to least at least two differences and similarities between internal and external fertilization 2) Students will be able to describe two developmental features of: monotremes, marsupials, birds and mammals

III. **Purpose:** The purpose of this lesson is for students to learn about internal and external fertilization and development along with the various way mammals fertilize and develop.

IV. **Procedures** (anticipatory set, body, closure)
Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

### a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>- Guided reading accompanied with a wksht.</td>
<td>- p. 821- 826. Students can work in pairs for this activity.</td>
</tr>
<tr>
<td>Go over it.</td>
<td></td>
</tr>
</tbody>
</table>

### b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Notes of external, internal fertilization</td>
<td>III. Mammal development.</td>
</tr>
<tr>
<td>and development, use a lot of PICTURES</td>
<td>A. Internal fertilization: Eggs are fertilized inside the</td>
</tr>
<tr>
<td></td>
<td>body of the egg producing individual. In sponges the sperm</td>
</tr>
<tr>
<td></td>
<td>are released into the water, and the female takes in the</td>
</tr>
<tr>
<td></td>
<td>sperm to fertilize the egg. Arthropods undergo internal</td>
</tr>
<tr>
<td></td>
<td>fertilization by mating. In most chordates males have</td>
</tr>
<tr>
<td></td>
<td>external sexual organ that deposits sperm inside the female</td>
</tr>
<tr>
<td></td>
<td>during mating. (PICTURES of each)</td>
</tr>
<tr>
<td>- External versus internal development</td>
<td>B. External fertilization: Eggs are fertilized outside the</td>
</tr>
<tr>
<td></td>
<td>body of the egg-producing individual. Corals, worms, and</td>
</tr>
<tr>
<td></td>
<td>mollusks release large numbers of eggs and sperm into the</td>
</tr>
<tr>
<td></td>
<td>water and hope for them to fertilize. To increase the likely</td>
</tr>
<tr>
<td></td>
<td>hood of this they synchronize the release of their gametes</td>
</tr>
<tr>
<td></td>
<td>with tides, phases of the moon, of seasons. Some fish who</td>
</tr>
<tr>
<td></td>
<td>swim in schools will release the eggs and sperm in the school</td>
</tr>
<tr>
<td></td>
<td>so they fertilize. FYI, PICTURES</td>
</tr>
<tr>
<td></td>
<td>C. Internal development- the embryos develop within the</td>
</tr>
<tr>
<td></td>
<td>mother. The embryo receives its nutrients from the mother.</td>
</tr>
<tr>
<td></td>
<td>PICTURES, EXAMPLES</td>
</tr>
<tr>
<td></td>
<td>D. External development- the embryo develops outside the</td>
</tr>
<tr>
<td></td>
<td>mother. The embryo develops in an egg and depends entirely</td>
</tr>
<tr>
<td></td>
<td>on the yolk sac for food until it is fully developed and</td>
</tr>
<tr>
<td></td>
<td>hatches.</td>
</tr>
<tr>
<td>Review sheet (fertilization and development of animals)</td>
<td>-Have students complete ALONE, should</td>
</tr>
</tbody>
</table>
-Monotremes, marsupials, and placental mammals

-Internal structure of the chicken egg. not take very long, then go over it. -NYS likes to test this A LOT. Pass out diagram and fill it out with the students. E. Monotremes- combined mammalian and reptilian traits. Like reptilians they lay eggs that hatch in about ten days. But like mammals the young monotremes are nourished by milk from the mother’s mammary glands. PICTURES, EXAMPLES

F. Marsupials: Bear live young at a very early stage and then they finish development in the mothers pouch. The pouch is called the marsupium, the young spend months there feeding of the mothers nipple until they are fully developed and can survive on their own. EXAMPLES, PICTURES.

E. Placentals: young develop inside the mother attached to a placenta which provides nourishment and removes wastes. Allows young to develop inside the mother for a long time and be born at a fairly advanced stage of development.

Quick review sheet on mammal development. -Students do this alone, should not take long. Then go over.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRA review, any questions about the test</td>
<td>- CRA to measure student’s knowledge of today’s lesson.</td>
</tr>
<tr>
<td>Review sheet for them (COUNTS as instructional project)</td>
<td></td>
</tr>
</tbody>
</table>

V. **Enrichment**: the wrkshts, guided reading, images, and videos.

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: Could you fit all of this into one lesson? How did the students do with the material? Are they getting it or was a lot of review question asked?
Assessment: informal questioning, observations of how well they do on wrkshts, and the exam next class. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher_______________________

80 minute period of Honors Living environments

Unit: Meiosis and development

Lesson 6: Unit CRA

I. Objective: 1) Students will be able to apply their knowledge gained in previous lessons in an attempt to pass this exam.

Standards can be found in the previous lesson as there would be about 3 pages worth of them I did not place them in this lesson.

II. Criteria:
• Knowledge of the stages, functions and processes of Meiosis I
• Understanding of the vocabulary terms crossing over and synapses.
• Knowledge of Meiosis II
• Understanding of vocabulary terms: zygote, non-disjunction and disjunction
• Knowledge of human development
• Understanding of the importance of gastrulation.
• Knowledge of human development vocabulary
- Understanding of the differences between internal and external fertilization
- Knowledge of development other than humans including: monotremes, marsupials, birds and mammals

III. **Purpose**: The purpose of this lesson is to test the students knowledge and understanding of the material that they have learned in previous lessons.

IV. **Procedures** (anticipatory set, body, closure)

**Materials**: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review yesterday’s CRA</td>
<td>- Use general feedback guide and feedback guide after CRA</td>
</tr>
</tbody>
</table>

b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Review with students for 20 minutes using around the world</td>
<td>- Ask a question have students answer. Two students go against each other first to raise hand answers, if they answer correct they move on going around the world.</td>
</tr>
<tr>
<td>- pass out CRA</td>
<td></td>
</tr>
<tr>
<td>- students take exam should only take about half of the block.</td>
<td></td>
</tr>
</tbody>
</table>

c. **Closure**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Collect CRA</td>
<td>-</td>
</tr>
</tbody>
</table>

V. **Enrichment**: the exam, the review session

VI. **Evaluation/assessment/reflection** (student learning): REFLECTION: was it fair? How did students do?
Assessment: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

DNA/RNA unit

Teacher_________________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 1 : History of DNA

Objective: 1) Students will also be able to describe the basic history behind DNA and the field of genetics.

Criteria: 1) Students will be able to describe at least three experiments that lead to the discovery of the structure of DNA.

Standards: There are a lot of standards so I am simply putting in the numbers and a link to find them, it would take up to much space to write them all out.

1.1.1a, 1.1.1b, 1.1.2a, 1.1.3a, 1.1.4a, 1.2.2a, 1.2.3a, 1.2.4, 1.3.1a, 1.3.3, 1.3.4a, 1.3.5a, 1.3.5b, 4.1.2i, 4.2.1b, 4.2.1c, 4.2.1f, 4.2.1g, 4.2.1h, 4.2.1i, 4.5.1f, 4.5.2b


I. Purpose: The purpose of this lesson is for students to learn about bird egg development in a NYS required lab. Students will also learn about the basic history of DNA and genetics.
II. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduce topic</td>
<td>-Videos graphics</td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-History of DNA, use a guided reading sheet to get them started, just for the Griffith experiment, then give them the rest of the information</td>
<td>-T.H. Morgan discovered that genes are located somewhere on the chromosomes. The rest of the information is on the notesheet attached and the guided reading sheet. Cover in detail Griffith, and Avery, Macleod, McCarty, and Hershey, Chase, and Watson, Crick, Rosalina Franklin, and Chargaff</td>
</tr>
<tr>
<td>-ANY movies on this…</td>
<td><a href="http://nortonbooks.com/college/biology/animations/ch12a01.htm">http://nortonbooks.com/college/biology/animations/ch12a01.htm</a></td>
</tr>
<tr>
<td>-DVD of Bill Nye about Hershey and Chase and Watson and Crick.</td>
<td>-Use videos, clips, animations here to make this more interesting.</td>
</tr>
<tr>
<td>-Get through as much as you can in day 1 Then day two start with Chicks lab again part two of it, then continue with history of DNA.</td>
<td></td>
</tr>
</tbody>
</table>

c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review sheet for history of DNA -CRA</td>
<td>-CRA to gauge student understanding.</td>
</tr>
</tbody>
</table>

III. Enrichment: CRA, videos, animations

IV. Evaluation/assessment/reflection (student learning): REFLECTION: How did the chicks lab go? Even split into two parts was it too boring? With the history of DNA were the videos helpful in engaging the students and keeping the interested?
Assessment: the review at the end of day 2, and informal questioning throughout the lessons. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher______________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 2: Nucleic acids, DNA and RNA

Objective: 1) Students will be able to draw the structure of DNA. 2) Students will be able to describe the basic structure of DNA and RNA.

Standards:

1.1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.

1.1.1b Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.

1.1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.

1.1.3a Scientific explanations are accepted when they are consistent with experimental and observational evidence and when they lead to accurate predictions.

1.1.3b All scientific explanations are tentative and subject to change or improvement.

Each new bit of evidence can create more questions than it answers. This leads to increasingly better understanding of how things work in the living world.
1.1.4a Well-accepted theories are ones that are supported by different kinds of scientific investigations often involving the contributions of individuals from different disciplines.

1.2.2a Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.

1.3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

1.3.3 Assess correspondence between the predicted result contained in the hypothesis and actual result, and reach a conclusion as to whether the explanation on which the prediction was based is supported.

1.3.5b Scientists use peer review to evaluate the results of scientific investigations and the explanations proposed by other scientists. They analyze the experimental procedures, examine the evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations for the same observations.

4.2.1f In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular ÒbasesÓ) and replicated by means of a template.

I. **Purpose:** The purpose of this lesson is to familiarize the students with the structure and importance of DNA and RNA.
II. **Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review Yesterday’s CRA</td>
<td>-Use general feedback guide and feedback guide after CRA</td>
</tr>
<tr>
<td>-Review game with the smartboard</td>
<td>-Create a chart with the scientists name, the discovery and the dates, have some of them filled in and have students fill in the rest of them.</td>
</tr>
</tbody>
</table>

b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Begin with the structure of DNA</td>
<td>-Watson and Crick and credited for this, but a lot of their information and ideas were stolen from Rosalina Franklin.</td>
</tr>
<tr>
<td>-What makes up DNA, what discoveries help lead to solving the structure this should be a review. The double helix model, antiparallel strands, hydrogen bonding, and base pairing.</td>
<td>-Components of DNA, Nucleic acids and nucleotides, Nitrogenous bases and covalent bonds (Phosphate group, Deoxyribose sugar, base (4 types)).</td>
</tr>
<tr>
<td>-Base pairing make sure to talk about how adenine only bonds with thymine, and cytosine with Guanine.</td>
<td>-Solving the structure= Chargaff’s rule of the bases, Franklin’s X-rays, Watson and Crick.</td>
</tr>
<tr>
<td>-Have worksheets for the students to color in to help with understanding.</td>
<td>-The Double-Helix model= explains Chargaff’s rule and how the 2 strands of DNA are held together. Antiparallel strands. The strands run in opposite directions which enables the bases on both strands to come into contact at the center of the molecule. Hydrogen bonding are the forces that hold the two strands together, the bonds form between certain bases. However hydrogen bonds are relatively weak. Base pairing, the bonds only occur between certain bases A-T, C-G. This also explain Chargaff’s rule.</td>
</tr>
</tbody>
</table>

Build your own DNA double helix model. Create a worksheet for students to fill in as they build the model. What do the gummies represent? What about the toothpicks, and the twislers? What color gummy represents what base pair, what bases pair with what?
c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-wrap up and review</td>
<td></td>
</tr>
<tr>
<td>CRA</td>
<td><a href="http://www2.edc.org/weblabs/HowDoesDNAWork/DNA.html">http://www2.edc.org/weblabs/HowDoesDNAWork/DNA.html</a></td>
</tr>
<tr>
<td></td>
<td>- use CRA to measure student knowledge of today’s lesson</td>
</tr>
</tbody>
</table>

III. **Enrichment**: the model activities, and worksheets, and animations

IV. **Evaluation/assessment/reflection** (student learning): REFLECTION: **Assessment**: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher_______________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 3: DNA replication

**Objective**: 1) Students will be able to describe the process of DNA replication. 2) Students will also be able to explain the function of each enzyme that is involved in DNA replication.

**Criteria**: 1) Students will be able to describe all steps of the DNA replication process using the key vocabulary. 2) Students will be able to define the function of each enzyme in the DNA replication process and describe where it falls in the process.
Standards: 1.2.4, 1.3.5b, 4.1.2j, 4.2.1c, 4.2.1f, 4.2.1h, 4.5.1f

I. Purpose: The purpose of this lesson is for students to learn about the process of DNA and of the enzymes that help out with this process.

II. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
</table>
-Introductory video or activity into DNA replication. | -Use general feedback guide, scoring matrices, and lesson two feedback guide.  
-The link to the left is a worksheet for review, something to start off with. http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120076/micro04.swf::DNA%20Replication%20F ork (this one is good to start with, maybe with no volume) |

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
</table>
| -DNA replication, what role does DNA polymerase play, what other enzymes help out, what are telomeres, prokaryotic, versus eukaryotic DNA replication  
-Base pairing activity. Give students one side of the DNA and they have to write the opposite side of it.  
Animations of this, worksheets, videos. Maybe a graded worksheet to check for understanding. | -Each strand of the double helix therefore has all the information needed to reconstruct the other half by the mechanism of base pairing. Before the cell divides it replicates its DNA. Happens is S phase. During replication the DNA molecule splits into two strands and then produces two new complementary strands following the rules of base pairing.  
-replication is carried out by a series of enzymes.1) the enzymes unzip the DNA by breaking the hydrogen bonds. The main enzyme involved is DNA polymerase. This enzyme joins individual nucleotides to
Telomerase

- Prokaryotic DNA replication (images, animations)
- Eukaryotic DNA replication (images, animations)

produce a new strand of DNA. It also “proofreads” each new DNA strand.

- At the tips of chromosomes are known as telomeres. This part of DNA is very hard to replicate. Cells use a special enzyme called telomerase, to solve this problem by adding short repeated DNA sequences. Telomerase helps to prevent genes from being damaged or lost in replication in fast dividing cells.

- Replication in most prokaryotic cells starts from a single point and proceeds in two directions until the entire chromosome is copied.

- In eukaryotic cells, replication may begin at dozens or even hundreds of places on the DNA molecule, proceeding in both directions until each chromosome is completely copied.

### c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRA</td>
<td>- Use CRA to measure student understanding of lesson.</td>
</tr>
</tbody>
</table>

### III. Enrichment: The animations, worksheets and models.

### IV. Evaluation/assessment/reflection (student learning): REFLECTION: Did you rush through this information? Or were you able to slow down and use the materials effective to help with understanding?

### Assessment: Informal questioning, and homework. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

**Teacher________________**

80 minute period of Honors Living environments
Unit: DNA/RNA

Lesson 4: Lab on DNA replication

**Objective:** 1) Students will be able to construct double helix models of DNA and demonstrate their knowledge of DNA replication by showing this model undergoing replication.

**Criteria:** 1) Students will be able to label structures of DNA and label diagrams of DNA replication. 2) Students will be able to fill out a complementary strand of DNA from the original strand.

I. **Purpose:** The purpose of this lesson if for students to get an experience with three dimensional models. Also students will get to visualize the double helix model of DNA and watch it undergo replication in front of them.

II. **Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRA</td>
<td>-Use general CRA feedback manual and scoring matrices along</td>
</tr>
<tr>
<td>-pass out labs and give</td>
<td>with the feedback suggestions listed after CRA three</td>
</tr>
<tr>
<td>instructions</td>
<td></td>
</tr>
</tbody>
</table>

b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-let students complete the</td>
<td></td>
</tr>
<tr>
<td>-If there is time left after</td>
<td></td>
</tr>
<tr>
<td>the lab is complete, find</td>
<td></td>
</tr>
<tr>
<td>another activity that relates</td>
<td></td>
</tr>
<tr>
<td>to this topic or begin lesson</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
</tbody>
</table>

  c. **Closure**
### Steps
- Collect labs, review what they saw.
- CRA

### Key Questions and Ideas
- Use CRA to measure students understanding of today’s lesson

### III. Enrichment: the hands-on three dimensional lab

### IV. Evaluation/assessment/reflection (student learning): REFLECTION: How long did it take? Was the activity a good fit to go with the lab? Did the students understand what and why they were doing this lab?

### Assessment: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

### Teacher

#### 80 minute period of Honors Living environments

**Unit:** DNA

**Lesson 5: RNA**

**Objective:** 1) Students will be able to describe the different types of RNA and their functions. 2) Students will be able to explain the process of RNA editing

**Criteria:** 1) Students will be able to list at least three types of RNA and describe their functions. 2) Students will be able to explain the steps of RNA editing and explain two reasons as to why this is important.

**Standards:** 4.2.1f, 4.2.1g, 4.2.1j, 4.5.1c, 4.5.1f, 4.5.1g
I. **Purpose**: The purpose of this lesson is for students to learn about the different types of RNA and about the process of RNA editing.

II. **Procedures** (anticipatory set, body, closure)

**Materials**: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRA</td>
<td>-Use general CRA feedback guide and scoring matrices as well as feedback guide provided after CRA 4.</td>
</tr>
<tr>
<td>-Comparing and contrasting RNA and DNA</td>
<td>- Make a chart of this. 3 important differences 1) the sugars are different 2) RNA is generally single-stranded and not double 3) RNA has uracil instead of Thymine.</td>
</tr>
</tbody>
</table>

b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Functions of RNA, Types of RNA editing, and lead into transcription.</td>
<td>- Functions of RNA include carrying information from the DNA to the protein. THERE are three types RNA mRNA, tRNA and rRNA. Each has a certain job it completes. The mRNA is the messenger and carries the code from the DNA to the Ribosome. To get certain genes from the DNA and to get the corrected DNA the RNA undergoes editing where the introns are kept and the exons are cut out. The tRNA carries the specific amino acid for the codon on the mRNA and enters into the ribosome. When the mRNA goes through the ribosome it is “read” and the tRNA puts the correct amino acids onto the protein chain, but more about this during translation. The ribosomes are made up of 2 rRNA molecules and up to 80 molecules of proteins.</td>
</tr>
<tr>
<td>Images, animations of editing.</td>
<td></td>
</tr>
<tr>
<td>Transcription is the process of DNA information being copied onto the RNA usually the mRNA.</td>
<td></td>
</tr>
<tr>
<td>Activities for RNA structure, then lead into Transcription.</td>
<td></td>
</tr>
</tbody>
</table>
c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- CRA</td>
<td>- Use CRA to measure students understanding</td>
</tr>
<tr>
<td>- If you get to transcription use the RNA section 10-2 review sheet for the last few minutes of class. Whatever they don’t finish they will finish at the beginning of next class.</td>
<td>of lesson</td>
</tr>
</tbody>
</table>

III. **Enrichment**: Pictures, worksheets, and diagrams

IV. **Evaluation/assessment/reflection** (student learning): REFLECTION: How did the students take in this material? Was the RNA types a fairly easy concept for them? How much time was left over for transcription?

**Assessment**: The worksheets, some will be collected and graded, the homework, and as always informal questioning. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 6: Transcription

**Objective**: 1) Students will be able to describe the process of transcription. 2) Students will be able to explain the process of RNA editing and promoters.
Criteria: 1) Students will be able to explain each step of the transcription and list the enzymes used. 2) Students will be able to list a least one promoter and define what a promoter is.

I. Purpose: The purpose of this lesson is for students to learn about the process of transcription, RNA editing, and promoters.

II. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterdays CRA</td>
<td>-Use CRA general feedback guide and scoring matrices and feedback suggestions provided in after CRA 5.</td>
</tr>
<tr>
<td>-This topic may have already been started in the last class.</td>
<td>-Have them try to explain the process of what is going on, not using exact terms but general words such as enzymes look like they are copying the molecule.</td>
</tr>
<tr>
<td>-a video of transcription without words for the students to guess what is going on</td>
<td></td>
</tr>
</tbody>
</table>

b. Body

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>The process of transcription</td>
<td>Transcription is where RNA is made or synthesized. Segments of DNA serve as templates to produce complementary RNA molecules.</td>
</tr>
<tr>
<td></td>
<td>-Prokaryotes=RNA synthesis and protein synthesis take place in the cytoplasm. In Eukaryotes the RNA is created in the nucleus and the proteins are synthesized in the cytoplasm.</td>
</tr>
<tr>
<td></td>
<td>-an important role in the process of transcription is RNA polymerase, which is similar to DNA polymerase. It binds to the DNA molecule and separates it into two strands. Then it uses one of the strands as a template from which it assembles nucleotides into a complementary strand of RNA.</td>
</tr>
<tr>
<td>-model representations of this, worksheet activities with colors, animations, anything that will help with the abstraction of this concept.</td>
<td></td>
</tr>
</tbody>
</table>
NOTE: RNA does not have thymine so it is uracil that is complementary to the adenine. The ability to copy a single DNA sequence makes it possible for a single gene to produce hundreds to thousands of RNA molecules. (3 types mRNA, tRNA, rRNA) HOW ARE EACH type are made from the DNA.

- Promoters - The enzyme only binds to certain promoters, regions of NA that have specific base sequences. Similar sequences in the DNA cause transcription to stop.

Promoters

From here either move into the genetic code, how the four bases in a certain order are coded for an amino acid. They are read in sequences of 3 base pairs, this is needed before you start translation.

More on the genetic code is found in lesson 8

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- CRA</td>
<td>- Use CRA to measure student knowledge of lesson.</td>
</tr>
<tr>
<td>- To review transcription use the model kits</td>
<td>- this review could go along with the lab activity, or just be something extra.</td>
</tr>
<tr>
<td>and have the kids make models and have them</td>
<td></td>
</tr>
<tr>
<td>race</td>
<td></td>
</tr>
</tbody>
</table>

### c. Closure

**Steps**

- CRA
  - To review transcription use the model kits and have the kids make models and have them race

**Key Questions and ideas**

- Use CRA to measure student knowledge of lesson.
- this review could go along with the lab activity, or just be something extra.

### III. Enrichment: The models, animations and worksheets used to help with the concept.

### IV. Evaluation/assessment/reflection (student learning): REFLECTION:

Did the activities flow? Did you break up the notes and worksheets in a way that made sense? Were the animations and models helpful?

**Assessment:** Informal questioning of the students, the upcoming exam, and the homework. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students
responding to questions during the lesson? How well did they perform on the CRA?

What further instruction is needed if any?

Teacher_______________

80 minute period of Honors Living environments

Unit: DNA

Lesson 8: The genetic code and translation

Objective: 1) Students will be able to explain the genetic code, and how it used. 2)

Students will be able to describe the process of translation.

Criteria: 1) Students will be able to use the genetic code and match mRNA sequences to amino acid sequences. 2) Students will be able to list enzymes and components of translation and describe the process step by step.

Standards: 1.2.3b, 4.1.2i, 4.2.1f, 4.2.1g, 4.2.1i, 4.2.1j, 4.5.1g

I. Purpose: The purpose of this lesson is for students to learn about the genetic code, how it is used, and how mRNA is used to create proteins in the process of translation.

II. Procedures (anticipatory set, body, closure)

Materials: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. Anticipatory set

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRA -If you started to genetic code last class pick up with that, if not introduce it and begin from there.</td>
<td>-Use general feedback guide and scoring matrices along with feedback directly after CRA 6 -There is a lot that has to be done in this lesson and hopefully some of it could have been started the day before. If not do not try and rush the material, make sure the</td>
</tr>
</tbody>
</table>
### b. Body

<table>
<thead>
<tr>
<th><strong>Steps</strong></th>
<th><strong>Key Questions and ideas</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>-The genetic code.</td>
<td>-Proteins are made by joining amino acids together into long chains called polypeptides. As many as 20 different amino acids can be found in polypeptides. The order in which the amino acids are found determine the properties of the protein, which in turn determines the function of the protein. The four base pairs A, C, G, T create a language which codes for the type of amino acid. The genetic code is read three “letters” at a time, so that each “word” is three bases long and corresponds to a single amino acid. Show both the square chart and circle chart on how to read the genetic code and find out what amino acids go to which sequences of bases. Start, stop codons= sequences of bases that tell where protein synthesis should begin and end.</td>
</tr>
<tr>
<td>Discuss what it is and how it is used.</td>
<td></td>
</tr>
<tr>
<td>What are codons</td>
<td></td>
</tr>
<tr>
<td>How to read the genetic code</td>
<td></td>
</tr>
<tr>
<td>Worksheets were they have to convert an mRNA strand into an amino acid sequence.</td>
<td></td>
</tr>
<tr>
<td>Translation</td>
<td>-Ribosomes use the sequences of codons in mRNA to assemble amino acids into polypeptide chains. The decoding of an mRNA message into a protein is a process known as translation. A. Translation begins when a ribosome attaches to a mRNA molecule in the cytoplasm an finds the AUG start codon. Each tRNA has an anticodon whose bases are complementary to the bases of a codon on the mRNA strand. B. The polypeptide “Assembly line”. The ribosome joins the two amino acids, the start one (methionine) and the next amino acid. It breaks the bond between the methionine and its tRNA. The tRNA floats away from the ribosome allowing another tRNA to attach. The ribosome moves along the mRNA from right to left binding new tRNA molecules and amino acids creating</td>
</tr>
<tr>
<td>3 parts to translation, use links for animations, and attached worksheets as you move through the steps</td>
<td></td>
</tr>
<tr>
<td>This may take a while to get through, use many worksheets and animations and check for understanding as much as possible.</td>
<td></td>
</tr>
</tbody>
</table>
The roles of tRNA and rRNA

a long polypeptide chain. C. The process continues until a stop codon is reached. When the polypeptide is complete, it and the mRNA are released from the ribosome. The tRNA molecules deliver exactly the right amino acid called for by each codon on the mRNA. They act as adapters that enable the ribosome to “read” the mRNA’s message accurately. Ribosomes themselves are made of about 80% proteins and 3 or 4 different rRNA molecules. These rRNA molecules help hold ribosomal proteins in place and help locate the beginning of the mRNA message.

c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-CRA</td>
<td>-Use CRA to measure students knowledge of lesson</td>
</tr>
<tr>
<td>-Review everything</td>
<td>-use a worksheet that reviews the whole process from DNA to protein, including DNA replication and RNA editing.</td>
</tr>
</tbody>
</table>

III. Enrichment:

IV. Evaluation/assessment/reflection (student learning): REFLECTION: Assessment: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA?

What further instruction is needed if any?

Teacher_________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 8: mutation of DNA
**Objective:** 1) Students will be able to describe what a mutation is and how they happen. 2) Students will be able to explain the effects mutations have on genes.

**Criteria:** 1) Students will be able to define the three types of point mutations. 2) Students will be able to explain at least two effects that mutations have.

**Standards:** 1.2.1, 4.2.1h, 4.2.2d, 4.3.1b, 4.3.1c, 4.3.1d, 4.3.1g

I. **Purpose:** The purpose of this lesson is for students to learn about mutations, what they are and how they effect genes.

II. **Procedures** (anticipatory set, body, closure)

**Materials:** various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

   a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review yesterday’s CRA</td>
<td>-Use general feedback guide and scoring matrices with the feedback provide directly after CRA 7.</td>
</tr>
<tr>
<td>Introductory video clip about mutations</td>
<td></td>
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</tbody>
</table>

   b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of mutations</td>
<td>Mutations are heritable changes in genetic information.</td>
</tr>
<tr>
<td>Have a worksheet for them to identify</td>
<td>Types of mutations: point mutations are mutations that involve change in one or a few nucleotides because they occur at a single point in the DNA sequence. 3 types of point mutations, Substitutions, Insertions, and Deletions.</td>
</tr>
<tr>
<td>different types of mutations</td>
<td>-A substitution mutation is where one base is changed to a different base. These mutations usually affect no more than a single amino acid, and sometimes have no effect at all. Generally a change in the first base of the codon has more affect than the</td>
</tr>
</tbody>
</table>
third base. EX. CCC to CCA still proline, but CCC to ACC changes proline to threonine.
-Insertions

c. Closure

<table>
<thead>
<tr>
<th>Steps</th>
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</tr>
</thead>
<tbody>
<tr>
<td>-CRA</td>
<td>-Use CRA to measure student knowledge of lesson.</td>
</tr>
</tbody>
</table>

III. Enrichment:

IV. Evaluation/assessment/reflection (student learning): REFLECTION: Assessment: The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?

Teacher________________

80 minute period of Honors Living environments

Unit: DNA/RNA

Lesson 10: lab, review, unit CRA

Objective: 1) Students will be able to complete a DNA extraction lab. 2) Students will be able to complete unit CRA

Criteria: 1) Students will complete DNA extraction lab. 2) Students will be able to describe at least three experiments that lead to the discovery of the structure of DNA. 3) Students will be able to draw and label the three main components of DNA. 4) Students will be able to list two differences and two similarities between DNA and RNA. 5)
Students will be able to describe all steps of the DNA replication process using the key vocabulary. 6) Students will be able to define the function of each enzyme in the DNA replication process and describe where it falls in the process. 7) Students will be able to label structures of DNA and label diagrams of DNA replication. 8) Students will be able to fill out a complementary strand of DNA from the original strand. 9) Students will be able to list at least three types of RNA and describe their functions. 10) Students will be able to explain the steps of RNA editing and explain two reasons as to why this is important. 11) Students will be able to explain each step of the transcription and list the enzymes used. 12) Students will be able to list a least one promoter and define what a promoter is. 13) Students will be able to use the genetic code and match mRNA sequences to amino acid sequences. 14) Students will be able to list enzymes and components of translation and describe the process step by step. 15) Students will be able to define the three types of point mutations. 16) Students will be able to explain at least two effects that mutations have.

I. **Purpose**: The purpose of this lab is for students to finish learning about translation, then review replication and transcription. Students will also complete a DNA extraction lab.

II. **Procedures** (anticipatory set, body, closure)

**Materials**: various worksheets and PowerPoint, worksheets will be provided and attached to this lesson plan.

a. **Anticipatory set**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Review yesterday’s CRA</td>
<td>-Use general feedback guide and scoring matrices and feedback provided directly after CRA 8.</td>
</tr>
<tr>
<td>-students will work on a From genes to</td>
<td>-Remind students to pick up the worksheet as they come in, and to check the board for what is planned for the day.</td>
</tr>
<tr>
<td>proteins worksheet (1st page only) while</td>
<td></td>
</tr>
<tr>
<td>homework is collected.</td>
<td></td>
</tr>
</tbody>
</table>
b. **Body**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>If limited time just jump straight into the lab. Lab takes about 30 minutes so leave time for this. Students can ask review questions for the unit CRA while they work on the lab. Leave about 30-40 minutes for unit CRA</td>
<td>-The DNA extraction lab manual will be attached to this lesson, Materials needed are strawberries, DNA spoolers, are the key supplies, other supplies listed on the lab</td>
</tr>
</tbody>
</table>


c. **Closure**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Key Questions and ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Collect unit CRA</td>
<td>-</td>
</tr>
</tbody>
</table>

III. **Enrichment**: Diagrams of the process of translation, The comic version of Translation, and the DNA extraction lab

IV. **Evaluation/assessment/reflection** (student learning): REFLECTION: Timing, how was it? Does translation need more time spent on it? How did the lab go?

**Assessment**: The exam next week, informal questioning of the students, the worksheets. The CRA’s given to students at the end of the class help to gauge the level of student understanding of the current criteria based on the lesson objectives. Are students responding to questions during the lesson? How well did they perform on the CRA? What further instruction is needed if any?