

SCIENCE PRACTICE QUESTIONS

1. Many systems in the living and physical worlds have mechanism that use feedback to help maintain equilibrium- that is, help to keep the overall conditions of the system relatively constant over time. Which of the following processes is the best example of a mechanism that uses feedback to maintain equilibrium in the human body system?

- A. the increase in breathing rate while exercising
- B. the direction of temperature by a finger touching a cool surface.
- C. The continual growth of hair and nails
- D. The loss of blood at the site of a cut.

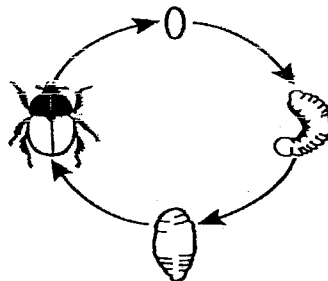
2. Read the passage below; then answer the question that follows.

Scientific and technological advances have led to the development of computer technology that is smaller, faster, and more versatile with each new innovation. Huge amounts of information are accessible at all times. Instant communication via e-mail, voice, video, and text messaging is possible all over the world. Virtual friends exchange information continuously at social networking sites. At the same time, many believe that this technology has contributed to information overload, increased social isolation, reduced attention span, and declining social skills for many individuals.

The passage above best illustrates that technological innovations often:

- A. require that certain social and economic conditions be present before they are accepted.
- B. are made possible by breakthroughs in one or more areas.
- C. have unforeseen consequences that offset some of their advantages.
- D. are gradually accepted by all segments of society.

The illustration below shows the life cycle of a beetle. The life cycle of a grasshopper, which undergoes gradual metamorphosis, differs from the life cycle of a beetle in that the young grasshoppers:



- C. Cells replicate through a process of cell division and can only be small due to physical limitations.
 - D. Organisms grow through an increase in the number of cells and all cells are bounded by individual cell walls.
6. Which of the following common diseases or disorders is caused by the dysfunction of the pancreas?
- A. diabetes
 - B. cancer
 - C. arteriosclerosis
 - D. hypertension
7. Cellular respiration is most directly associated with which of the following life processes?
- A. the release of energy from the breakdown of food
 - B. the transfer of genetic information during cell division
 - C. the growth of new tissue as the body responds to injury
 - D. the regulation of feedback mechanisms of the nervous system
8. The erosion of limestone would have the greatest effect on which of the following biogeochemical cycles?
- A. The carbon cycle
 - B. The water cycle
 - C. The nitrogen cycle
 - D. The oxygen cycle
9. Which of the following is the primary function of chlorophyll in green plants?
- A. protection from insect pests
 - B. regulation of nutrient uptake

help the students recognize the characteristics of scientific inquiry that distinguish it from other ways of learning, it is most important that the students:

- A. describe exactly what they do during each of the soil tests.
- B. be encouraged to guess what the outcome will be before conducting the experiment.
- C. use the same procedures to conduct each of the soil tests.
- D. are first told what kinds of results to expect when the experiment is done properly.

Read the passage below; then answer the two questions that follow.

A second-grade teacher has decided to have students monitor the weather throughout the school year as part of their study of the environment around their school.

14. The teacher wants to ensure that the activity promotes the use of appropriate scientific practices. In order to achieve this goal, it is important that the teacher encourage students to:
- A. record data from many different locations.
 - B. collect data in a systematic manner at a regular time each day.
 - C. use the data to demonstrate the importance of math in science.
 - D. understand the technology used to collect and record the data.
15. Which of the following weather measurements is most helpful in making predictions about weather changes in the next 24 to 48 hours?
- A. atmospheric pressure
 - B. wind speed
 - C. temperature
 - D. rainfall amount
16. For a new scientific theory to become generally accepted in the scientific community, the theory must be:
- A. representable using a physical model.

of the following best describes the central theme of the hypothesis put forward by Copernicus?

- A. The pathway of the moon as it orbits the earth is elliptical.
- B. The solar system is one of many planetary systems in the universe.
- C. The planets of the solar system orbit the sun.
- D. The blocking of sunlight by the moon causes solar eclipses.

20. Which of the following provides the best example of how technology supports the development of new scientific knowledge?

- A. An engineer finds flaws in a computer chip using a microscope.
- B. A biologist identifies the cause of a disease using genetic engineering.
- C. A geologist uses aerial photographs to map the extent of a landslide.
- D. A doctor uses a laser to conduct eye surgery.

OPEN-RESPONSE ITEM ASSIGNMENT #1

Use the information below to complete the exercise that follows.

An important learning standard for kindergarten students is to identify objects and materials as being either solids, liquids, or gases.

Using your knowledge of physical science and child development, prepare a response in which you:

- describe a physical property of liquids that distinguishes them from solids;
- summarize a learning experience that would help kindergarten students distinguish liquids and solids;
and
- explain why this experience fosters learning and development for kindergarten students.

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

Liquids are something the children are familiar with, because they drink juices, take baths, and swim in pools. They may not know that some liquids can also be solids, like water. When it is solid, water is ice. Children may not know that the ice they skate on in the winter and the cubes they put in a glass of soda in the summer are really water when it's solid.

To help children learn about solids and liquids, I would use snack time to show them the difference between pouring a cup of juice and what happens when the juice turns into solid ice. They could each take a turn pouring juice from a pitcher into their own cup as we talk about liquids and how they flow. Then I would bring out frozen juice pops, and have them talk about the difference between the frozen solid juice pops and the liquid juice they can drink. While children talk about other liquids and solids they know, I would write them on a big chart to post in the room.

This activity is good for children because it gives them some hands-on experience with both a solid and a liquid while we are talking about it. This is also a visual activity, which is good for visual learners. It gives everyone something concrete to work with, which is very important to their learning.

SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

The molecules that make up a liquid are much more spread out than the molecules that make up a solid. They're so densely packed there's not much room between each molecule, so it usually takes force to break down the object. In art class, for example, I have to use a hammer to smash the clay pots that didn't come out right, but when I'm working with clay that's too soupy the pot won't even stand up when I try to shape it. It's because the molecules in liquids have a lot of space between them. They are so loosely organized that something liquid will change shape if you push it, drop it or pour it from one container to another.

To teach liquids and solids in a kindergarten class, I would set up four stations for small groups around the room. One station could have a pitcher of colored water and different sized glasses, cups, and plastic containers (fat, skinny, tall, flat). Another station could have different sized containers along with some solids like ping-pong balls, sponge cubes, and paper napkins. The other stations, one with solids one with liquids, might have sieves and nets. At each station, small groups of children would play with pouring the liquids or solids from one container to another and discuss the behavior of the materials while the teacher observes and asks questions like, "What's going to happen to the (water, balls, etc.) when you put it into this container?" After the children have had a chance to rotate among all the stations, the teacher could do a group meeting to make a class chart of their learning about liquids and solids.

Activities like this promote development through interaction. Most importantly, this gives the children a chance to hear ideas other kids have, and that helps them to add to or correct their own ideas and learn more than they could learn on their own. The teacher talks with children, too, about their predictions and discoveries, which adds to their thinking and builds the vocabulary that will help them to understand and explain their physical world.

Performance Characteristics:

Purpose	The extent to which the response achieves the purpose of the assignment.
Subject Matter Knowledge	Accuracy and appropriateness in the application of subject matter knowledge.
Support	Quality and relevance of supporting details.
Rationale	Soundness of argument and degree of understanding of the subject matter.

Scoring Scale:

Score Point	Score Point Description
4	<p>The "4" response reflects a thorough knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is fully achieved. • There is a substantial, accurate, and appropriate application of subject matter knowledge. • The supporting evidence is sound; there are high-quality, relevant examples. • The response reflects an ably reasoned, comprehensive understanding of the topic.
3	<p>The "3" response reflects an adequate knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is largely achieved. • There is a generally accurate and appropriate application of subject matter knowledge. • The supporting evidence is adequate; there are some acceptable, relevant examples. • The response reflects an adequately reasoned understanding of the topic.
2	<p>The "2" response reflects a limited knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is partially achieved. • There is a limited, possibly inaccurate or inappropriate, application of subject matter knowledge. • The supporting evidence is limited; there are few relevant examples. • The response reflects a limited, poorly reasoned understanding of the topic.
1	<p>The "1" response reflects a weak knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is not achieved. • There is little or no appropriate or accurate application of subject matter knowledge. • The supporting evidence, if present, is weak; there are few or no relevant examples. • The response reflects little or no reasoning about or understanding of the topic.
U	The response is unrelated to the assigned topic, illegible, primarily in a language other than English, not of sufficient length to score, or merely a repetition of the assignment.
B	There is no response to the assignment.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a strong response because it is characterized by the following:

Purpose: The candidate has responded fully to each of the bullets in this assignment, addressing the physical properties of matter, the process of teaching that content at the kindergarten level, and the underlying learning process.

Subject Matter Knowledge: Each paragraph of this response demonstrates sound knowledge of the subject matter. The first paragraph fully explains density of molecules as the physical property that distinguishes liquids from solids. The use of a personal example (clay pots) works because the candidate uses it to illustrate the more scientific explanation of the properties of liquids and solids. The learning activity is appropriate for kindergarteners on several levels, such as the number and variety of concrete materials, the children's active participation, and the teacher's clarification and extension of their thinking and learning. The last paragraph is a substantial discussion of the importance of "interaction" in learning.

Support: The candidate applies one specific idea about the properties of matter to both liquids and solids (density of molecules) and develops that idea clearly. The second paragraph conveys a lot of information about the learning experience: small group stations, materials to use, the idea of having some stations with porous and some with nonporous containers, and the role of the teacher in this setting. The last paragraph focuses on just one related aspect of learning and development: interaction. However, this idea is developed through a number of specific phrases, such as "a chance to hear ideas other kids have," "add to or correct their own ideas," and "builds the vocabulary."

Rationale: Each aspect of the assignment is carefully reasoned from a clear starting point to a conclusion. The premise that solids have densely packed molecules is followed logically by the notion of "loosely organized" molecules in liquids. The learning activity starts with the broad idea of setting up the room into learning stations, continues with specifying contrasting materials for liquids and solids, and then explains exactly what the children would do and what role the teacher would play in this setting. The final paragraph gives several important reasons for including "interaction" in the design of a kindergarten learning experience. Thoroughly explaining a general concept, such as the importance of interaction, and linking it specifically to the learning experience chosen, strengthens a response more than simply listing a variety of concepts that are not fully explained or not directly and specifically related to the activity chosen.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a weak response because it is characterized by the following:

Purpose: This response only partially addresses the assignment. The physical properties that distinguish liquids from solids are only indirectly addressed in the first paragraph (e.g., liquids "are something the children are familiar with" and "the ice they skate on" is "really water when it's solid"). The learning experience lacks important details that would indicate whether or not the candidate understands the range of materials and experiences that kindergarteners would need to help them understand the physical properties that distinguish liquids from solids. The response is weakened by not including a specific reference to kindergarteners.

Subject Matter Knowledge: The candidate provides correct examples of the liquid and solid forms of water, however, using examples of materials that change from liquid to solid will not help kindergarteners formulate a generalized understanding of the physical properties of these states of matter that would be true of any liquid or any solid. To have children pour juice and "talk about the difference" between the frozen and solid juice is appropriate when talking about how liquids and solids change form, however, the candidate needs to elaborate on this starting point in order to demonstrate a depth of understanding of the subject matter. The learning activity described and the explanation of how it fosters development are so general in their content and purpose that they might be applied to several different grades for several different curriculum objectives.

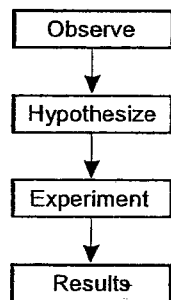
Support: The learning experience is limited to that one material (juice) on one occasion (snack time), after which the children are expected to generalize the concepts to create a chart of liquids and solids. The activity could have been made stronger by using several snack items and different steps in the snack process for a special lesson that would allow for a variety of observations about liquids and solids (e.g., washing up with liquid and solid hand soap, making waffles with syrup and apple slices, clearing the table with liquid waste in one pan and solid in another).

Rationale: This response is weakened by assumptions about children's learning that are questionable. For example, assuming that children already understand liquids and "may not know" solids is less effective a starting point than finding out what they do know. The activity relies more on showing and talking about liquids and solids than on more meaningful discovery-based activities. The rationale for the activity is weak. Phrases such as "some hands-on experience," "a visual activity," and "something concrete" require explanation and relevant details to communicate the candidate's reasoning about how this specific activity fosters learning and development. The ideas are so broadly related to the concept of liquids and solids that they do not build an argument for why this approach to learning is appropriate for these concepts at this grade level.

SCIENCE ANSWER KEY

- | | |
|-------|-------|
| 1. A | 11. D |
| 2. C | 12. B |
| 3. A | 13. C |
| 4. C | 14. B |
| 5. A | 15. A |
| 6. A | 16. B |
| 7. A | 17. D |
| 8. A | 18. A |
| 9. C | 19. C |
| 10. A | 20. B |

- B. based on verifiable evidence.
 - C. subject to mathematical proof.
 - D. able to explain a wide variety of natural phenomena.
17. Mathematical analysis is often an important part of interpreting scientific results primarily because it can:
- A. remove the risk that a researcher will be biased toward a particular result.
 - B. improve the validity of the collected data.
 - C. decrease the need for outside review of the research by scientific researchers.
 - D. reveal important relationships or trends in the collected data.
18. Use the diagram below to answer the question that follows.



- During a scientific investigation, which of the following is the primary goal of the "Experiment" step shown in the diagram above?
- A. to gather data related to the hypothesis
 - B. to assess whether the results will be useful in confirming the hypothesis
 - C. to generate new hypotheses that will help explain observations
 - D. to organize data to conform with the hypothesis
19. During the early sixteenth century, the astronomer Nicolaus Copernicus published a scientific hypothesis on a topic that had been studied and debated for centuries. Which

C. absorption of solar energy

D. control of growth 94

10. In 1987 many industrialized nations agreed to limit the production and sale of certain chemicals known to damage the ozone layer in the earth's upper atmosphere. This international agreement was based on scientific evidence that showed that the ozone layer plays an important role in:
- A. protecting living organisms from harmful ultraviolet radiation.
 - B. reducing the toxicity of chemicals emitted from smokestacks.
 - C. promoting the formation of precipitation.
 - D. allowing built-up heat in the atmosphere to escape into space.
11. Which of the following sets of factors is most directly responsible for causing ocean tides?
- A. the shape, depth, and topography of the seafloor near coastlines
 - B. the rotation of the earth on its axis and its orbital motion
 - C. the atmospheric and ocean currents in coastal regions
 - D. the gravitational interactions of the earth, sun, and moon
12. During the process of photosynthesis, plants make sugars primarily from which of the following substances?
- A. oxygen and minerals
 - B. water and carbon dioxide
 - C. carbohydrates and oxygen
 - D. enzymes and water.
13. A teacher plans an experiment to help students understand how scientific inquiry differs from other ways of learning about the world. The experiment involves determining which of three types of soils can hold the most water before becoming saturated. To

- A. grow into adults more quickly, and do not need to molt as they grow.
 - B. look like small adults and do not go through a larval or pupal stage.
 - C. live in different habitats and eat different food from the adults.
 - D. pupate and then become adults, but do not change in appearance or form.
3. A flower grower has been growing several acres of daisies for many years. The grower lets the daisies go to seed late in the year so that new plants naturally replace older ones that die. This year, in the middle of the field, the grower finds a plant with pink flowers instead of the usual white flowers. Aside from the unusual color, the plant is identical to all the other daisies in the field. The grower has never seen a pink-flowered daisy in the field before. The appearance of the pink-flowered daisy was most likely caused by:
- A. a mutation in one of the sex cells produced by a parent of the daisy.
 - B. hybridization between a daisy plant and a plant belonging to a non-daisy species.
 - C. a dominant gene that has been carried undetected in the population for many years.
 - D. unusual nutrients and soil conditions where the pink-flowered daisy is growing.
4. A fourth-grade teacher has students attach the terminals of small light-emitting diode (LED) to an electric motor. The students then vigorously spin the shaft of the motor and observe that the LED gives off a quick flash of light. The principle demonstrated in this exercise could best be used to help explain:
- A. how energy is stored in batteries.
 - B. why refrigerators are able to cool warm air.
 - C. how electricity is generated in large power plants.
 - D. why a balloon sticks to a wall after rubbing it on a sweater.
5. During the nineteenth century, scientists developed several principles to describe cells. These principles developed into cell theory. Which of the following are fundamental principles of cell theory?
- A. Cells are the basic living unit of organization and arise from pre-existing cells.
 - B. Cells have specialized structures, and cell function is different in plant and animal cells.