

Supplementary Material: Researcher-Designed Science Content Knowledge Test

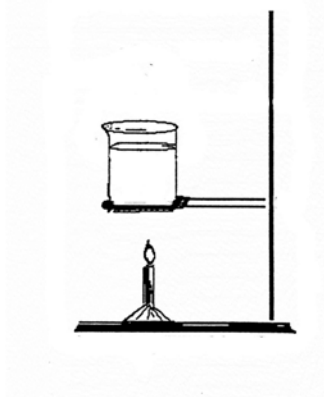
1. What causes ocean currents to form?

- A. Ocean currents form when cold water rises and warm water sinks.
- B. Ocean currents form in water when warm water rises and cold water sinks.
- C. The rising and sinking of water cannot cause ocean currents to form. Ocean currents form when cold water moves along the surface of the earth toward warmer water.
- D. The rising and sinking of water cannot cause ocean currents to form. Ocean currents form only when wind pushes the water.

2. Which of the following contributes to the transfer of thermal energy from place to place around the earth?

- A. The movement of ocean water, but not the movement of air
- B. The movement of air but not the movement of ocean water
- C. Both the movement of ocean water and the movement of air
- D. Neither the movement of ocean water nor the movement of air because thermal energy moves separately from the water and the air

3. Which of the following statements describes what happens when a container of water is warmed over a flame?



- A. Warmer water at the bottom rises toward the top and the colder water at the top sinks toward the bottom.
- B. Warmer water rises at the bottom toward the top but colder water at the top does not sink toward the bottom.

- C. The warmer water at the bottom does not rise. Thermal energy rises through the water, warming the water as it rises.
- D. The warmer water at the bottom and thermal energy both rise, but they rise separately.

4. Which of the following statements is TRUE about the transfer of thermal energy between air in the atmosphere and water in the ocean?

- A. Thermal energy is always transferred from the warmer material to the colder material.
- B. Thermal energy is always transferred from water to air.
- C. Thermal energy is always transferred from air to water.
- D. Thermal energy cannot be transferred between air and water.

5. What makes air become more humid one day than it was the day before?

- A. The only way the air can become more humid is if the temperature of the air increases.
- B. The only way the air can become more humid is if the amount of liquid water in contact with the air increases.
- C. The only way the air can become more humid is if both the temperature of the air and the amount of liquid water in contact with the air increase.
- D. Either increasing the temperature of the air or increasing the amount of liquid water in contact with the air can make the air more humid, but both do not need to increase to make the air more humid.

6. The air above a lake is warmer in the summer than in the fall. Based on this information, which of the following statements is TRUE about the effect that the warmer air temperature would have on the humidity of the air?

- A. The humidity of the air could be lower in the summer than in the fall because warmer air can hold less water vapor than cooler air.
- B. The humidity of the air could be higher in the summer than in the fall because warmer air can hold more water vapor than cooler air.
- C. The humidity of the air would be the same in summer and fall because the amount of water vapor in the air does not depend on the temperature of the air.

- D. The humidity of the air would be the same in summer and fall because even though the amount of water vapor in air depends on the temperature of the air, the amount of water vapor in the air does not affect how humid the air is.

7. Air is moving from Location 1 toward Location 2. The air is expected to become cooler as it reaches Location 2. If the amount of water vapor in the air is the same at both locations, where is rain more likely to fall?

- A. Rain is more likely to fall at Location 1 because the air is warmer there.
- B. Rain is more likely to fall at Location 2 because the air will be cooler there.
- C. It depends where the wind is blowing harder because where rain is more likely to fall does not depend on the air temperature, it only depends on how fast the wind is blowing.
- D. Rain is equally likely to fall at Location 1 and Location 2 because there is the same amount of water vapor in the air at both locations.

8. What makes rain fall from a cloud?

- A. Rain falls from a cloud any time wind blows on the clouds.
- B. Rain falls from a cloud when two clouds collide, causing them to burst open.
- C. Rain falls from a cloud when the air in the cloud cools, causing water droplets to form.
- D. Rain falls from a cloud when the pool of water in the cloud becomes too large, so the cloud can no longer hold the water inside.

9. Where can new clouds form?

- A. New clouds form only near factories and cities because clouds need pollution in the air to form.
- B. New clouds form only over lakes or oceans because clouds need a body of water below them to form.
- C. New clouds can form anywhere, even far from bodies of water and cities because water in the air can move from place to place and can form clouds without pollution.
- D. New clouds do not form. Clouds just move from place to place.

10. If the temperature of the air in a town is cool, and the town has no rivers or lakes and is not close to an ocean, could the air at that town have water vapor in it?

- A. No, the air at the town must be both warm and be close to a large body of water for the air to have water vapor in it.
- B. No, the air at the town does not have to be warm, but it must be close to a large body of water to have water vapor in it.
- C. No, the air at the town does not have to be close to a large body of water, but it must be warm to have water vapor in it.
- D. Yes, the air at that town could have water vapor in it because the water vapor can come from water in plants or soil even when the air is cool.

11. Which of the following statements is TRUE about air temperature and water vapor in the air?

- A. Water vapor in the air comes from the evaporation of liquid water, and liquid water evaporates only when the air is very warm.
- B. Water vapor in the air comes from the evaporation of liquid water, and liquid water evaporates only when the air is very cool.
- C. Water vapor in the air comes from the evaporation of liquid water, and liquid water evaporates both when the air is very cool and when the air is very warm.
- D. Liquid water cannot become water vapor in the air when the air is very cool or when the air is very warm.

12. How long does it take for moving water to wear down earth's solid rock layer?

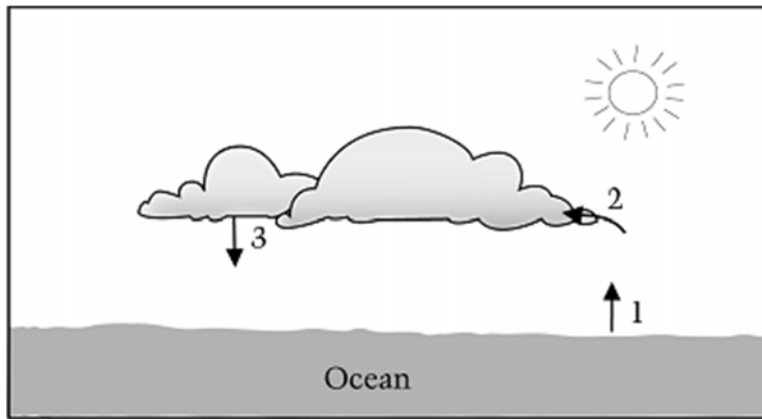
- A. Whenever water is moving over solid rock, a little bit of the rock is worn down even if you can't see it.
- B. Moving water can wear down solid rock, but it takes about ten years or more to cause any change, no matter how small.
- C. Moving water can wear down solid rock, but it takes millions of years or more to cause any change, no matter how small.
- D. Moving water cannot wear down solid rock.

13. Water evaporates and falls back to Earth as rain or snow. What is the primary energy source that drives this cycle?

- A. The wind
- B. The Sun
- C. Air pressure

D. Ocean currents

Question refers to the following diagram, which represents a portion of Earth's water cycle.

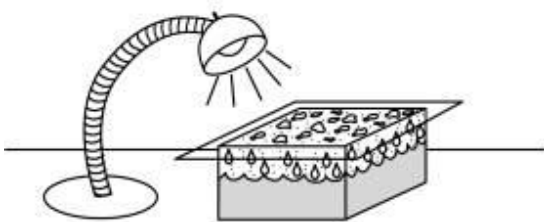


14. Which process is represented by 2?

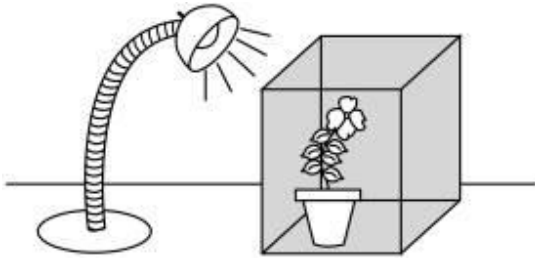
- A. Liquid water evaporating
- B. Cool air warming as it rises
- C. Clouds blocking the Sun's energy
- D. Water vapor condensing

15. Which of the following would be the best model to show the interactions between water and the Sun's heat energy in cycles of precipitation?

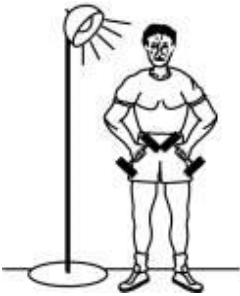
- A. A light shines on an aquarium covered with glass, and water droplets form on the inside of the glass.



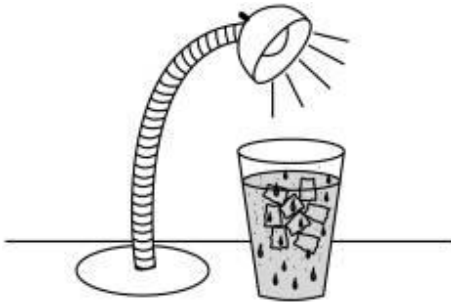
- B. A light shines on a closed cardboard box containing a plant.



C. A light shines on a man's face. Droplets of sweat form on his face as he exercises.



D. A light shines on a glass of iced tea. Water droplets form on the outside of the glass.



16. If you breathe on a mirror, part of the mirror clouds up. What are you actually seeing when you see the mirror cloud up?

- A. Water droplets that formed from cooled water vapor in your breath
- B. Carbon dioxide that you are breathing out from your lungs
- C. Oxygen that you are breathing out from your lungs
- D. Cooled nitrogen in the air around you

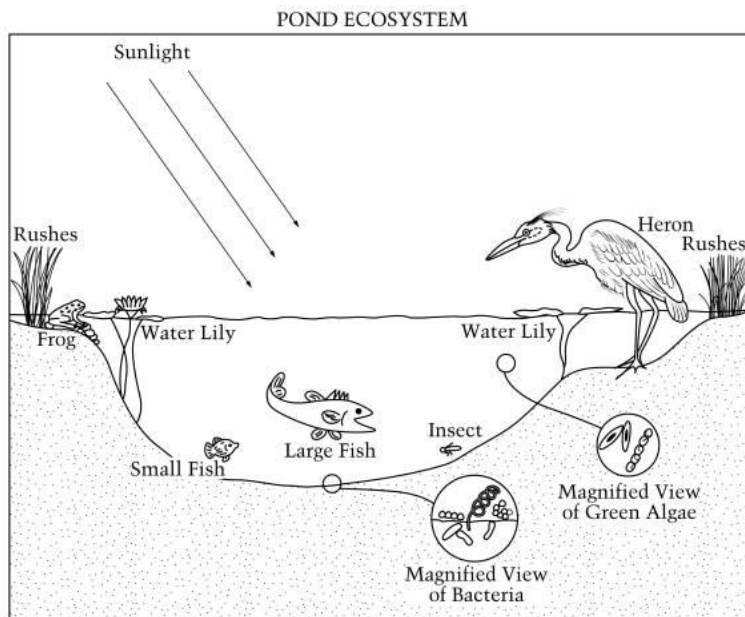
17. Which is an example of water condensing?

- A. A puddle disappearing on a hot summer afternoon
- B. Sweat forming on your forehead after you do a lot of exercise
- C. Ice cubes melting when you put them out in the sun
- D. Dew forming on plants during a cold night

18. All of the following are examples of erosion **EXCEPT**:

- A. The wind in the desert blows sand against a rock.
- B. A glacier picks up boulders as it moves.
- C. A flood washes over a riverbank, and the water carries small soil particles downstream.
- D. An icy winter causes the pavement in a road to crack.

Additional Information The picture below shows a pond ecosystem. Use this picture and what you know about the things in it to answer the questions in this section.



19. If air pollution causes the rain that falls on this pond to become much more acidic, after two years how will this acidity affect the living things in this pond?

- A. There will be more plants and animals because the acid is a source of food.
- B. There will be fewer plants and animals because the acid will dissolve many of them.
- C. There will be fewer plants and animals because many of them cannot survive in water with high acidity.
- D. There will be more plants and animals because the acid will kill most of the disease-causing microorganisms.

20. What property of water is most important for living organisms?

- A. It is odorless.
- B. It does not conduct electricity.
- C. It is tasteless.
- D. It is liquid at most temperatures on Earth.

Answer Key

Question	AAAS/NAEP Item Code	Correct Answer
1	CL007002	B
2	CL019002	C
3	CL137001	A
4	CL139001	A
5	WC066002	D
6	WC071003	B
7	WC082003	B
8	WC084002	C
9	WC089002	C
10	WC114001	D
11	WC115001	C
12	WE018003	A
13	2011-8S11 #15 K120301	B
14	2009-8S10 #13 K116201	D
15	2000-8S21 #10 K046101	A
16	2005-8S13 #4 K035701	A
17	2005-8S13 #8 K036201	D
18	2005-8S14 #9 K037801	D
19	2000-8S9 #12 K031612	C
20	2000-8S21 #3 K045401	D

*Questions from the National Assessment of Educational Progress (NAEP) Question Tool and the American Association for the Advancement of Science (AAAS) 2061 Science Assessment Item Bank

Supplementary Material: Student Semi-Structured Focus Group Questions

Semi-Structured Focus Group #1 (Pre):

1. What are your personal goals for the upcoming Project-Based Inquiry (PBI) Global?
2. What types of activities tend to motivate you to learn in school?
3. What challenges do you face when trying to use technology in the classroom?
4. What do you know about the UN Sustainable Development Goals (SDGs)?
5. What do you know about the PBI Global topic clean water and sanitation? What more do you hope to learn this semester?
6. What benefits (if any) do you see in collaborating with another school on this topic?
7. What challenges or obstacles do you think you will encounter during PBI Global?
8. What are you most looking forward to during PBI Global?
9. Do you have anything else you would like to share?

Semi-Structured Focus Group #2 (Mid):

1. How is your PBI Global going so far?
2. How are you using the PBI Global model (different phases) to guide your inquiry?
How did your team
 - a. Design their compelling question
 - b. Gather and analyze sources related to the topic of your compelling question
 - c. Creatively synthesize claims and evidences to respond to your compelling question
 - d. Critically evaluate and revise your products
3. What are the pros and cons of using the PBI Global phases to structure your inquiry?
4. What technologies is your team using during PBI Global? What challenges (if any) have you encountered?
5. What are you learning about clean water and sanitation (SDG 6)?
6. How is the cross-school collaboration going? What is working well and what are the challenges?
7. What else would you like to share about the PBI Global model and the topic of clean water and sanitation?

Semi-Structured Focus Group #3 (Post):

1. Were your personal goals for PBI Global met and how?
2. What challenges or obstacles did you face during PBI Global?
3. What technologies did your team use during PBI Global?
4. How did PBI Global foster cross-school understandings among your teammates?
5. With what phase(s) or aspect(s) of the PBI Global process did your team most struggle?
 - a. Designing your compelling question
 - b. Gathering and analyzing sources related to the topic of your compelling question
 - c. Creatively synthesizing claims and evidences to respond to your compelling question
 - d. Critically evaluating and revising your products
 - e. Sharing, publishing, and acting
6. With what phase(s) or aspect(s) of the PBI Global process did your team most excel?
 - a. Designing your compelling question
 - b. Gathering and analyzing sources related to the topic of your compelling question
 - c. Creatively synthesizing claims and evidences to respond to your compelling question
 - d. Critically evaluating and revising your products
 - f. Sharing, publishing, and acting
7. What did you learn from participating in the showcase?
8. How did planning for the showcase affect the quality of your final products?
9. How would you describe the quality of your team's final PBI Global products?
10. Is there anything you would do differently the next time you engage in PBI Global?
11. What was the most important thing you learned through your inquiry?
12. Do you have anything else you would like to share?