

CAN YOU SPOT THE SCIENTIFIC METHOD CRITICAL THINKING/PROBLEM SOLVING

Name _____

Date _____

Class _____

Each sentence below describes a step of the scientific method. Match each sentence with a step of the scientific method listed below.

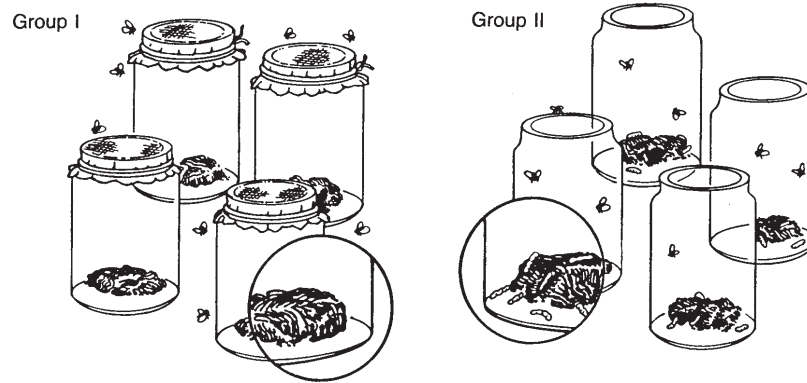
- A. Recognize a problem
- B. Form a hypothesis
- C. Test the hypothesis with an experiment
- D. Draw conclusions

- _____ 1. Stephen predicted that seeds would start to grow faster if an electric current traveled through the soil in which they were planted.
- _____ 2. Susan said, "If I fertilize my geranium plants, they will blossom."
- _____ 3. Jonathan's data showed that household cockroaches moved away from raw cucumber slices.
- _____ 4. Rene grew bacteria from the mouth on special plates in the laboratory. She placed drops of different mouthwashes on bacteria on each plate.
- _____ 5. Kathy used a survey to determine how many of her classmates were left-handed and how many were right-handed.
- _____ 6. Jose saw bats catching insects after dark. He asked, "How do bats find the insects in the dark?"
- _____ 7. Justin wondered if dyes could be taken out of plant leaves, flowers, and stems.
- _____ 8. Alice soaked six different kinds of seeds in water for 24 hours. Then she planted the seeds in soil at a depth of 1 cm. She used the same amount of water, light, and heat for each kind of seed.
- _____ 9. Bob read about growing plants in water. He wanted to know how plants could grow without soil.

- _____ 10. Kevin said, "If I grow five seedlings in red light, I think the plants will grow faster than the five plants grown in white light."
- _____ 11. Angela's experiment proved that earthworms move away from light.
- _____ 12. Scott said, "If acid rain affects plants in a particular lake, it might affect small animals, such as crayfish, that live in the same water."
- _____ 13. Michael fed different diets to three groups of guinea pigs. His experiment showed that guinea pigs need vitamin C and protein in their diets.
- _____ 14. Kim's experiment showed that chicken eggshells were stronger when she gave the hen feed, to which extra calcium had been added.

Scientific Method

Long ago, many people believed that living things could come from nonliving things. They thought that worms came from wood and that maggots came from decaying meat. This idea was called spontaneous generation. In 1668, an Italian biologist, Francesco Redi, did experiments to prove that maggots did not come from meat. One of his



experiments is shown below.

Redi placed pieces of meat in several jars. He divided the jars into two groups. He covered the first group of jars with fine cloth. He left the second group of jars uncovered. Redi observed the jars for several days. He saw flies on the cloth of the covered jars, and he saw flies laying eggs on the meat in the uncovered jars. Maggots appeared only on the meat in the group of jars left uncovered.

1. Scientists use a series of organized steps called scientific method to solve problems. List the steps that are often used. _____

2. What was the problem in Redi's experiment? _____

3. What do you think his hypothesis was? _____

4. How did he test his hypothesis? _____

5. What was the variable in his experiment? _____

6. What was the control in his experiment? _____

7. What do you think Redi's conclusion was.? _____

Name _____

Class _____

Date _____

Performing an Experiment

Read the following statements and then answer the questions.

1. A scientist wants to find out why sea water freezes at a lower temperature than fresh water.
2. The scientist goes to the library and reads a number of articles about the physical properties of solutions.
3. The scientist also reads about the composition of sea water.
4. The scientist travels to a nearby beach, and observes the conditions there. The scientist notes the taste of the sea water and other factors such as waves, wind, air-pressure, temperature, and humidity.
5. After considering all this information, the scientist sits at a desk and writes, "My guess is that sea water freezes at a lower temperature than fresh water because sea water has salt in it."
6. The scientist goes back to the laboratory and does the following:
 - a. Fills each of two beakers with 1 liter of fresh water.
 - b. Dissolves 35 grams of table salt in one of the beakers.
 - c. Places both beakers in a refrigerator whose temperature is - 1 degree C.
 - d. Leaves the beakers in the refrigerator for 24 hours.
7. After 24 hours, the scientist examines both beakers and finds the fresh water to be frozen. The salt water is still liquid.
8. The scientist writes in a notebook, "It appears as if salt water freezes at a lower temperature than fresh water does."
9. The scientist continues, "Therefore, I suggest that the reason sea water freezes at a lower temperature is that sea water contains dissolved salts while fresh water does not."

Questions

- A. Which statements contain *conclusions*? _____
- B. Which statements refer to *research*? _____
- C. Which statement contains a *hypothesis*? _____
- D. Which statements contain *observations*? _____
- E. Which statements describe an *experiment*? _____
- F. Which statement supports the *hypothesis*? _____
- G. In which statement is the *problem* defined? _____
- H. Which statement contain *data*? _____
- I. Which is the *variable* in the experiment? _____
- J. What is the *control* in the experiment? _____
- K. Which statement includes an *inference*? _____

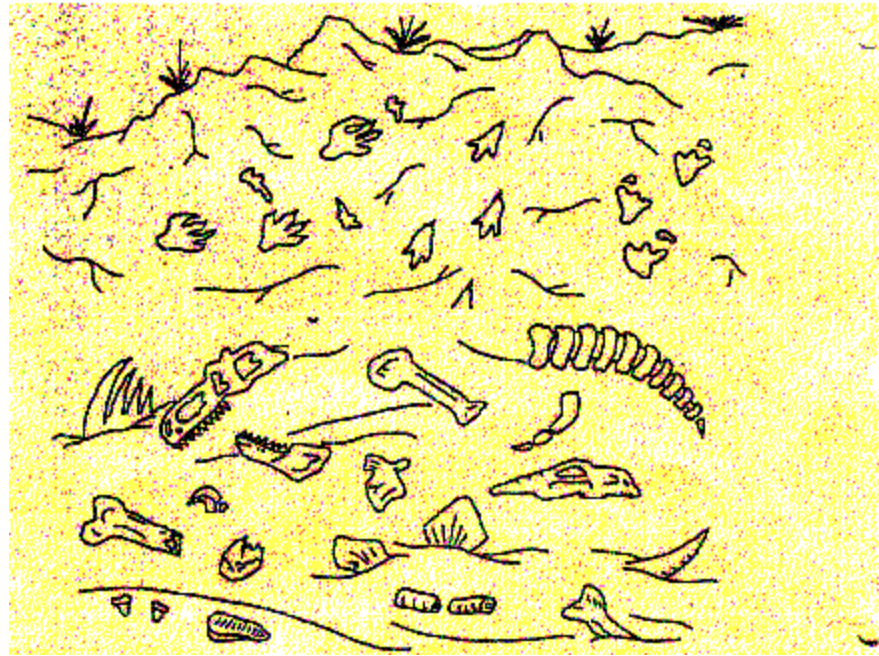


Dinosaur Scene:

A time machine has been invented that travels into the past and takes pictures, sending them to the present. You are asked to look at one of the pictures and interpret what you see. Put an "O" before the statements that are observations and an "I" before the statements that are inferences.

- ___ 1. The volcano is erupting.
- ___ 2. The camptosaurus is going to eat the stegosaurus.
- ___ 3. The stegosaurus will run into the water to escape.
- ___ 4. The camptosaurus is leaving tracks in the ground.
- ___ 5. The ground where the camptosaurus is walking is wet.
- ___ 6. There are plants growing in the water.
- ___ 7. The camptosaurus is going into the water to eat the plants.
- ___ 8. There is a tree growing next to the river.
- ___ 9. The tree looks like a palm tree.
- ___ 10. The climate is warm.
- ___ 11. The stegosaurus is eating the plant.
- ___ 12. The stegosaurus is an herbivore.
- ___ 13. There are bones from a dead animal by the shore.
- ___ 14. The camptosaurus killed the animal.
- ___ 15. Some more bones are in the water.
- ___ 16. The camptosaurus can't swim and will drown.
- ___ 17. Lava is coming down the sides of the volcano.
- ___ 18. The camptosaurus has sharp teeth for eating meat.

Suppose you are a paleontologist and you have just discovered a layer of rock with many fossils in it, both petrified bones and tracks. Decide whether the following statements are observations or inferences.



- _____ There are tracks from three different animals in the rock.
- _____ One animal was chasing another animal.
- _____ Two different animals died in this spot.
- _____ When the animals walked here the ground was wet.
- _____ One of the animals that died here had bony plates.
- _____ One of the animals that died here had sharp teeth.
- _____ The animal that had sharp teeth ate meat.

Inferences and Observations

An observation is anything that can be taken in through the senses. This would be things that you see, hear, taste, smell, touch, or taste. An inference is a statement that explains the observations.

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter "O" for an observation, or the letter "I" for an inference.

1. _____ It is summertime.
2. _____ It is day time.
3. _____ They saw birds.
4. _____ They saw seagulls.
5. _____ They went swimming.
6. _____ One friend's name was Bob.
7. _____ It was a warm day.
8. _____ The birds were black and white.
9. _____ They ate lunch and drank Coke.
10. _____ The people are friends.

QUALITATIVE VS. QUANTITATIVE WORK SHEET

All of the observations in this worksheet were qualitative; that is, you observed a quality about an object (it smelled good, it was green, etc.). Another type of observation is quantitative, meaning that it can be described or measured in concrete numerical terms. The following observations are quantitative:

There are 30 students in my class. I weigh 98 pounds. 1 ate a pound of potatoes.

Determine which of the following statements are quantitative and which are qualitative.

1. _____ The cup had a mass of 454 grams.
2. _____ The temperature outside is 25° C.
3. _____ It is warm outside.
4. _____ The tree is 30 feet tall.
5. _____ The building has 25 stories.
6. _____ The building is taller than the tree.
7. _____ The sidewalk is long.
8. _____ The sidewalk is 100 meters long.
9. _____ The race was over quickly.
10. _____ The race was over in 10 minutes.

CONSTRUCTING INFERENCES FROM OBSERVATIONS

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter "O" for an observation, or the letter "I" for an inference.

1. _____ It is summertime.
2. _____ It is daytime.
3. _____ They saw birds.
4. _____ They saw seagulls.
5. _____ They went swimming.
6. _____ One friend's name was Bob.
7. _____ It was a warm day.
8. _____ The birds were black and white.
9. _____ They ate lunch and drank Coca-Cola.
10. _____ The people are friends.