Name _____ Date _____

Scientific Inquiry

Use the text to answer each question below.

1. Science is both what you *learn* in science class and what you *do* in science class. It's knowledge about space, energy, atoms and the human body. It's also a method of investigation, which is the process used to build that knowledge.

Scientists experimenting in the lab

Science is focused on and limited to the natural world, or things we can perceive directly with our senses or indirectly with tools. The effect of radiation on human cells is a topic scientists can study because they can observe and measure it. The effect of an imperceptible, supernatural force on human life is not a scientific topic because it cannot be observed or measured. Science must be testable. That means you can experiment and/or investigate a scientific claim or hypothesis.

Which of the following is **not** an example of a question for scientific study?

A. If ghosts are real, how do they move?

B. If a factory opens in a city, how will it affect air quality?

C. How does sunlight affect plant growth?

D. If a person starts exercising, how will their health change?

2. Empirical evidence is observable or measurable information gained through experimentation and observation. Science is based on empirical evidence and is ongoing. After a hypothesis has been tested and there is empirical evidence supporting it, that hypothesis is not "true" and that science is not "done."

In science, there must be a possibility of evidence not supporting a claim. This characteristic of science is called falsifiability. Another key characteristic of the scientific process is that it's replicable. That means that it can be repeated to yield the same results. Different teams of scientists should be able to come to the same conclusions when they follow the same steps with the same variables. Science aims to explain the natural world, not just what might be true some of the time.

Empirical evidence

A. should never be replicable and repeated.

B. helps scientists understand the natural world.

C. will always make a hypothesis true.

D. comes from made up stories about the world.

3. Pseudoscience is any belief or process that attempts to look scientific but is not. Appearing to be scientific can make a product, belief or process seem more legitimate and convincing. That's why it's important to know how to tell pseudoscience from real science.

Unlike science, pseudoscience often lacks carefully controlled experimentation. It might claim to have evidence or results, but those results might not have been found through the steps of the scientific method. With pseudoscience, empirical evidence might not matter as much as faith or an authority—like a celebrity spokesperson. With science, the empirical evidence matters most.

Which of the following is a clue that something is pseudoscience?

A. the presence of empirical evidence
B. the use of a famous athlete for support
C. the support of a respected scientist
D. the use of the scientific method

4. You might think of laws as the rules that regulate what is and is not allowed in a country. But laws in science are different. After all, science does not pass judgment on what should or should not happen; it is limited to what does happen. In science, a law is an observed part of nature without an explanation. Laws in science are also called principles.

A law might summarize a series of observations or the results of many experiments. It can be used to make predictions and must be absolute, universal and simple. Sometimes, laws can be stated as mathematical equations. Newton's second law of motion, for example, describes the relationship between force, mass and acceleration. It can be simply stated as the equation F = ma, where F is force, m is mass and a is acceleration.

Which of the following is true about scientific laws?

A. They are also called principles.
B. They are universal statements.
C. They can sometimes be stated as equations.
D. All of the above.

5. The word “theory” has a specific meaning in science. Outside of science, you might say you have a theory when you have an idea about something. In science, a theory is a well-tested explanation. It describes and explains why natural phenomena occur.

A theory is a testable explanation of a law or laws. The theory of evolution, for example, explains that organisms slowly change over time due to genetic mutations that benefit their species' survival. Other theories in science include the Big Bang theory, the theory of relativity and the theory of plate tectonics. Evidence for theories often comes from different fields of science.

Evidence supporting plate tectonics comes from the fields of seismology, the study of earthquakes; paleontology, the study of fossils; and geology, the study of rocks. That’s why in science a statement is never *just* a theory! Like a hypothesis, however, a theory is never proven. It is supported by evidence.

Which of these would provide the best evidence for the theory of evolution?

A. Certain areas on the West Coast of America are more prone to earthquakes.

B. Fossils are typically found by paleontologists working with geologists.

C. Fossils of lion skulls show that lions used to look different.

D. Animals today share the exact same traits as animals from millions of years ago.

6. Science is modifiable, meaning it’s able to be changed. With new tools, new observations are possible and new empirical evidence can change what we know to be true. This has happened throughout the history of science and will continue to happen with future advances. A theory is modified when new evidence is found that does not support all parts of the existing theory.

Atomic theory is a great example of this. In 1897 the scientist JJ Thomson discovered the electron and proposed a new model for the atom. In this model, the negatively charged electrons were distributed throughout the positively charged substance of the atom like raisins in a cake or plums in a pudding.

In 1911, Ernest Rutherford made a scientific breakthrough that led to a modification of the plum pudding model. He discovered the atom’s nucleus where the atom’s positive charge was located. The theory was modified. Rutherford’s planetary model of the atom has the electrons orbit the nucleus like planets.

When would a theory be modified?

A. when new observations are made with updated tools

B. when a celebrity says a theory is wrong

C. when scientists don’t like the existing theoretical model

D. when the existing theory is considered too negative or grim

7. In science, a model represents an observed pattern, object, phenomenon or process. The food pyramid is a model for many scientific studies on diet and health. Rats are used to model the human body in some lab experiments. Models can also be mathematical, such as a model that uses equations to represent weather patterns or black holes. Like theories, models can be modified to fit new evidence.

Models help predict and communicate phenomena. They can be used to understand something too big, too small or too dangerous to experience ourselves. Models can also explain the past. The spherical Earth model helps explain many phenomena, including lunar eclipses and why boats look like they disappear in the distance.

Models are not perfect representations and don't explain every detail of a phenomenon. The spherical Earth model cannot be used to measure exact distances between two countries. Topographical features on the surface are not depicted in the model. Including all of these features would make the model too complex to use.

The spherical Earth model

A. cannot be used to predict when the next lunar eclipse will occur.

B. cannot represent any natural phenomenon we observe on Earth's surface.

C. accurately depicts all the topographical features on the planet.

D. cannot be used to find the distance between China and Australia.