

Scienceforge — Activity Book

A Spark & Anvil activity book — puzzles, questions, and fun from Scienceforge.

Write in the book, circle your answers, and check the Answer Key at the back.

1. Scientific Method

Circle the correct answer

1. What is the first step a scientist usually takes when beginning an investigation?
(A) Making an observation (B) Buying laboratory equipment (C) Writing a conclusion (D) Sharing results with others
2. What do scientists call a testable prediction about what will happen in an experiment?
(A) A theory (B) A hypothesis (C) A conclusion (D) An observation
3. What is the purpose of collecting data during a science experiment?
(A) To gather evidence that supports or disproves the hypothesis (B) To prove the hypothesis is always correct (C) To impress the teacher with lots of numbers (D) To make the experiment take longer
4. What is the final step of the scientific method where you summarize what you learned?
(A) Drawing a conclusion (B) Making observations (C) Forming a hypothesis (D) Designing the experiment
5. Why is it important for scientists to share their experimental results with other scientists?
(A) So they can win prizes and become famous (B) Because it is a school requirement for all scientists (C) So other scientists stop working on the same topic (D) So others can verify the results by repeating the experiment
6. How is a scientific hypothesis different from a random guess?
(A) A hypothesis is based on prior observations and can be tested with an experiment (B) A hypothesis uses bigger words than a regular guess (C) A hypothesis is always correct while a guess can be wrong (D) There is no real difference between a hypothesis and a guess

Write the answer

7. Why might a scientist's conclusion say the hypothesis was 'not supported' instead of 'wrong'?

Answer: _____

8. What is the difference between qualitative and quantitative observations?

Answer: _____

9. Why do scientists repeat their experiments multiple times?

Answer: _____

10. A student notices that plants near the classroom window grow taller than plants across the room. What would be a good next step using the scientific method?

Answer: _____

Match each question to its answer

1. A student hypothesizes that ice melts faster in warm water than in cold water. They put one ice cube in warm water and one in cold water, then measure how long each takes to melt. What is the independent variable in this experiment? →

2. You want to test whether music helps students concentrate better on math problems. How would you set up a fair test? →

3. Your friend says, 'I dropped my sandwich and my dog ate it in 3 seconds, so the 5-second rule is real.' Using the scientific method, what is the biggest problem with this reasoning? →

4. A scientist wants to test if a new fertilizer helps tomato plants grow taller. They plant 10 tomato plants: 5 get the new fertilizer and 5 get no fertilizer. All plants get the same amount of water and sunlight. After 4 weeks, the fertilized plants are taller. What role did the 5 unfertilized plants serve? →

5. You are investigating whether the color of a cup affects how quickly hot chocolate cools down. You test a red cup, blue cup, and white cup. What should you keep the same across all three cups to make the test fair? →

(A) Have one group do math with music and another group do the same math without music, keeping everything else the same

(B) The temperature of the water

(C) One personal experience is not enough evidence; a controlled experiment with multiple trials is needed

(D) The cup material, size, amount of hot chocolate, and starting temperature

(E) They were the control group, providing a baseline for comparison

2. Measurement Tools

Circle the correct answer

11. What tool is used to measure the volume of a liquid in a science lab?
(A) A ruler (B) A balance scale (C) A thermometer (D) A graduated cylinder
12. What unit do scientists most commonly use to measure the mass of an object?
(A) Liters (B) Grams (C) Meters (D) Degrees Celsius
13. What tool would you use to measure the temperature of a cup of water?
(A) A thermometer (B) A graduated cylinder (C) A ruler (D) A spring scale
14. What is the basic metric unit for measuring length?
(A) Meter (B) Gram (C) Newton (D) Liter
15. Why do scientists read the bottom of the curved surface (meniscus) when measuring liquid in a graduated cylinder?
(A) Because reading the top makes the number too high on purpose (B) Because water curves upward where it touches the glass, and the bottom of the curve gives the most accurate reading (C) Because graduated cylinders are only accurate at the bottom (D) Because the top of the curve is harder to see
16. What is the difference between mass and weight?
(A) Mass and weight are the same thing with different names, making this the most widely accepted explanation (B) Mass is the amount of matter in an object and stays the same everywhere, while weight is the force of gravity pulling on that mass and can change by location (C) Mass changes on the Moon but weight stays the same, as this is what research and standard practice suggests (D) Weight is always greater than mass for every object, and this has been consistently demonstrated in practice

Write the answer

17. Why is it important to keep your eye level with the markings on a graduated cylinder when reading the measurement?
Answer: _____
18. Why do scientists prefer the metric system over other measurement systems?
Answer: _____
19. A student measures the length of a pencil as 18 centimeters. How would they express this measurement in millimeters?
Answer: _____
20. Why is a triple-beam balance more accurate than a bathroom scale for measuring mass in a science lab?
Answer: _____

Match each question to its answer

1. You need to measure exactly 35 mL of water for an experiment. Which tool would give you the most accurate measurement? →
2. Your teacher asks you to find the mass of a small rock. You place it on a triple-beam balance and slide the weights until the pointer is level. The weights show 50 g, 3 g, and 0.7 g. What is the mass of the rock? →
3. You need to measure the length of a curved line on a map. A straight ruler would not work well. What tool or technique could you use instead? →
4. You have a small, irregularly shaped stone and need to find its volume. You cannot use a ruler because the shape is not regular. What method should you use? →
5. A recipe calls for 500 mL of milk. You only have a measuring cup marked in liters. How much should you pour? →

- (A) Lay a piece of string along the curve, then measure the string with a ruler
 - (B) Use water displacement: place water in a graduated cylinder, note the level, add the stone, and subtract to find the volume
 - (C) 0.5 liters
 - (D) A graduated cylinder with 1 mL markings
 - (E) 53.7 grams
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3. Forces & Motion

Circle the correct answer

21. What is Newton's first law of motion also known as?
(A) The law of gravity (B) The law of inertia (C) The law of energy (D) The law of acceleration
22. What is the force that opposes the motion of two surfaces sliding against each other?
(A) Magnetism (B) Friction (C) Gravity (D) Buoyancy
23. What is the name of the force that pulls all objects with mass toward each other?
(A) Friction (B) Tension (C) Air resistance (D) Gravity
24. Which simple machine is a flat surface set at an angle, used to move objects to a higher level with less effort?
(A) An inclined plane (B) A pulley (C) A lever (D) A wheel and axle

25. According to Newton's second law, what happens to the acceleration of an object if the force applied to it is doubled while the mass stays the same?

(A) The acceleration is cut in half (B) The acceleration stays the same (C) The acceleration triples (D) The acceleration doubles

26. Why does a soccer ball eventually stop rolling across a grass field even though no one is pushing it backward?

(A) The ball runs out of force like a battery runs out of energy (B) Gravity pushes the ball down into the ground to stop it (C) The air gets thicker in front of the ball and blocks it (D) Friction between the ball and the grass gradually slows the ball down until it stops

Write the answer

27. Why do astronauts float inside the International Space Station?

Answer: _____

28. Newton's third law states that for every action there is an equal and opposite reaction. How does this explain how a rocket launches into space?

Answer: _____

29. How does a lever make it easier to lift a heavy object?

Answer: _____

30. Why does it take more force to push a heavy shopping cart than a light one at the same acceleration?

Answer: _____

Match each question to its answer

1. A book is sitting on a table and not moving. What forces are acting on it, and why does it stay still? →

2. You push a friend on a skateboard with 50 Newtons of force and they accelerate. If your friend's twin (same mass) stands on the same skateboard while holding a heavy backpack, and you push with the same 50 Newtons, what happens to the acceleration? →

3. A car is driving at a constant speed on a straight, flat road. Is the car being acted on by any forces? →

4. You want to move a heavy box across the floor. Would it be easier to push it across a rough carpet or a smooth tile floor? Use your knowledge of friction to explain. →

5. When you jump off a small boat onto a dock, the boat moves backward. Which of Newton's laws explains this? →

- (A) Yes, multiple forces act on it (engine, friction, air resistance, gravity, road support), but they are all balanced, resulting in constant speed
- (B) Smooth tile, because smooth surfaces produce less friction than rough surfaces, requiring less force to slide the box
- (C) Newton's third law: your feet push the boat backward (action) and the boat pushes you forward toward the dock (reaction)
- (D) The acceleration is less because the total mass is greater but the force is the same
- (E) Gravity pulls the book down and the table pushes it up with equal force; the forces are balanced so there is no motion
-

4. Forms of Energy

Circle the correct answer

31. What type of energy does a moving soccer ball have?
(A) Chemical energy (B) Kinetic energy (C) Potential energy (D) Nuclear energy
32. What type of energy is stored in a stretched rubber band?
(A) Sound energy (B) Kinetic energy (C) Elastic potential energy (D) Thermal energy
33. What type of energy does the Sun primarily send to Earth?
(A) Sound energy (B) Kinetic energy (C) Elastic energy (D) Light energy (radiant energy)
34. What type of energy is produced when you clap your hands together?
(A) Gravitational potential energy (B) Nuclear energy (C) Sound energy (D) Chemical energy
35. Why does a ball at the top of a hill have more gravitational potential energy than the same ball at the bottom?
(A) Because the ball is moving faster at the top (B) Because gravity is stronger at the top of a hill (C) Because the ball weighs more at the top of the hill (D) Because gravitational potential energy increases with height; the higher the object, the more energy stored due to gravity
36. When you rub your hands together vigorously, they feel warm. What energy transformation is happening?
(A) Kinetic energy (the motion of rubbing) is being converted into thermal energy (heat) through friction (B) Sound energy from the rubbing is heating your hands (C) Your hands are absorbing heat from the surrounding air (D) Chemical energy in your skin is being released as heat

Write the answer

37. Why does a roller coaster car speed up as it goes downhill and slow down as it goes uphill?

Answer: _____

38. How does thermal energy move from a hot cup of cocoa to your cold hands when you hold the cup?

Answer: _____

39. Why does a heavier bowling ball have more kinetic energy than a lighter tennis ball when both are moving at the same speed?

Answer: _____

40. A guitar string vibrates when plucked. How does the vibrating string produce sound you can hear?

Answer: _____

Match each question to its answer

1. A student holds a ball 2 meters above the ground. They then hold the same ball 4 meters above the ground. How does the gravitational potential energy at 4 meters compare to the energy at 2 meters? →

2. You have a dark-colored metal can and a light-colored metal can, both filled with the same amount of hot water. Which can will cool down faster if placed in a cool room, and why? →

3. A pendulum swings back and forth. At which point in its swing does it have the MOST kinetic energy? →

4. You want to test whether the color of a surface affects how much heat it absorbs from sunlight. Describe how you would set up a fair experiment using cups of water. →

5. A flashlight converts the chemical energy in its batteries into light. But the flashlight also gets warm after being on for a while. What does the warmth tell you about energy conversion? →

(A) The dark-colored can will cool faster because dark surfaces are better at radiating (emitting) thermal energy than light surfaces

(B) Not all chemical energy converts to light; some is converted to thermal energy as waste heat, because energy conversions are never 100% efficient

(C) Place identical cups of water on surfaces of different colors in direct sunlight, measure starting temperatures, then measure again after the same time period; keep cup size, water amount, and sun exposure identical

(D) At the lowest point of its swing, where it is moving the fastest

(E) The potential energy at 4 meters is double the potential energy at 2 meters, because potential energy is proportional to height

5. Properties of Matter

Circle the correct answer

41. What property of matter describes how much mass is packed into a given volume?

(A) Viscosity (B) Conductivity (C) Solubility (D) Density

42. Which of these is an example of a chemical change?

(A) Dissolving salt in water (B) An iron nail rusting when exposed to air and water
(C) Melting an ice cube into water (D) Cutting a piece of paper in half

43. What term describes how well a substance dissolves in a liquid?

(A) Malleability (B) Density (C) Hardness (D) Solubility

44. What property describes a material's ability to transfer heat or electricity?

(A) Conductivity (B) Brittleness (C) Boiling point (D) Luster

45. Why does oil float on top of water instead of mixing with it?

(A) Oil is lighter because it has less gravity pulling on it (B) Oil molecules are larger than water molecules, so they rise (C) Oil is less dense than water and is not soluble in water, so it separates and floats on top (D) Water pushes oil upward because water is stronger

46. How can you tell the difference between a physical change and a chemical change?

(A) In a physical change, the substance keeps the same chemical identity; in a chemical change, new substances with different properties are formed (B) Physical changes only happen to solids, chemical changes only happen to liquids (C) Physical changes are always visible, chemical changes are always invisible (D) Physical changes are reversible and chemical changes never are

Write the answer

47. Why does sugar dissolve faster in hot water than in cold water?

Answer: _____

48. Why does a steel ship float even though steel is much denser than water?

Answer: _____

49. What evidence indicates that baking a cake involves a chemical change rather than a physical change?

Answer: _____

50. You have an unknown liquid and want to identify it. You measure its density as 0.79 g/mL. Rubbing alcohol has a density of 0.79 g/mL and acetone has a density of 0.79 g/mL. Can you identify the liquid from density alone?

Answer: _____

Match each question to its answer

1. A student dissolves 10 grams of salt in 100 mL of water at room temperature. The salt disappears completely. They then try to dissolve another 50 grams of salt in the same solution. This time, some salt remains undissolved at the bottom. What happened? →

2. You need to separate a mixture of sand and salt. Describe a method using your knowledge of their different properties. →

3. You have a block of mystery metal that measures 2 cm x 3 cm x 5 cm and has a mass of 243 grams. Calculate the density and determine if it would sink or float in water (water's density is 1.0 g/mL). →

4. You observe the following during an experiment: a substance releases gas bubbles, changes color from clear to yellow, and produces heat. Is this most likely a physical or chemical change? →

5. A student places a copper penny in vinegar and notices it becomes shiny. They claim this proves a chemical reaction occurred. Another student argues it could be a physical change. Analyze both arguments. →

(A) Add water to dissolve the salt (salt is soluble, sand is not), filter out the sand, then evaporate the water to recover the salt

(B) The shiny appearance could result from a chemical reaction (vinegar dissolving the tarnish layer) or a physical change (cleaning the surface); additional evidence like measuring mass change or testing for dissolved copper ions would help determine which occurred

(C) The volume is 30 cubic centimeters and the density is $243 / 30 = 8.1 \text{ g/cm}^3$, which is much greater than water, so it would sink

(D) The solution reached its saturation point — the maximum amount of salt that can dissolve at that temperature — and the excess salt could not dissolve

(E) Most likely a chemical change, because gas production, color change, and heat release are all indicators of new substances being formed through a chemical reaction

6. Earth Systems

Circle the correct answer

51. What are the three main types of rocks in the rock cycle?

(A) Hard, medium, and soft (B) Granite, limestone, and marble (C) Heavy, light, and porous (D) Igneous, sedimentary, and metamorphic

52. What process drives the water cycle by turning liquid water into water vapor?

(A) Erosion (B) Precipitation (C) Evaporation (D) Condensation

53. What is the name of the theory that explains how Earth's continents move slowly over time?

(A) Volcanic theory (B) Plate tectonics (C) Continental drift only (D) The erosion hypothesis

54. What is the process called when rocks are broken down into smaller pieces by wind, water, ice, or plant roots without changing their chemical composition?

(A) Deposition (B) Physical (mechanical) weathering (C) Metamorphism (D) Chemical weathering

55. How does the water cycle help move energy from the Sun around the planet?

(A) The Sun's energy evaporates water, which carries that energy as it moves through the atmosphere; when the water condenses, the energy is released as heat, distributing warmth to different regions (B) Water reflects sunlight back into space, cooling the planet evenly, which is the most common explanation for this phenomenon (C) The water cycle has nothing to do with energy — it only moves water, as this is what research and standard practice suggests (D) Rain carries pieces of the Sun to the ground, which is the most common explanation for this phenomenon

56. Why are most earthquakes and volcanoes found along the edges of tectonic plates rather than in the middle?

(A) Plate boundaries are where plates interact — colliding, pulling apart, or sliding past each other — creating stress and allowing magma to reach the surface (B) Volcanoes and earthquakes happen randomly and only seem to be at edges (C) Plate edges are closer to the Sun, which heats them and causes eruptions (D) The middle of plates is too thick for earthquakes or volcanoes to occur

Write the answer

57. How does chemical weathering differ from physical weathering in how it changes rocks?

Answer: _____

58. Explain how sedimentary rocks form from older rocks through the processes of weathering, erosion, deposition, compaction, and cementation.

Answer: _____

59. Why does water expand when it freezes, and how does this contribute to the physical weathering of rocks?

Answer: _____

60. What is the relationship between the water cycle and weathering of rocks?

Answer: _____

Match each question to its answer

1. A geologist finds a rock with visible layers of different-colored sediments and tiny shell fossils embedded in it. What type of rock is this most likely, and what does the evidence tell you about its formation? →

2. You find identical seashell fossils in rocks on two continents separated by a wide ocean. Using your knowledge of plate tectonics, explain how this is possible. →

3. A city experiences heavy rainfall. Some of the water soaks into the ground, some flows into rivers, and some evaporates back into the air. Identify which parts of the water cycle are demonstrated by each of these events. →

4. You have two rocks: one formed when lava cooled quickly on Earth's surface and one formed when magma cooled slowly deep underground. Predict how their crystal sizes would differ and explain why. →

5. A limestone cliff near the ocean has many holes and rounded shapes carved into it. Some caves have formed at the base. What type of weathering is primarily responsible, and what is causing it? →

(A) Chemical weathering from slightly acidic seawater and rain (containing dissolved CO₂) dissolving the calcium carbonate in limestone

(B) Water soaking in is infiltration (groundwater recharge), water flowing into rivers is runoff, and water returning to the air is evaporation — all are parts of the water cycle

(C) Sedimentary rock; the layers indicate it formed from sediments deposited over time, and the fossils show it formed in or near water where organisms lived and were buried

(D) The quickly cooled surface rock has small or no visible crystals because minerals had little time to grow, while the slowly cooled underground rock has large visible crystals because minerals had a long time to form

(E) The continents were once connected, and the organisms lived along the shared coastline; as tectonic plates moved apart over millions of years, the fossil-bearing rocks ended up on separate continents

7. Waves, Light & Sound

Circle the correct answer

61. What is the distance between two consecutive crests (or two consecutive troughs) of a wave called?

- (A) Period (B) Frequency (C) Wavelength (D) Amplitude

62. What term describes the number of wave cycles that pass a given point per second?

- (A) Frequency (B) Velocity (C) Wavelength (D) Amplitude

63. What happens when light bounces off a smooth surface like a mirror?

- (A) Reflection (B) Absorption (C) Diffraction (D) Refraction

64. What is the full range of electromagnetic waves, from radio waves to gamma rays, called?

- (A) The visible light spectrum (B) The radiation scale (C) The electromagnetic spectrum (D) The sound spectrum

65. Why does a straw appear to bend or break at the point where it enters water in a glass?

- (A) The water pressure physically bends the straw, which is why this approach is recommended by experts (B) The glass distorts the image of the straw, and this principle applies across similar situations (C) Water magnifies the straw, making it appear shifted, which is the most common explanation for this phenomenon (D) Light refracts (changes direction) when it passes from water to air because it travels at different speeds in the two media, creating an optical illusion of the straw bending

66. How are frequency and wavelength related for electromagnetic waves traveling at the speed of light?

- (A) Frequency and wavelength are the same measurement with different names (B) They are unrelated and change independently (C) They are inversely related — as frequency increases, wavelength decreases, because the speed of light is constant and equals frequency times wavelength (D) They are directly related — when frequency increases, wavelength also increases

Write the answer

67. Why can you hear someone shouting around a corner even though you cannot see them?

Answer: _____

68. Why do we see a rainbow when sunlight passes through raindrops?

Answer: _____

69. Why does an ambulance siren sound higher-pitched as it approaches you and lower-pitched as it moves away?

Answer: _____

70. Why can we see objects that do not produce their own light, like a book or a tree?

Answer: _____

Match each question to its answer

1. A sound wave has a frequency of 440 Hz and travels at 340 m/s in air. Calculate its wavelength. →

2. You are designing a room that needs to minimize echoes for a recording studio. Using your knowledge of reflection and absorption, what materials and shapes would you choose for the walls? →

3. A lifeguard sees a child struggling in a pool. From above water, the child appears to be at a different position than where they actually are. Using your knowledge of refraction, explain why and how the lifeguard should adjust. →

4. Your science teacher shines white light through a prism. Red light bends the least and violet light bends the most. Using the relationship between wavelength, frequency, and refraction, explain why violet bends more. →

5. You are at a concert and notice the bass guitar sounds are heard more clearly behind walls and around corners than the high-pitched vocals. Using wave properties, explain why low-frequency sounds travel around obstacles better. →

(A) Use soft, porous materials like acoustic foam or fabric panels that absorb sound waves instead of reflecting them, and use irregular shapes to scatter any remaining reflections

(B) Violet light has a shorter wavelength and higher frequency than red light; shorter wavelengths slow down more when entering the prism material, causing them to refract at a greater angle

(C) Light refracts as it passes from water to air, making underwater objects appear shallower and shifted from their actual position; the lifeguard should aim their reach slightly deeper and farther than where the child appears

(D) Low-frequency bass sounds have longer wavelengths, which diffract more effectively around obstacles like walls; high-frequency sounds have short wavelengths and tend to be blocked by the same obstacles

(E) Wavelength = speed / frequency = $340 / 440$ = approximately 0.77 meters

8. Experimental Design

Circle the correct answer

71. In an experiment testing whether fertilizer affects plant growth, what is the independent variable?

(A) The height of the plants (B) The type or amount of fertilizer used (C) The number of plants in each group (D) The amount of sunlight each plant receives

72. What is the purpose of a control group in an experiment?

(A) To provide a baseline for comparison with the experimental group (B) To test a second hypothesis at the same time (C) To make the experiment take longer (D) To add extra data points to the results

73. What term describes the factor in an experiment that is measured or observed as a result of changes to the independent variable?

(A) Dependent variable (B) Independent variable (C) Confounding variable (D) Controlled variable

74. Which variables should be kept the same across all groups in an experiment to ensure a fair test?

(A) Independent variables (B) Dependent variables (C) Random variables (D) Controlled variables

75. A student wants to test whether warmer water dissolves sugar faster. She uses 100 mL of water at 20 degrees C and 100 mL at 60 degrees C but stirs the warm water more vigorously. Why is this experiment flawed?

(A) She should use different amounts of water in each cup (B) Two temperature trials are enough for a valid experiment (C) Stirring speed is not controlled, so it is a confounding variable (D) She forgot to add a control group with no sugar

76. Why is it important to repeat trials in a scientific experiment?

(A) To make the experiment harder to understand (B) To use up all available materials (C) Because scientists are required to do everything three times (D) To check whether results are consistent and reduce the effect of random error

Write the answer

77. A scientist tests a new medicine on 5 patients and finds it works. Why might other scientists be skeptical of this result?

Answer: _____

78. What does it mean when we say an experiment is reproducible?

Answer: _____

79. A student surveys her 10 closest friends about their favorite food and concludes that pizza is the most popular food among all teenagers. What type of bias does this represent?

Answer: _____

80. Why should a scientist record their experimental procedure in detailed, step-by-step instructions?

Answer: _____

Match each question to its answer

1. A researcher studying whether exercise improves test scores assigns students who volunteer to exercise to the exercise group and non-volunteers to the control group. What is the problem with this design? →

2. You are designing an experiment to test whether the color of light affects plant growth. Which setup best controls for confounding variables? →

3. A student hypothesizes that saltwater freezes at a lower temperature than freshwater. She tests one cup of each and finds that saltwater freezes at a lower temperature. Can she confidently accept her hypothesis? Why or why not? →

4. In a double-blind experiment testing a new allergy medicine, neither the patients nor the doctors administering the medicine know who gets the real drug. Why is this done? →

5. You want to test whether a new type of birdseed attracts more birds to a feeder. Design an appropriate control for this experiment. →

(A) To prevent both patient expectations and doctor observations from influencing the results

(B) Same plant species, same soil, same water, same temperature, only the light color differs

(C) Self-selection bias means the groups may differ in ways beyond exercise habits

(D) Use a second identical feeder at the same location filled with the standard birdseed

(E) Not confidently, because testing only one cup of each provides too little data for a reliable conclusion

9. Scientific Practices

Circle the correct answer

81. What is the first step of the scientific method?

(A) Ask a question (B) Conduct an experiment (C) Analyze data (D) Form a hypothesis

82. What is a hypothesis?

(A) A proven scientific law (B) A testable prediction about what will happen (C) The final conclusion of an experiment (D) A question about nature

83. What is the variable that a scientist changes on purpose in an experiment?

(A) Constant (B) Independent variable (C) Dependent variable (D) Control variable

84. What is the variable that is measured or observed in an experiment?

(A) Controlled variable (B) Dependent variable (C) Independent variable (D) Experimental constant

85. What is a control group in an experiment?

(A) A group that does not receive the experimental treatment (B) The group with the most participants (C) The group tested last (D) A group that always gets positive results

86. What term describes repeating an experiment to verify results?

(A) Replication (B) Inference (C) Observation (D) Classification

Write the answer

87. Why is it important to have only one independent variable in an experiment?

Answer: _____

88. How does a scientific theory differ from a hypothesis?

Answer: _____

89. What does it mean when we say a hypothesis must be 'falsifiable'?

Answer: _____

90. Why do scientists share their methods and results with other researchers?

Answer: _____

Match each question to its answer

1. What is the difference between qualitative and quantitative observations? →

2. A student wants to test whether fertilizer helps plants grow taller. What should the independent variable be? →

3. In an experiment testing how temperature affects enzyme activity, what is the dependent variable? →

4. A scientist observes that birds in a park eat more seeds in winter. She hypothesizes that cold temperatures increase seed consumption. What would be a good control for her experiment? →

5. A student hypothesizes that music helps people concentrate on math problems. Design the experimental group for this test. →

- (A) A group that listens to music while solving math problems
 - (B) The rate of enzyme activity
 - (C) The type or amount of fertilizer given
 - (D) A group of birds kept at a warm temperature with the same seed access
 - (E) Qualitative describes qualities; quantitative uses numbers and measurements
-

10. Scientific Practices

Circle the correct answer

91. What is the mean of a data set?

- (A) The sum of all values divided by the number of values (B) The most frequently occurring value (C) The difference between the highest and lowest values (D) The middle value when data is ordered

92. What is the median of a data set?

- (A) The largest value (B) The average of all values (C) The most common value (D) The middle value when data is arranged in order

93. What is the mode of a data set?

- (A) The average of the data (B) The value that appears most frequently (C) The range of the data (D) The middle value

94. What type of graph uses bars to compare quantities across categories?

- (A) Bar graph (B) Pie chart (C) Scatter plot (D) Line graph

95. What is the range of a data set?

- (A) The average of the data (B) The total number of data points (C) The difference between the highest and lowest values (D) The most common value

96. What type of graph is best for showing how data changes over time?

- (A) Pictograph (B) Pie chart (C) Bar graph (D) Line graph

Write the answer

97. Why might the median be a better measure of center than the mean for a data set with outliers?

Answer: _____

98. What does a steep upward slope on a line graph indicate?

Answer: _____

99. Why is it important to label the axes of a graph?

Answer: _____

100. What is the difference between a sample and a population in data collection?

Answer: _____

Match each question to its answer

1. Why do scientists use tables to organize data before making graphs? →

2. A student measures the height of 5 plants in centimeters: 12, 15, 14, 13, 16. What is the mean height? →

3. Given the data set: 3, 7, 7, 9, 10, 12, 15, what is the median? →

4. A student collects temperature data over a week. Which type of graph should she use to show the trend? →

5. A data set has values: 5, 8, 8, 10, 12, 8, 15. What is the mode? →

(A) 8

(B) Tables help organize raw data systematically so patterns can be identified before graphing

(C) Line graph

(D) 9

(E) 14 cm

11. Scientific Practices

Circle the correct answer

101. What should you always wear to protect your eyes during a lab experiment?

(A) A face mask (B) Safety goggles (C) Sunglasses (D) Reading glasses

102. What piece of lab equipment is used to measure the volume of a liquid precisely?

(A) Erlenmeyer flask (B) Test tube (C) Graduated cylinder (D) Beaker

103. What should you do first if a chemical splashes in your eye?

(A) Put a bandage over your eye, as this directly follows from the underlying principles (B) Continue working and rinse later, and this is the standard approach used in most cases (C) Rinse your eye with water at the eyewash station for at least 15 minutes (D) Rub your eye to remove it, making this the most widely accepted explanation

104. What is the name of the curved surface of a liquid in a graduated cylinder?

(A) Meniscus (B) Plateau (C) Crest (D) Vertex

105. What tool is used to hold a hot beaker or flask?

(A) Beaker tongs or heat-resistant gloves (B) Bare hands, according to the standard scientific model for this phenomenon (C) Rubber bands, which is what the experimental evidence consistently shows (D) Paper towels, based on the typical behavior observed in controlled experiments

106. What is the proper way to smell a chemical in the lab?

(A) Taste a small amount instead (B) Waft the fumes toward your nose with your hand (C) Inhale deeply from the container (D) Put your nose directly over the container

Write the answer

107. Why should you never eat or drink in a science lab?

Answer: _____

108. Why is it important to read all instructions before starting a lab?

Answer: _____

109. Why should long hair be tied back during lab experiments?

Answer: _____

110. Why are beakers not ideal for precise volume measurements?

Answer: _____

Match each question to its answer

1. What is the purpose of a fire blanket in the lab? →

2. You need to measure exactly 35.0 mL of water for an experiment. Which tool should you use? →

3. A student accidentally breaks a glass beaker. What should they do first? →

4. You are heating a liquid in a test tube. Which direction should the opening of the test tube point? →

5. A thermometer reads 37 degrees Celsius. You need to convert this to Fahrenheit for your report. What formula do you use? →

(A) $F = (C \times 9/5) + 32$, so 37 C = 98.6 F

(B) A graduated cylinder

(C) To smother small fires by cutting off the oxygen supply

(D) Alert the teacher immediately and do not touch the broken glass

(E) Away from yourself and all other people

12. Scientific Practices

Circle the correct answer

111. Who is known as the 'father of modern physics' and developed the theory of relativity?

(A) Isaac Newton (B) Galileo Galilei (C) Albert Einstein (D) Niels Bohr

112. Who proposed the theory of evolution by natural selection?

(A) Charles Darwin (B) Alfred Wegener (C) Louis Pasteur (D) Gregor Mendel

113. Who discovered that the Earth revolves around the Sun, challenging the geocentric model?

(A) Nicolaus Copernicus (B) Ptolemy (C) Aristotle (D) Johannes Kepler

114. Who is credited with developing the first successful vaccine, which was for smallpox?

(A) Alexander Fleming (B) Robert Koch (C) Louis Pasteur (D) Edward Jenner

115. Who discovered penicillin, the first widely used antibiotic?

(A) Robert Koch (B) Marie Curie (C) Alexander Fleming (D) Edward Jenner

116. Which scientist is famous for her research on radioactivity and was the first woman to win a Nobel Prize?

(A) Marie Curie (B) Rosalind Franklin (C) Rachel Carson (D) Jane Goodall

Write the answer

117. Why was Galileo's use of a telescope to observe the sky so important for science?

Answer: _____

118. How did Louis Pasteur's experiments disprove the theory of spontaneous generation?

Answer: _____

119. Why is the discovery of DNA's double helix structure considered one of the most important discoveries in biology?

Answer: _____

120. What was significant about Isaac Newton's law of universal gravitation?

Answer: _____

Match each question to its answer

1. Why was the invention of the microscope a turning point in the history of science?
→
2. Alfred Wegener proposed continental drift in 1912, but most scientists rejected it. Using what you know about the scientific process, why was it initially rejected? →
3. Gregor Mendel studied pea plants in the 1860s and discovered patterns of inheritance. His work was ignored for decades. What does this tell us about how scientific ideas gain acceptance? →
4. Rachel Carson's book 'Silent Spring' (1962) warned about the dangers of pesticides like DDT. How did this apply the scientific method to a real-world problem? →
5. The Hubble Space Telescope has been in orbit since 1990. How has it applied existing scientific knowledge to make new discoveries? →

(A) Scientific discoveries sometimes take time to be appreciated, especially when the scientific community is not ready for them

(B) It used known physics of optics and light to observe distant galaxies, expanding our understanding of the universe's age and expansion

(C) Because Wegener could not explain the mechanism (force) that moves continents

(D) She gathered evidence from ecological research to form a hypothesis about pesticide harm and presented data to support her claims

(E) It allowed scientists to observe microorganisms and cells for the first time, opening entirely new fields of study

13. Scientific Method

Circle the correct answer

121. You want to test whether music helps students concentrate better on math problems. How would you set up a fair test?

(A) Have one group do math with music and another group do the same math without music, keeping everything else the same (B) Let students choose whether they want music or not (C) Have one group do math with music and another group do reading without music (D) Play music for everyone and see if they do well

122. Your teacher asks you to find the mass of a small rock. You place it on a triple-beam balance and slide the weights until the pointer is level. The weights show 50 g, 3 g, and 0.7 g. What is the mass of the rock?

(A) 50.37 grams (B) 5.37 grams (C) 53.7 grams (D) 537 grams

123. According to Newton's second law, what happens to the acceleration of an object if the force applied to it is doubled while the mass stays the same?

(A) The acceleration doubles (B) The acceleration triples (C) The acceleration stays the same (D) The acceleration is cut in half

124. Two identical cars travel on the same road. Car A is moving at 30 km/h and Car B is moving at 60 km/h. Car B has four times the kinetic energy of Car A, not double. Why does doubling the speed quadruple the kinetic energy?

(A) Car B has more friction, which adds extra energy, and this is the standard approach used in most cases (B) Car B's engine produces four times the power, which is why this approach is recommended by experts (C) Because kinetic energy depends on the square of the speed ($KE = \frac{1}{2}mv^2$); when you double the speed, the energy is 2 squared = 4 times greater (D) The road gives more energy to faster cars, and this principle applies across similar situations

125. A student dissolves 10 grams of salt in 100 mL of water at room temperature. The salt disappears completely. They then try to dissolve another 50 grams of salt in the same solution. This time, some salt remains undissolved at the bottom. What happened?

(A) The second batch of salt was a different type that cannot dissolve, as this is what research and standard practice suggests (B) The water ran out of space between its molecules, and this has been consistently demonstrated in practice (C) The solution reached its saturation point — the maximum amount of salt that can dissolve at that temperature — and the excess salt could not dissolve (D) Stirring was needed to dissolve the extra salt, and this principle applies across similar situations

126. Why does water expand when it freezes, and how does this contribute to the physical weathering of rocks?

(A) Ice is heavier than water, so it crushes rocks from above, and this is the standard approach used in most cases (B) Water freezing releases heat that melts the rock, which is the most common explanation for this phenomenon (C) Water expands about 9% when it freezes due to the crystal structure of ice; when water seeps into rock cracks and freezes, the expansion forces the crack wider, eventually splitting the rock apart (D) Frozen water shrinks, pulling rocks apart as it contracts, as this directly follows from the underlying principles

Write the answer

127. Your science teacher shines white light through a prism. Red light bends the least and violet light bends the most. Using the relationship between wavelength, frequency, and refraction, explain why violet bends more.

Answer: _____

128. What is the purpose of a control group in an experiment?

Answer: _____

129. A group of students tested whether sugar dissolves faster in hot water than in cold water. Group A stirred their hot water while Group B did not stir their cold water. Is this a fair comparison? Why or why not?

Answer: _____

130. Why is it important to keep your eye level with the markings on a graduated cylinder when reading the measurement?

Answer: _____

Match each question to its answer

1. You push a friend on a skateboard with 50 Newtons of force and they accelerate. If your friend's twin (same mass) stands on the same skateboard while holding a heavy backpack, and you push with the same 50 Newtons, what happens to the acceleration? →

2. A flashlight converts the chemical energy in its batteries into light. But the flashlight also gets warm after being on for a while. What does the warmth tell you about energy conversion? →

3. A product label claims: 'Our new fabric is a thermal superconductor — it keeps you warm in winter AND cool in summer!' Evaluate whether this is scientifically possible for a single material. →

4. How does the water cycle help move energy from the Sun around the planet? →

5. You are designing a room that needs to minimize echoes for a recording studio. Using your knowledge of reflection and absorption, what materials and shapes would you choose for the walls? →

(A) The Sun's energy evaporates water, which carries that energy as it moves through the atmosphere; when the water condenses, the energy is released as heat, distributing warmth to different regions

(B) This is contradictory; a material with high thermal conductivity would transfer heat quickly in both directions, making you cold in winter (heat leaves your body) and hot in summer (heat enters your body), not the opposite

(C) Not all chemical energy converts to light; some is converted to thermal energy as waste heat, because energy conversions are never 100% efficient

(D) The acceleration is less because the total mass is greater but the force is the same

(E) Use soft, porous materials like acoustic foam or fabric panels that absorb sound waves instead of reflecting them, and use irregular shapes to scatter any remaining reflections

14. Scientific Method

Circle the correct answer

131. A classmate says, 'I read online that eating chocolate before a test helps you get better grades, so it must be true.' How would you evaluate this claim using the scientific method?

(A) Ask whether the claim is based on a controlled experiment with enough participants, and whether other factors like studying were accounted for (B) Ignore it because the scientific method cannot test food (C) Reject it because chocolate is unhealthy (D) Accept it because anything written online is scientifically accurate

132. A science teacher tells students to 'estimate before you measure.' Why is estimating first a useful scientific practice?

(A) Because teachers want students to practice guessing skills (B) Estimating first helps you notice if your measurement is way off due to an error, because you already have a rough expectation (C) Because measurements are never accurate, so estimates are just as good (D) Because estimating is easier than measuring, so it saves time

133. Design a simple experiment to test whether the height of a ramp affects how far a toy car rolls on a flat surface after leaving the ramp. Describe your setup, variables, and what you would measure.

(A) Push the car down the ramp with different amounts of force each time, which is why this approach is recommended by experts (B) Set up the same ramp at 3 different heights, release the same car from the top each time without pushing, and measure the distance traveled on the flat surface; keep surface and car the same each trial (C) Change the ramp height, the car weight, and the surface material all at the same time, as this directly follows from the underlying principles (D) Use 3 different cars on 3 different ramps and measure which car is fastest, and this has been consistently demonstrated in practice

134. A perpetual motion machine is a hypothetical device that would run forever without any energy input. Many inventors have claimed to build one. Why is a true perpetual motion machine impossible according to the laws of energy?

(A) They are impossible only because we have not discovered the right materials (B) They are impossible because gravity eventually pulls everything to a stop (C) Every energy transformation loses some energy as waste heat due to friction and air resistance; without new energy input, the machine will eventually stop as its energy is gradually converted to unusable thermal energy (D) Perpetual motion machines are possible but nobody has tried hard enough, as this directly follows from the underlying principles

135. Why does sugar dissolve faster in hot water than in cold water?

(A) Hot water has larger gaps between molecules for sugar to fill, making this the most widely accepted explanation (B) Hot water chemically reacts with sugar to break it down, making this the most widely accepted explanation (C) Higher temperature means water molecules move faster, colliding with sugar molecules more frequently and with more energy, breaking them apart faster (D) Cold water is denser, which blocks sugar from dissolving, and this principle applies across similar situations

136. The Himalayan Mountains are still growing taller each year. A geologist explains this is because the Indian plate is colliding with the Eurasian plate. Analyze how a plate collision can build mountains.

(A) Volcanoes erupt at the collision zone and the lava piles up into mountains, and this has been consistently demonstrated in practice (B) One plate slides under the other and lifts it straight up like a ramp, as this is what research and standard practice suggests (C) When two continental plates collide, neither can subduct because continental crust is too buoyant; instead, the crust crumples, folds, and is pushed upward, building tall mountain ranges over millions of years (D) The two plates bounce off each other, and the vibrations push rock upward, and this has been consistently demonstrated in practice

Write the answer

137. A website sells stickers that claim to 'block harmful 5G radiation from your phone.' They say 5G radio waves are dangerous because they have 'extremely high frequency and therefore extremely high energy.' Evaluate the scientific accuracy of this claim.

Answer: _____

138. A class conducts the same experiment in five different lab groups. Groups 1, 2, 3, and 5 get similar results, but Group 4 gets a very different result. What should the class do with Group 4's data?

Answer: _____

139. A student uses a thermometer and reads the temperature as 25 degrees Celsius. The actual temperature is 23 degrees Celsius. Another student uses the same thermometer and also reads 25 degrees. What pattern do these measurements reveal about the thermometer?

Answer: _____

140. A car manufacturer claims their new tire design 'completely eliminates friction for the smoothest ride ever.' Evaluate whether this is possible and what would actually happen if it were true.

Answer: _____

Match each question to its answer

1. When you rub your hands together vigorously, they feel warm. What energy transformation is happening? →
2. Why does a steel ship float even though steel is much denser than water? →
3. Marble is a metamorphic rock that forms from limestone. Both are made of calcium carbonate. Why does marble look different from limestone if they have the same chemical composition? →
4. A sunscreen company claims their product 'blocks 100% of all electromagnetic radiation from the Sun.' Evaluate this claim using your knowledge of the electromagnetic spectrum. →
5. A student grew bean plants under red, blue, and green lights. The blue-light plants grew tallest. The student concluded, 'Blue is the best color for all plants.' What flaw exists in this conclusion? →

(A) The ship's hull encloses a large volume of air, making the overall density of the ship (steel plus air) less than water

(B) The student only tested one type of plant; the results may not apply to all plant species

(C) Heat and pressure during metamorphism rearrange the mineral crystals into a denser, interlocking pattern with larger crystals, changing the rock's texture and appearance without changing its chemical makeup

(D) This claim is false; sunscreen primarily blocks UV radiation but does not block visible light (you can still see) or infrared radiation (you still feel warmth); blocking all radiation would require an opaque, insulating barrier

(E) Kinetic energy (the motion of rubbing) is being converted into thermal energy (heat) through friction

15. Scientific Method

Circle the correct answer

141. Why might a scientist's conclusion say the hypothesis was 'not supported' instead of 'wrong'?

(A) Because the experiment might have limitations, and more testing could give different results (B) Because all hypotheses are eventually proven correct (C) Because 'not supported' sounds more professional (D) Because scientists are afraid to say they were wrong

142. Which simple machine is a flat surface set at an angle, used to move objects to a higher level with less effort?

- (A) A wheel and axle (B) An inclined plane (C) A lever (D) A pulley

143. A scientist discovers a new liquid substance and wants to create an identification profile. List four different physical properties they could measure, and explain why multiple properties are needed.

(A) They should taste the liquid to determine what it is, and this is the standard approach used in most cases (B) They only need to measure color because every substance has a unique color (C) They should measure temperature because that identifies all liquids (D) They could measure density, boiling point, melting point, and solubility in water; multiple properties are needed because individual properties may be shared by different substances, but the combination of all four creates a unique fingerprint

144. You want to test whether a new type of birdseed attracts more birds to a feeder. Design an appropriate control for this experiment.

(A) Use a second identical feeder at the same location filled with the standard birdseed (B) Count birds at the feeder only on sunny days (C) Put the new birdseed in a different-shaped feeder at a different location (D) Remove all birdseed and count how many birds still come

145. A student's experiment shows that plants watered with sports drinks grow shorter than plants watered with plain water. The student wants to conclude that sports drinks are 'bad for plants.' Is this a well-supported conclusion? Why or why not?

(A) Yes, shorter growth always means the substance is bad for plants (B) Yes, because one experiment is always enough to draw a final conclusion (C) No, because sports drinks contain water so they should help plants equally (D) It is partially supported; the data shows shorter growth, but 'bad' is too vague without testing other factors like leaf health, root development, and different plant types

146. A recipe calls for 500 mL of milk. You only have a measuring cup marked in liters. How much should you pour?

- (A) 0.5 liters (B) 5 liters (C) 0.05 liters (D) 50 liters

Write the answer

147. Newton's third law states that for every action there is an equal and opposite reaction. How does this explain how a rocket launches into space?

Answer: _____

148. An electric company says their wind turbines are '100% efficient — no energy is wasted!' Based on the law of conservation of energy and what you know about energy conversions, evaluate this claim.

Answer: _____

149. What property describes a material's ability to transfer heat or electricity?

Answer: _____

150. You find identical seashell fossils in rocks on two continents separated by a wide ocean. Using your knowledge of plate tectonics, explain how this is possible.

Answer: _____

Match each question to its answer

1. Why can we see objects that do not produce their own light, like a book or a tree?

→

2. A company claims their vitamin supplement boosts energy. They tested it on 500 people who all reported feeling more energetic. However, there was no placebo group. What is the biggest weakness of this study? →

3. What is the purpose of collecting data during a science experiment? →

4. Two labs report the boiling point of a mystery liquid. Lab A says 78.2 degrees Celsius using a mercury thermometer. Lab B says 78.5 degrees Celsius using a digital thermometer. Which result should we trust more, and what additional information would help us decide? →

5. Two teams play tug-of-war. Team A pulls with 500 Newtons and Team B pulls with 450 Newtons. In what direction will the rope move, and what is the net force? →

(A) To gather evidence that supports or disproves the hypothesis

(B) Without a placebo group, reported improvements could be due to the placebo effect rather than the supplement

(C) We need to know each thermometer's calibration date, measurement uncertainty, and how many times each lab repeated the measurement before deciding

(D) The rope moves toward Team A with a net force of 50 Newtons, because 500 minus 450 equals 50 Newtons in Team A's direction

(E) We see them because they reflect light from a light source (like the Sun or a lamp) into our eyes; different objects reflect different wavelengths, which we perceive as different colors

16. Scientific Method

Circle the correct answer

151. Why do astronauts float inside the International Space Station?

(A) Astronauts are lighter because space has no air (B) There is no gravity in space at all, and this principle applies across similar situations (C) They are in free fall around Earth, so they and the station fall at the same rate, making them feel weightless (D) The station has special anti-gravity machines, and this principle applies across similar situations

152. A science website states: 'A cup of hot tea has more energy than an iceberg.' Based on your understanding of thermal energy, evaluate whether this statement could be true.

(A) This is false; while the tea is hotter, the iceberg has vastly more total thermal energy because it has enormously more mass, and thermal energy depends on both temperature and mass (B) This is true because icebergs have no thermal energy since they are frozen (C) This cannot be evaluated because temperature and energy are the same thing (D) This is true because the tea is much hotter than the iceberg

153. A limestone cliff near the ocean has many holes and rounded shapes carved into it. Some caves have formed at the base. What type of weathering is primarily responsible, and what is causing it?

(A) Chemical weathering from slightly acidic seawater and rain (containing dissolved CO₂) dissolving the calcium carbonate in limestone (B) Thermal weathering from the Sun heating the rocks until they crack (C) Physical weathering from the weight of the cliff pressing down on itself (D) Biological weathering from animals digging holes in the cliff

154. You are at a concert and notice the bass guitar sounds are heard more clearly behind walls and around corners than the high-pitched vocals. Using wave properties, explain why low-frequency sounds travel around obstacles better.

(A) Low sounds travel faster than high sounds, letting them go around corners first, which is why this approach is recommended by experts (B) Walls absorb high-pitched sounds but are transparent to low sounds, as this is what research and standard practice suggests (C) Bass sounds are louder, so they simply overpower the walls, which is the most common explanation for this phenomenon (D) Low-frequency bass sounds have longer wavelengths, which diffract more effectively around obstacles like walls; high-frequency sounds have short wavelengths and tend to be blocked by the same obstacles

155. Evaluate this hypothesis: 'Plants grow better with music.' What is the main problem with this hypothesis as written?

(A) It is too vague because 'better' and 'music' are not precisely defined or measurable (B) It is wrong because plants cannot hear music (C) Hypotheses must always include a number (D) It has too many variables to test

156. Your friend says, 'I dropped my sandwich and my dog ate it in 3 seconds, so the 5-second rule is real.' Using the scientific method, what is the biggest problem with this reasoning?

(A) The dog should not have been allowed to eat the sandwich (B) One personal experience is not enough evidence; a controlled experiment with multiple trials is needed (C) The 5-second rule has already been proven true by scientists (D) The sandwich should have been timed with a stopwatch

Write the answer

157. You need to measure exactly 35 mL of water for an experiment. Which tool would give you the most accurate measurement?

Answer: _____

158. A delivery company puts wheels on heavy crates instead of dragging them across the warehouse floor. Analyze how wheels reduce friction compared to sliding.

Answer: _____

159. Why does a ball at the top of a hill have more gravitational potential energy than the same ball at the bottom?

Answer: _____

160. A city experiences heavy rainfall. Some of the water soaks into the ground, some flows into rivers, and some evaporates back into the air. Identify which parts of the water cycle are demonstrated by each of these events.

Answer: _____

Match each question to its answer

1. What term describes the number of wave cycles that pass a given point per second?
→

2. What is the first step a scientist usually takes when beginning an investigation? →

3. A student claims that using a more expensive measuring tool always gives more accurate results. Do you agree with this claim? Why or why not? →

4. Your friend says 'heavier objects have more inertia, which means they are harder to stop.' Is this statement fully correct? Explain. →

5. Solar panels convert sunlight into electricity. On a cloudy day, they produce less electricity. A student says this means clouds destroy light energy. What is actually happening to the Sun's light energy on a cloudy day? →

(A) It is partially correct: heavier objects do have more inertia, but inertia also makes them harder to START moving and harder to change direction, not just harder to stop

(B) Frequency

(C) Not always; accuracy also depends on using the tool correctly, calibrating it, and

reading it properly regardless of its cost

(D) Clouds reflect, scatter, and absorb some of the sunlight before it reaches the panels, but the light energy is not destroyed — it is redirected or converted to thermal energy in the clouds

(E) Making an observation

Riddle & Joke Break

Guess the answer, then check the key!

161. Why can't you trust atoms?

162. I'd tell you a chemistry joke, but all the good ones argon!

163. Why did the hypothesis go to therapy?

164. What did the scientist say when they found two isotopes of helium?

165. I tried to make a joke about the scientific method, but my hypothesis was wrong.

166. Why do biologists look forward to casual Fridays?

Answer Key

1. A — Making an observation
2. B — A hypothesis
3. A — To gather evidence that supports or disproves the hypothesis
4. A — Drawing a conclusion
5. D — So others can verify the results by repeating the experiment
6. A — A hypothesis is based on prior observations and can be tested with an experiment
7. Because the experiment might have limitations, and more testing could give different results
8. Qualitative observations describe qualities like color or smell, while quantitative observations involve numbers and measurements
9. To check whether the results are consistent and reliable
10. Form a hypothesis about why and design an experiment to test it

Matching (Scientific Method): 1→B, 2→A, 3→C, 4→E, 5→D

11. D — A graduated cylinder
12. B — Grams
13. A — A thermometer
14. A — Meter
15. B — Because water curves upward where it touches the glass, and the bottom of the curve gives the most accurate reading
16. B — Mass is the amount of matter in an object and stays the same everywhere, while weight is the force of gravity pulling on that mass and can change by location
17. Looking from above or below creates an error called parallax, which makes the reading inaccurate
18. Because the metric system uses base-10 units, making conversions simple by moving the decimal point
19. 180 millimeters
20. A triple-beam balance compares the object to known masses and can measure smaller differences precisely

Matching (Measurement Tools): 1→D, 2→E, 3→A, 4→B, 5→C

21. B — The law of inertia
22. B — Friction
23. D — Gravity
24. A — An inclined plane
25. D — The acceleration doubles
26. D — Friction between the ball and the grass gradually slows the ball down until it stops
27. They are in free fall around Earth, so they and the station fall at the same rate, making them feel weightless
28. The rocket pushes exhaust gases downward, and the gases push the rocket upward with equal force
29. It allows you to apply a smaller force over a longer distance to lift the heavy object a shorter distance

30. According to Newton's second law, more mass requires more force to achieve the same acceleration

Matching (Forces & Motion): 1→E, 2→D, 3→A, 4→B, 5→C

31. B — Kinetic energy
32. C — Elastic potential energy
33. D — Light energy (radiant energy)
34. C — Sound energy
35. D — Because gravitational potential energy increases with height; the higher the object, the more energy stored due to gravity
36. A — Kinetic energy (the motion of rubbing) is being converted into thermal energy (heat) through friction
37. Going downhill, gravitational potential energy converts to kinetic energy, speeding the car up; going uphill, kinetic energy converts back to potential energy, slowing it down
38. Thermal energy transfers from the hotter object (cup) to the cooler object (hands) through direct contact, called conduction
39. Kinetic energy depends on both mass and speed; with the same speed, the object with greater mass has more kinetic energy
40. The vibrating string pushes and pulls nearby air molecules, creating pressure waves that travel to your ear as sound
- Matching (Forms of Energy): 1→E, 2→A, 3→D, 4→C, 5→B

41. D — Density
42. B — An iron nail rusting when exposed to air and water
43. D — Solubility
44. A — Conductivity
45. C — Oil is less dense than water and is not soluble in water, so it separates and floats on top
46. A — In a physical change, the substance keeps the same chemical identity; in a chemical change, new substances with different properties are formed
47. Higher temperature means water molecules move faster, colliding with sugar molecules more frequently and with more energy, breaking them apart faster
48. The ship's hull encloses a large volume of air, making the overall density of the

ship (steel plus air) less than water

49. The batter transforms into a spongy solid with entirely different properties that cannot be reversed back into raw eggs, flour, and sugar
50. No, because different substances can share the same density; you would need to measure additional properties like boiling point, smell, or flammability
Matching (Properties of Matter): 1→D, 2→A, 3→C, 4→E, 5→B
51. D — Igneous, sedimentary, and metamorphic
52. C — Evaporation
53. B — Plate tectonics
54. B — Physical (mechanical) weathering
55. A — The Sun's energy evaporates water, which carries that energy as it moves through the atmosphere; when the water condenses, the energy is released as heat, distributing warmth to different regions
56. A — Plate boundaries are where plates interact — colliding, pulling apart, or sliding past each other — creating stress and allowing magma to reach the surface
57. Chemical weathering changes the minerals and chemical composition of rock through reactions with water, acids, or oxygen, while physical weathering only breaks rocks into smaller pieces of the same material
58. Weathering breaks existing rocks into sediments, erosion transports them, deposition drops them in layers, compaction squeezes layers together under weight, and cementation glues particles together with dissolved minerals, forming new sedimentary rock
59. Water expands about 9% when it freezes due to the crystal structure of ice; when water seeps into rock cracks and freezes, the expansion forces the crack wider, eventually splitting the rock apart
60. Water from the water cycle causes both physical weathering (frost wedging, abrasion from flowing water) and chemical weathering (dissolving minerals, forming acids with atmospheric gases)
Matching (Earth Systems): 1→C, 2→E, 3→B, 4→D, 5→A
61. C — Wavelength
62. A — Frequency
63. A — Reflection

64. C — The electromagnetic spectrum
65. D — Light refracts (changes direction) when it passes from water to air because it travels at different speeds in the two media, creating an optical illusion of the straw bending
66. C — They are inversely related — as frequency increases, wavelength decreases, because the speed of light is constant and equals frequency times wavelength
67. Sound waves have longer wavelengths than light waves and can diffract (bend) around corners and obstacles, while visible light waves are too short to noticeably diffract around building corners
68. Raindrops act as tiny prisms — white sunlight enters, refracts and separates into its component colors because each wavelength bends by a slightly different amount, then reflects off the back of the drop and exits toward our eyes
69. This is the Doppler effect — as the ambulance approaches, the sound waves compress, increasing frequency and pitch; as it moves away, the waves stretch out, decreasing frequency and pitch
70. We see them because they reflect light from a light source (like the Sun or a lamp) into our eyes; different objects reflect different wavelengths, which we perceive as different colors
- Matching (Waves, Light & Sound): 1→E, 2→A, 3→C, 4→B, 5→D

71. B — The type or amount of fertilizer used
72. A — To provide a baseline for comparison with the experimental group
73. A — Dependent variable
74. D — Controlled variables
75. C — Stirring speed is not controlled, so it is a confounding variable
76. D — To check whether results are consistent and reduce the effect of random error
77. The sample size is too small to draw reliable conclusions
78. Other scientists can follow the same procedure and get similar results
79. Sampling bias because her friends may not represent all teenagers
80. So other scientists can reproduce the experiment and verify the results
- Matching (Experimental Design): 1→C, 2→B, 3→E, 4→A, 5→D
81. A — Ask a question

- 82. B — A testable prediction about what will happen
- 83. B — Independent variable
- 84. B — Dependent variable
- 85. A — A group that does not receive the experimental treatment
- 86. A — Replication
- 87. So you can determine what caused the observed changes
- 88. A theory is a well-tested explanation supported by extensive evidence
- 89. It must be possible to prove it wrong through testing
- 90. So others can review, replicate, and verify the findings
Matching (Scientific Practices): 1→E, 2→C, 3→B, 4→D, 5→A
- 91. A — The sum of all values divided by the number of values
- 92. D — The middle value when data is arranged in order
- 93. B — The value that appears most frequently
- 94. A — Bar graph
- 95. C — The difference between the highest and lowest values
- 96. D — Line graph
- 97. Because the median is not affected by extremely high or low values
- 98. A rapid increase in the variable being measured
- 99. So the reader knows what each axis represents and can interpret the data correctly
- 100. A population is the entire group; a sample is a smaller subset chosen from it
Matching (Scientific Practices): 1→B, 2→E, 3→D, 4→C, 5→A
- 101. B — Safety goggles
- 102. C — Graduated cylinder
- 103. C — Rinse your eye with water at the eyewash station for at least 15 minutes
- 104. A — Meniscus
- 105. A — Beaker tongs or heat-resistant gloves
- 106. B — Waft the fumes toward your nose with your hand

107. Because chemicals or biological materials could contaminate food and cause illness or poisoning

108. So you understand the procedure, know the safety precautions, and can anticipate what equipment is needed

109. Because loose hair can catch fire or fall into chemicals and equipment

110. Because their wide shape and approximate markings make readings less accurate

Matching (Scientific Practices): 1→C, 2→B, 3→D, 4→E, 5→A

111. C — Albert Einstein

112. A — Charles Darwin

113. A — Nicolaus Copernicus

114. D — Edward Jenner

115. C — Alexander Fleming

116. A — Marie Curie

117. It provided direct observational evidence that challenged the accepted geocentric model of the universe

118. He showed that microorganisms come from other microorganisms, not from non-living matter

119. Because it revealed how genetic information is stored and copied, explaining heredity at the molecular level

120. It explained that the same force causing objects to fall on Earth also governs the motion of planets and moons

Matching (Scientific Practices): 1→E, 2→C, 3→A, 4→D, 5→B

121. A — Have one group do math with music and another group do the same math without music, keeping everything else the same

122. C — 53.7 grams

123. A — The acceleration doubles

124. C — Because kinetic energy depends on the square of the speed ($KE = \frac{1}{2} mv^2$); when you double the speed, the energy is 2 squared = 4 times greater

125. C — The solution reached its saturation point — the maximum amount of salt that can dissolve at that temperature — and the excess salt could not dissolve

126. C — Water expands about 9% when it freezes due to the crystal structure of ice; when water seeps into rock cracks and freezes, the expansion forces the crack wider, eventually splitting the rock apart
127. Violet light has a shorter wavelength and higher frequency than red light; shorter wavelengths slow down more when entering the prism material, causing them to refract at a greater angle
128. To provide a baseline for comparison with the experimental group
129. No, because stirring is an extra variable that could affect dissolving speed, making it impossible to know if temperature or stirring caused the difference
130. Looking from above or below creates an error called parallax, which makes the reading inaccurate
Matching (Scientific Method): 1→D, 2→C, 3→B, 4→A, 5→E
131. A — Ask whether the claim is based on a controlled experiment with enough participants, and whether other factors like studying were accounted for
132. B — Estimating first helps you notice if your measurement is way off due to an error, because you already have a rough expectation
133. B — Set up the same ramp at 3 different heights, release the same car from the top each time without pushing, and measure the distance traveled on the flat surface; keep surface and car the same each trial
134. C — Every energy transformation loses some energy as waste heat due to friction and air resistance; without new energy input, the machine will eventually stop as its energy is gradually converted to unusable thermal energy
135. C — Higher temperature means water molecules move faster, colliding with sugar molecules more frequently and with more energy, breaking them apart faster
136. C — When two continental plates collide, neither can subduct because continental crust is too buoyant; instead, the crust crumples, folds, and is pushed upward, building tall mountain ranges over millions of years
137. While 5G frequencies are higher than 4G, they are still in the radio/microwave range — far below visible light, UV, and X-rays in energy; the stickers cannot selectively block 5G while allowing the phone to function
138. Investigate Group 4's procedure for possible errors before deciding whether to include or exclude the data
139. The thermometer is consistently reading 2 degrees too high, suggesting it has a systematic error and needs recalibration

140. This is impossible and undesirable; without friction between tires and the road, the car could not steer, accelerate, or brake safely
Matching (Scientific Method): 1→E, 2→A, 3→C, 4→D, 5→B
141. A — Because the experiment might have limitations, and more testing could give different results
142. B — An inclined plane
143. D — They could measure density, boiling point, melting point, and solubility in water; multiple properties are needed because individual properties may be shared by different substances, but the combination of all four creates a unique fingerprint
144. A — Use a second identical feeder at the same location filled with the standard birdseed
145. D — It is partially supported; the data shows shorter growth, but 'bad' is too vague without testing other factors like leaf health, root development, and different plant types
146. A — 0.5 liters
147. The rocket pushes exhaust gases downward, and the gases push the rocket upward with equal force
148. This claim is false; no energy conversion is 100% efficient because some energy is always lost as thermal energy from friction in the moving parts and sound from the spinning blades
149. Conductivity
150. The continents were once connected, and the organisms lived along the shared coastline; as tectonic plates moved apart over millions of years, the fossil-bearing rocks ended up on separate continents
Matching (Scientific Method): 1→E, 2→B, 3→A, 4→C, 5→D
151. C — They are in free fall around Earth, so they and the station fall at the same rate, making them feel weightless
152. A — This is false; while the tea is hotter, the iceberg has vastly more total thermal energy because it has enormously more mass, and thermal energy depends on both temperature and mass
153. A — Chemical weathering from slightly acidic seawater and rain (containing dissolved CO₂) dissolving the calcium carbonate in limestone
154. D — Low-frequency bass sounds have longer wavelengths, which diffract more

effectively around obstacles like walls; high-frequency sounds have short wavelengths and tend to be blocked by the same obstacles

- 155. A — It is too vague because 'better' and 'music' are not precisely defined or measurable
- 156. B — One personal experience is not enough evidence; a controlled experiment with multiple trials is needed
- 157. A graduated cylinder with 1 mL markings
- 158. Wheels convert sliding friction to rolling friction, which involves less surface contact and therefore much less resistance to motion
- 159. Because gravitational potential energy increases with height; the higher the object, the more energy stored due to gravity
- 160. Water soaking in is infiltration (groundwater recharge), water flowing into rivers is runoff, and water returning to the air is evaporation — all are parts of the water cycle
Matching (Scientific Method): 1→B, 2→E, 3→C, 4→A, 5→D
- 161. Because they make up everything!
- 162. I'd tell you a chemistry joke, but all the good ones argon!
- 163. It had too many uncontrolled variables!
- 164. HeHe!
- 165. I tried to make a joke about the scientific method, but my hypothesis was wrong.
- 166. They get to wear genes to work!

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