

CAEC SCIENCE



TEST INFO

35 Questions
90 minutes

ALEX DAVEY-MUISE

**YARMOUTH COUNTY
LEARNING NETWORK**



MADE WITH CANVA

Key Characteristics of Science

Science is a systematic approach to discovering and understanding the natural world. It involves observing phenomena, formulating and testing hypotheses, and refining ideas based on evidence. Science is dynamic and continuously evolving as new discoveries are made.

1

Empirical Evidence

- Definition: Science is based on evidence that we can see and measure.
- Importance: This evidence helps us draw conclusions and makes sure that scientific claims are based on real facts.

2

Hypothesis and Testing

- Definition: A hypothesis is a suggested explanation or guess that can be tested through experiments and observations
- Importance: Testing hypotheses helps scientists confirm or reject ideas based on the results they find.

3

Repeatability

- Definition: Experiments and observations should be able to be repeated by others to check the results.
- Importance: Being able to repeat tests helps ensure that scientific findings are reliable and accurate.

4

Falsifiability

- Definition: Scientific ideas must be capable of being proven false.
- Importance: This helps make sure that scientific ideas are strong and can change if new evidence comes up.

5

Peer Review

- Definition: Scientific research is reviewed by other experts in the field before being published.
- Importance: Peer review helps maintain high standards of research quality and accuracy.

6

Theory Development

- Definition: Share complete explanations based on lots of evidence. They change and improve as new information is discovered.
- Importance: Theories help us understand complicated events and make predictions about what might happen.



Quiz

1. What is a fundamental characteristic of scientific knowledge?

- a) It is static and unchanging.
- b) It is based on personal beliefs.
- c) It is constantly evolving based on new evidence.
- d) It is solely derived from philosophical reasoning.

2. Which of the following best describes the scientific method?

- a) A series of steps followed to confirm existing theories.
- b) An approach to solving problems that involves observation, experimentation, and analysis.
- c) A method of guessing and checking until something works.
- d) A random process that relies on intuition.

3. What role do hypotheses play in science?

- a) They are final conclusions that must not be changed.
- b) They are tentative explanations that can be tested and refined.
- c) They are untestable ideas that guide research.
- d) They are specific laws that apply universally.

5. F
4. T
3. F
2. T
1. T

4. Why is replication important in scientific experiments?

- a) To confirm that the results are consistent and reliable.
- b) To ensure that the original experiment was conducted correctly.
- c) To make the experiment more complex and impressive.
- d) To validate the personal beliefs of the scientist.

T or F
10. b
9. a
8. b
7. b
6. b
5. b
4. a

5. Which of the following is a key characteristic of scientific theories?

- a) They are absolute truths that cannot be disproven.
- b) They are comprehensive explanations based on a body of evidence.
- c) They are speculative ideas without empirical support.
- d) They are temporary ideas that will soon be discarded.

3. b
2. b
1. c

Answers

6. How does peer review contribute to the scientific process?

- a) It ensures that only popular ideas are published.
- b) It provides a mechanism for validating research through evaluation by other experts in the field.
- c) It delays the publication of research indefinitely.
- d) It promotes the individual opinions of researchers over collective knowledge.

7. What is the role of observation in science?

- a) To verify the correctness of the scientific method.*
- b) To gather data and evidence that informs and supports hypotheses and theories.*
- c) To prove that theories are always correct.*
- d) To replace experimentation in the scientific process.*

8. Which statement best describes a scientific law?

- a) It is a theory that has been proven beyond all doubt.*
- b) It is a descriptive statement about how things consistently occur under specific conditions.*
- c) It is an unchangeable fact that applies to all situations.*
- d) It is an outdated concept that is no longer relevant.*

9. What distinguishes science from pseudoscience?

- a) Science relies on empirical evidence and reproducible results, while pseudoscience lacks these qualities.*
- b) Science is less rigorous than pseudoscience.*
- c) Pseudoscience uses more complex terminology.*
- d) Science avoids empirical evidence to maintain objectivity.*

10. What is the importance of falsifiability in a scientific hypothesis?

- a) It ensures that the hypothesis is always correct.*
- b) It allows the hypothesis to be tested and potentially proven wrong.*
- c) It guarantees that the hypothesis will be accepted without question.*
- d) It prevents any further testing or refinement of the hypothesis.*

True or False?

1. Scientists can study how plants grow by controlling how much water they get.

2.. The impact of sunlight on the growth of flowers can be studied scientifically.

3. Whether a new flavor of ice cream is good or bad can be studied scientifically.

4. How exercise affects heart rate can be studied scientifically.

5. The supernatural world can be studied scientifically.

The Scientific Method

The scientific method is a way to explore questions and find answers about the world around us. It helps scientists and anyone curious to solve problems and learn new things in a clear and organized way.

1

Observation

- What It Is: Identifying something interesting or unusual.
- Example: Observing that plants in different environments grow at different rates.

2

Question

- What It Is: Formulating a specific question about your observation.
- Example: How does sunlight affect plant growth?

3

Hypothesis

- What It Is: Proposing an explanation or prediction that can be tested.
- Example: Plants that receive more sunlight will grow faster.

4

Experiment

- What It Is: Designing and conducting experiments to test your hypothesis.
- Example: Growing two sets of plants, one in sunlight and one in the dark, and measuring their growth.

5

Analysis

- What It Is: Reviewing and interpreting the data collected from the experiment.
- Example: Comparing the growth rates of plants in sunlight versus those in the dark.

6

Conclusion

- What It Is: Determining whether the data supports or refutes the hypothesis.
- Example: Concluding that plants in sunlight grow faster, supporting the hypothesis.



The Scientific Method

1. What is the first step in the scientific method?

- a) Conduct an experiment
- b) Formulate a hypothesis
- c) Make observations about the natural world
- d) Analyze the results

2. Which step involves making an educated guess about what will happen in an experiment?

- a) Observation
- b) Hypothesis
- c) Experiment
- d) Conclusion

3. During which step do you test your hypothesis?

- a) Analysis
- b) Observation
- c) Experiment
- d) Conclusion

4. After analyzing data, what is the next step?

- a) Form a new hypothesis
- b) Write a report
- c) Draw conclusions
- d) Conduct additional experiments

5. After concluding a study, scientists often:

- a) Stop all research in that area
- b) Seek funding for unrelated topics
- c) Identify new questions or areas for further research
- d) Change the outcomes based on their preferences

Answers
1. c
2. b
3. c
4. c
5. c
T or F
F
F
T
F
F

True or False?

1. The scientific method only includes five steps.

True

False

2. You can skip steps in the scientific method if you already know the answer.

True

False

3. The conclusion should be based on the data collected during the experiment.

True

False

4. Making a hypothesis is done after the experiment has been completed.

True

False

5. A hypothesis must be proven true to be considered valid.

True

False

Put the steps of scientific inquiry into the correct order.

Conclusion, hypothesis, question, analysis, observation, experiment.

5f
4.f
3.T
2.F
1.F
T or F
5.c
4.c
3.b
2.b
1.c

Answers

How do Scientists Ensure Reliability, Validity, Integrity, and Credibility?

Scientists must ensure that their work is trustworthy and that their findings are accurate and reliable. This helps make sure that the scientific knowledge we gain is based on solid evidence and can be used to make informed decisions.

1

Scientific Methods

Ensures that experiments are conducted systematically and that results are based on evidence.

2

Placebos

A placebo is a fake treatment that looks like the real treatment but has no effect. It's often used in experiments to see if the actual treatment has an effect beyond what people expect.

3

Double-Blind Studies

In a double-blind study, neither the participants nor the researchers know who is receiving the actual treatment and who is receiving a placebo.

This prevents bias from influencing the results, ensuring that the findings are more reliable and accurate.

4

Large Sample Sizes

Using a large number of participants in an experiment makes the results more reliable and reduces the chance that the findings are due to chance. It also helps in understanding the effects on a broader population.



How do Scientists Ensure Reliability, Validity, Integrity, and Credibility?

Checks and balances are essential in science to ensure accuracy, fairness, and trust. They help scientists work together effectively and improve the quality of research.

5

Random Sampling

Choosing participants randomly from a larger group to be part of the experiment ensures that every individual has an equal chance of being selected, which helps in making the results more generalizable and fair.

6

Peer Review

Other scientists review the research before it is published which ensures that the research is accurate, well-conducted, and that the conclusions are based on solid evidence. It helps catch mistakes and improve the quality of the research.

7

Replicating Research

Conducting the same experiment again to see if the same results are obtained confirms that the original findings are reliable and not just a fluke. Replication helps build confidence in the results.



Understanding Observations, Inferences, and Bias in Science

- *Observations are the factual data we collect through our senses.*
- *Inferences are logical conclusions drawn from observations.*
- *Bias is a tendency that can skew how we interpret data and needs to be managed carefully to ensure accurate and objective results.*

1

Observations

Definition: Observations are the facts or details that we notice using our senses (sight, hearing, touch, taste, and smell).

Types of Observations:

- Qualitative Observations: Descriptive and non-numeric. For example, "The liquid is blue" or "The plant has round leaves."
- Quantitative Observations: Numeric and measurable. For example, "The liquid is 50 mL" or "The plant is 20 cm tall."

- Examples:
- Qualitative: The sky is cloudy.
- Quantitative: There are 25 students in the classroom.
- Why They Matter: Observations provide the evidence needed to form hypotheses and conduct experiments. They must be accurate and detailed to ensure reliable scientific results.

2

Inferences

Definition: Inferences are logical conclusions or interpretations based on observations. They help us make sense of the data and understand what is not directly observable.

How to Make Inferences:

1. Observe: Gather the data or details.
2. Analyze: Look for patterns or connections in the observations.
3. Interpret: Draw conclusions based on the analysis.

Examples:

- Observation: The ground is wet.
- Inference: It rained recently.
- Observation: A plant is not growing well.
- Inference: The plant may not be getting enough sunlight.



Observation or Inference?

Circle the correct answer

1. The temperature in the room is 22°C.

OBSERVATION INFERENCE

2. If the room is too cold, everyone will feel uncomfortable.

OBSERVATION INFERENCE

3. The plant grew 5 centimeters in a week.

OBSERVATION INFERENCE

4. The experiment showed that the water boiled at 100°C.

OBSERVATION INFERENCE

5. A person who sneezes frequently must have a cold.

OBSERVATION INFERENCE

6. The car's engine makes a loud noise when it starts.

OBSERVATION INFERENCE

7. The grass is wet so it must have rained overnight.

OBSERVATION INFERENCE

1. Z
0.9
1.5
0.4
0.2
1.2
0.1
Answers

Understanding Observations, Inferences, and Bias in Science

3 Bias

- *Observations are the factual data we collect through our senses.*
- *Inferences are logical conclusions drawn from observations.*
- *Bias is a tendency that can skew how we interpret data and needs to be managed carefully to ensure accurate and objective results.*

Definition: Bias is when someone prefers one viewpoint or outcome, which can change how they see or report information. It can make scientific findings less objective.

Types of Bias:

- **Confirmation Bias:** This is when someone only looks for information that supports what they already believe. For example, they might notice results that back up their hypothesis but ignore those that don't.
- **Selection Bias:** This happens when the way people are chosen for a study leads to unbalanced data. For example, if a survey only includes a specific group that doesn't represent everyone, the results will be skewed.
- **Observer Bias:** This occurs when a person's expectations affect how they see results. For instance, if someone expects a certain outcome, they might interpret the data in a way that confirms their expectation.

Summary

- Observations are the factual data we collect through our senses.
- Inferences are logical conclusions drawn from observations.
- Bias is a tendency that can skew how we interpret data and needs to be managed carefully to ensure accurate and objective results.

Understanding and applying these concepts helps ensure that scientific investigations are reliable, objective, and valid.



Understanding Observations, Inferences, and Bias in Science

Answers

10. a
9. a
8. c
7. b
6. b
5. b
4. b
3. c
2. c
1. b

1. What is "confirmation bias"?

- A) The tendency to seek out information that goes against existing beliefs.
- B) The inclination to only look at information that supports what you already believe.
- C) The bias that happens when data is chosen in a non-random way.
- D) The mistake in data collection because of faulty tools.

2. Which type of bias is most likely to occur if a survey is only conducted among a specific group?

- A) Observer Bias
- B) Confirmation Bias
- C) Selection Bias
- D) Experimenter Bias

3. What is the main goal of using "blind testing" in experiments?

- A) To increase the number of subjects.
- B) To keep subjects from knowing the expected result.
- C) To make sure the experimenter doesn't know the treatment conditions.
- D) To confirm a hypothesis by skipping peer review.

4. Why is peer review important in scientific research?

- A) It reduces the number of experiments needed.
- B) It helps find and fix potential biases and errors.
- C) It speeds up the publication process.
- D) It ensures only positive results are published.

5. What is an example of "observer bias"?

- A) Measuring the same sample with two different tools.
- B) Expecting a certain result and interpreting unclear data in a way that supports that expectation.
- C) Choosing only specific data points for analysis.
- D) Randomly assigning subjects to different groups.

6. How can researchers minimize "confirmation bias" in their studies?

- A) By only collecting data that supports their hypothesis.
- B) By considering and reporting all data, including results that do not support their hypothesis.
- C) By avoiding the use of statistical analysis.
- D) By focusing solely on qualitative data.

7. What does "experimenter bias" refer to?

- A) Bias caused by the people taking part in a study.
- B) Bias that comes from how the experiment is done or what the experimenter expects.
- C) Bias that happens because subjects are randomly assigned.
- D) Bias caused by outside factors, like weather conditions.

8. Which of the following is NOT a method for minimizing bias in scientific research?

- A) Double-blind experiments
- B) Random sampling
- C) Selective reporting of results
- D) Using control groups

9. Why is random sampling important in research?

- A) It makes sure everyone has an equal chance to be chosen, reducing selection bias.
- B) It guarantees that the results will be good.
- C) It makes the group size larger to improve accuracy.
- D) It makes analyzing the data easier.

10. What is the role of a control group in an experiment?

- A) To create a standard for comparison and show the effect of the tested variable.
- B) To make the experimental group bigger.
- C) To make sure the experimenter doesn't have any bias.
- D) To prove that the hypothesis is right.

TALKING POINTS

What factors can you think of that might make a scientist want to influence the results of their experiment?

What influences your decisions? What are your biases?

Understanding Dependent and Independent Variables

1

Independent Variable

- *What Are Variables?*

In scientific experiments, variables are elements that can change and affect the outcome of the experiment.

Understanding the roles of different types of variables is crucial for designing and interpreting experiments effectively.

Definition: The independent variable is the variable that you, the researcher, intentionally change or manipulate in an experiment. It is the cause in a cause-and-effect relationship.

Characteristics:

- **Manipulated by the Experimenter:** You control this variable to observe its effect.
- **Plotted on the X-Axis:** In graphs, the independent variable is usually placed on the horizontal axis.

Examples:

- If you're testing the effect of different amounts of sunlight on plant growth, the amount of sunlight is the independent variable.
- If you're examining how different temperatures affect the rate of a chemical reaction, the temperature is the independent variable.

2

Dependent Variable

Definition: The dependent variable is the variable that you measure or observe in the experiment. It is the effect or outcome that is influenced by changes in the independent variable.

Characteristics:

- **Measured and Observed:** This variable responds to changes in the independent variable.
- **Plotted on the Y-Axis:** In graphs, the dependent variable is typically placed on the vertical axis.

Examples:

- In the plant growth experiment, the growth of the plant (e.g., height or biomass) is the dependent variable.
- In the chemical reaction experiment, the rate of the reaction (e.g., time taken or amount of product formed) is the dependent variable.



1. What is an independent variable in an experiment?

- A) The variable that you measure or observe.
- B) The variable that you change or manipulate.
- C) The variable that stays the same throughout the experiment.
- D) The variable that is not relevant to the experiment.

Answers

2. What is a dependent variable in an experiment?

- A) The variable that you change to see its effect.
- B) The variable that you keep constant during the experiment.
- C) The variable that you measure to observe the effect of the independent variable.
- D) The variable that is affected by random chance.

6. a
5. d
4. c
3. c
2. c
1. b

3. In an experiment to test how different amounts of water affect plant growth, what is the independent variable?

- A) The height of the plant.
- B) The type of plant used.
- C) The amount of water given.
- D) The amount of sunlight the plant receives.

4. In the same experiment, what is the dependent variable?

- A) The type of plant used.
- B) The amount of water given.
- C) The height of the plant.
- D) The type of soil used.

5. If you are studying how different temperatures affect the rate of ice melting, which of the following is the independent variable?

- A) The rate of ice melting.
- B) The amount of ice.
- C) The type of container.
- D) The temperature at which the ice is kept.

6. Why is it important to keep certain variables constant in an experiment?

- A) To ensure that only the independent variable affects the dependent variable.
- B) To make the experiment more complex.
- C) To increase the number of variables.
- D) To make the results less reliable.

Control Groups

- *What is a control group?*

In scientific experiments, a control group is a standard against which other groups are compared. It is used to ensure that the results of an experiment are due to the effect of the variable being tested and not other factors.

1

Purpose of a Control Group

- **Establish Baseline:** Provides a baseline measurement to compare the effects of the independent variable.
- **Minimize Variables:** Helps to control or minimize the impact of other variables that could affect the outcome.
- **Ensure Valid Results:** Confirms that any observed effects are due to the treatment or condition being tested.

2

Example of a Control Group in an Experiment

Testing the Effect of Different Fertilizers on Plant Growth

- **Independent Variable:** Type of fertilizer.
- **Dependent Variable:** Plant growth (measured in height or biomass).
- **Control Group:** **Plants that receive no fertilizer or a standard fertilizer (not part of the experimental treatments).**
- **Experimental Groups:** Plants that receive different types of experimental fertilizers.

Talking Point

Imagine you are a scientist who has developed a new drug.

Do you think it is important to have a control group? Why?



Tools and Data Collection

Using the right tool in a science experiment is crucial for several reasons:

1. Accuracy and Precision
2. Validity of results
3. Minimizing errors
4. Efficiency
5. Safety

1

Beaker

A flat-bottomed glass container used for measuring and mixing liquids.



2

Graduated Cylinder

A tall, narrow container marked with lines for measuring the volume of liquids accurately.



3

Test Tube

A small glass tube used for holding, mixing, or heating small amounts of substances.



4

Microscope

An optical instrument used to view objects that are too small to be seen by the naked eye.



5

Thermometer

A device used to measure temperature.



6

Pipette

A tool used to transfer a precise volume of liquid from one place to another.



7

Bunsen Burner

A gas burner used to heat substances in a laboratory setting.



8

Petri Dish

A shallow dish made of glass or plastic used to culture microorganisms.



Fill in the Blanks

1. The _____ is used to view objects that are too small for the human eye.

2. To measure the volume of a liquid accurately, you would use a _____.

3. A _____ is used to transfer small, precise volumes of liquid from one container to another.

Answers

4. To measure the temperature of a substance, use a _____.

5. _____ are used to grow cultures of microorganisms.

5. petri dishes
4. thermometer
3. pipette
2. Grad. cylinder
1. microscope

Estimate the metric measurement for the items below.



4.5cm/ 4m/ 40m



35ml/ 350ml/ 350l



1.2cm/ 1.2m/ 12m



40ml/ 400ml/ 4l



2.65mm/26.5mm/26.5cm



4g/ 40g/ 400g



2g/ 200g/ 2kg



22g/ 220g/ 2.2kg



100ml/ 1l/ 10l

Answers

Sugar = 2kg, Apple = 220g, Jug = 10l
car = 4m, can = 350ml, Goal = 1.2m, Milk = 4l, Loonie = 2.65mm, lipstick = 4g,

Measurements and Conversions

In science experiments, choosing the correct units of measurement is crucial for collecting accurate data and effectively communicating your results. Different types of measurements require specific units, depending on what is being measured.

1

Length

- Unit: Meter (m)
- Subunits: Millimeter (mm), Centimeter (cm), Kilometer (km)
- Example Measurement: The length of a piece of string could be measured in centimeters, while the distance between cities is measured in kilometers.

2

Mass

- Unit: Kilogram (kg)
- Subunits: Gram (g), Milligram (mg)
- Example Measurement: The mass of an apple might be measured in grams, while the mass of a textbook is measured in kilograms.

3

Volume

- Unit: Cubic meter (m^3) for large volumes, Liter (L) for liquids
- Subunits: Milliliter (mL), Cubic centimeter (cm^3)
- Example Measurement: The volume of a liquid in a beaker could be measured in milliliters, while the volume of a room could be measured in cubic meters.

4

Time

- Unit: Second (s)
- Subunits: Minute (min), Hour (h)
- Example Measurement: The time it takes for a reaction to occur could be measured in seconds, while the duration of an experiment might be recorded in minutes or hours.

5

Temperature

- Unit: Kelvin (K) for scientific contexts; Celsius ($^{\circ}\text{C}$) for everyday use
- Example Measurement: The temperature of a reaction might be measured in Celsius, while scientific experiments might use Kelvin.

6

Speed

- Unit: Meter per second (m/s)
- Example Measurement: The speed of a moving object could be measured in meters per second.



Read each scenario carefully and select the most appropriate units of measurement from the provided options. Some questions have more than 1 correct answer.

1. Measuring Length

Scenario: You need to measure the length of a classroom.

- a) Millimeters (mm)
- b) Centimeters (cm)
- c) Meters (m)
- d) Kilometers (km)

Answers

6. a or b
5. a or b
4. a
3. d
2. b
1. c

2. Measuring Mass

Scenario: You are measuring the mass of a textbook.

- a) Milligrams (mg)
- b) Grams (g)
- c) Kilograms (kg)
- d) Tonnes (t)

3. Measuring Volume

Scenario: You need to measure a small volume of a liquid in a laboratory experiment.

- a) Liters (L)
- b) Cubic centimeters (cm³)
- c) Meters cubed (m³)
- d) Milliliters (mL)

4. Measuring Time

Scenario: You are recording the duration of a 100m running race.

- a) Seconds (s)
- b) Minutes (min)
- c) Hours (h)
- d) Days (d)

5. Measuring Temperature

Scenario: You need to record the temperature of a chemical reaction in a lab.

- a) Celsius (°C)
- b) Kelvin (K)
- c) Fahrenheit (°F)
- d) Rankine (°R)

6. Measuring Speed

Scenario: You are measuring the speed of a car on a racetrack.

- a) Meters per second
- b) Kilometers per hour
- c) Miles per minute
- d) Feet per minute

Measurements and Conversions in the Metric System



King **H**enry **D**ied **B**y **D**rinking **C**hocolate **M**ilk
Kilo- *Hecto-* *Deka-* **Base** *Deci-* *Centi-* *Milli-*



Meters
Liters
Grams

1

Watch the video about conversions in the decimal system.



https://www.youtube.com/watch?v=fT_5CzsGuOg

2

Practice

- 3.5 kilometers (km) to meters (m)
- 550 millimeters (mm) to centimeters (cm)
- 12.7 meters (m) to millimeters (mm)
- 5 kilograms (kg) to grams (g)
- 0.75 grams (g) to milligrams (mg)
- 250 milliliters (mL) to liters (L)
- 4.5 liters (L) to milliliters (mL)

Answers

a. 3500m
b. 55cm
c. 12,700mm
d. 5000g
e. 750mg
f. 0.25l
g. 4500ml

WHMIS and Safety in Science

1

Labels

Purpose: Labels provide crucial information about the hazards of a material and how to handle it safely.

Features:

- **Pictograms:** Symbols that indicate the type of hazard (e.g., flammable, corrosive).
- **Signal Words:** Terms like "Danger" or "Warning" to indicate the severity of the hazard.
- **Hazard Statements:** Descriptions of the nature of the hazard.
- **Precautionary Statements:** Safety measures to take when handling the material.

WHMIS stands for Workplace Hazardous Materials Information System. It is Canada's national communication standard for hazardous workplace materials. The purpose of WHMIS is to ensure that workers are informed about the hazards of the materials they work with and how to handle them safely.

2

Safety Data Sheets

Purpose: SDS provide detailed information about a hazardous material, including its properties, hazards, and safe handling practices.

Sections:

- **Identification:** Product name, supplier information.
- **Hazard Identification:** Description of hazards.
- **Composition/Information on Ingredients:** Chemical ingredients and their concentrations.
- **First-Aid Measures:** Instructions for treating exposure.
- **Fire-Fighting Measures:** Guidance on how to handle fires involving the material.
- **Accidental Release Measures:** Procedures for dealing with spills or leaks.
- **Handling and Storage:** Safe practices for using and storing the material.
- **Exposure Controls/Personal Protection:** Recommended safety equipment and exposure limits.



WHMIS PICTOGRAMS AND PROPER HANDLING

	Biohazardous infectious materials	Use PPE, such as gloves and eye protection. Follow strict hygiene practices, such as washing hands thoroughly after handling. Dispose of properly according to regulations.
	Flame Over Circle: Oxidizing gases, liquids, and solids.	Store away from flammable and combustible materials. Use non-reactive containers and avoid mixing with incompatible substances. Ensure adequate ventilation.
	Flame: Flammable gases, liquids, and solids.	Keep away from open flames, heat sources, and sparks. Store in a cool, dry place in properly labeled containers.
	Exclamation Mark: Less severe health effects, such as skin irritation or respiratory issues.	Use PPE, such as gloves and eye protection. Store in a clean, dry area and follow proper handling procedures. Avoid prolonged exposure and handle with care.
	Health Hazard: Carcinogenicity, respiratory issues, reproductive toxicity.	Use in well-ventilated areas or with appropriate ventilation systems. Wear protective clothing and follow safety data sheet (SDS) instructions. Conduct regular health monitoring and training.
	Corrosion: Corrosive damage to metals, skin, or eyes.	Wear appropriate personal protective equipment (PPE), such as gloves and goggles. Store in a well-ventilated area and use corrosion-resistant containers. Handle with care to avoid spills and leaks.
	Skull and Crossbones: Acute toxicity that can cause serious health effects or death.	Use appropriate PPE, including respiratory protection if necessary. Store in a secure area away from food and drink. Follow strict hygiene practices, such as washing hands thoroughly after handling.
	Exploding Bomb: Explosives, self-reactive substances.	Store away from sources of ignition. Use explosion-proof equipment. Handle with care to avoid impact or friction.
	Environment: Harmful effects to aquatic life.	Avoid releasing into the environment; use containment measures. Dispose of properly according to regulations. Report spills or leaks immediately to appropriate authorities.
	Gases stored under pressure, liquified gases, and dissolved gases.	Protect from sunlight. Store in a well-ventilated place Store away from incompatible materials and ignition sources.

Fill in the hazard type in the table below

		Use PPE, such as gloves and eye protection. Follow strict hygiene practices, such as washing hands thoroughly after handling. Dispose of properly according to regulations.
		Store away from flammable and combustible materials. Use non-reactive containers and avoid mixing with incompatible substances. Ensure adequate ventilation.
		Keep away from open flames, heat sources, and sparks. Store in a cool, dry place in properly labeled containers.
		Use PPE, such as gloves and eye protection. Store in a clean, dry area and follow proper handling procedures. Avoid prolonged exposure and handle with care.
		Use in well-ventilated areas or with appropriate ventilation systems. Wear protective clothing and follow safety data sheet (SDS) instructions. Conduct regular health monitoring and training.
		Wear appropriate personal protective equipment (PPE), such as gloves and goggles. Store in a well-ventilated area and use corrosion-resistant containers. Handle with care to avoid spills and leaks.
		Use appropriate PPE, including respiratory protection if necessary. Store in a secure area away from food and drink. Follow strict hygiene practices, such as washing hands thoroughly after handling.
		Store away from sources of ignition. Use explosion-proof equipment. Handle with care to avoid impact or friction.
		Avoid releasing into the environment; use containment measures. Dispose of properly according to regulations. Report spills or leaks immediately to appropriate authorities.
		Protect from sunlight. Store in a well-ventilated place Store away from incompatible materials and ignition sources.

Pictogram practice

Answers

Refer to page
22 to check
your
answers.



Hazard Type(s):

Proper Handling:



Hazard Type(s):

Proper Handling:



Hazard Type(s):

Proper Handling:



Hazard Type(s):

Proper Handling:



Hazard Type(s):

Proper Handling:



Hazard Type(s):

Proper Handling:



Hazard icon matching game

<https://interacty.me/projects/f8f81f1de7dc84f5>

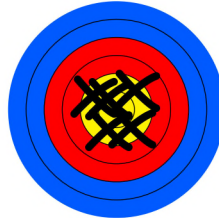
CAEC SCIENCE

Target Boards, Reliability, and Validity

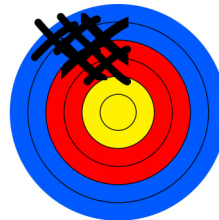
Target boards are a metaphorical concept used to illustrate the accuracy and precision of measurements in scientific experiments.

If your measurements are **close to the bullseye**, your results are **valid**.

If they all land in the **same area** then your results are **reliable**.

1**Reliable and Valid**

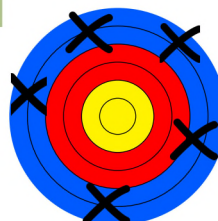
**Close to bullseye
Clustered together**

2**Reliable and Invalid**

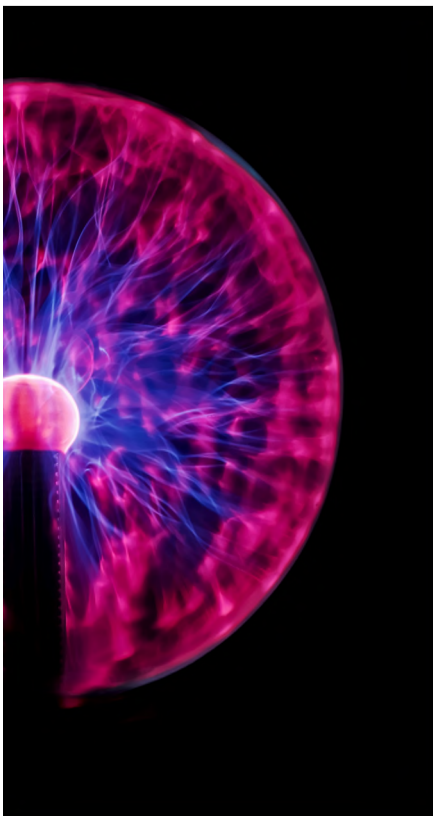
**Missed bullseye
Clustered together**

3**Unreliable and Valid**

**Close to bullseye.
Not clustered together.**

4**Unreliable and Invalid**

**Not close to bullseye
Not clustered together.**



CAEC SCIENCE

Representing Data

Different methods for representing data help us see, understand, and communicate information in various ways. By using tables, graphs, and diagrams, we can choose the best format to match the type of data we have and the message we want to convey.

1

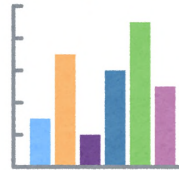
Tables



Makes it easy to read and compare different pieces of information.

2

Bar Graphs



Ideal for comparing quantities across different categories

3

Line Graphs



Excellent for displaying changes and trends over a period.

4

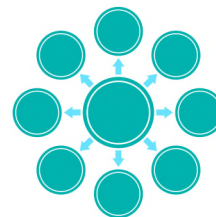
Pie Charts



Useful for showing the percentage of each category relative to the total.

5

Diagrams



Good for showing steps in a process or relationships between parts.

6

Scatter Plots



Scatter plots are used to identify and illustrate the relationship between two variables.



1. Garden Bird Sightings

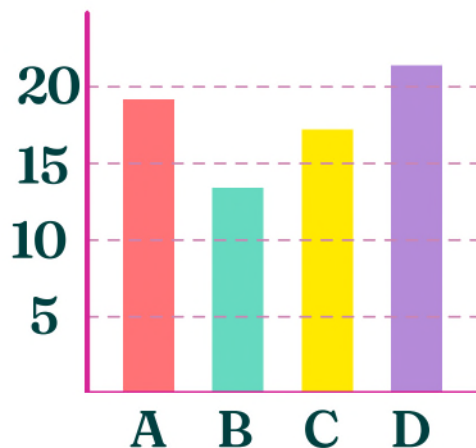
	Mon	Tues	Wed	Thurs
Bluebird	4	5	5	5
Magpie	5	2	4	4
Cardinal	1	1	0	1
Finch	3	2	2	1

- a. How many bluebirds were observed on Wednesday? _____
- b. How many Finches were observed on Thursday? _____
- c. What was the most commonly observed bird over the 4 day period? _____

Answers

c) fit
correlations
b) Strong
6.a) outlier

2. Preferred Coffee Brand



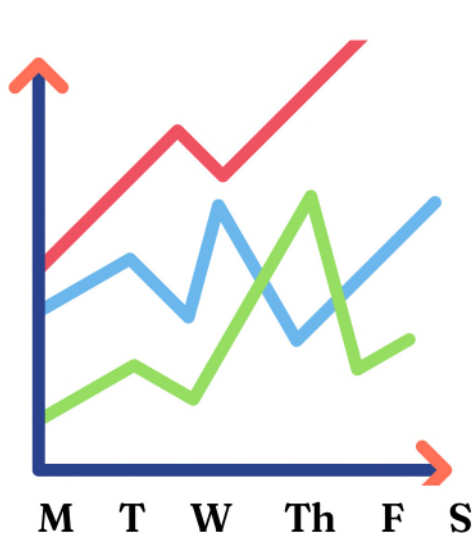
- Approximately how many people chose...
- option A? _____
- option B? _____
- option C? _____
- option D? _____

5. Condensation,
precipitation
4a. d
4b. Solar
4c. 35
3a. Location A
3b. Location B
3c. Location C
2a. 19
2b. 14
2c. 16
2d. 21

1a. 5
1b. 1
1c. bluebirds

CAEC SCIENCE

3. Average Daily Temperature



Location A

Location B

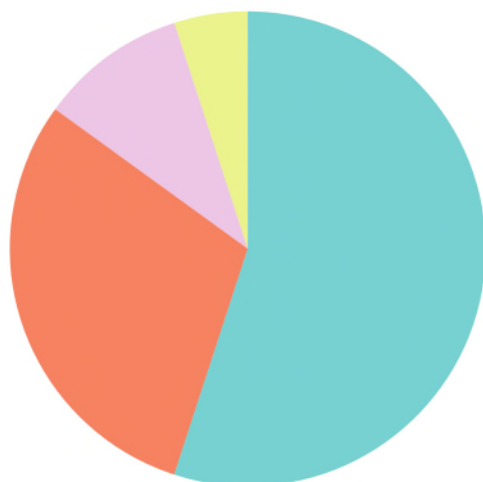
Location C

What location had the highest average temperatures? _____

Which location was coldest on Thursday? _____

Which location had the coldest average temperatures? _____

4. Residential Heating Methods



Oil

Wood

Electricity

Solar

Approximately what percentage of respondents heat with electricity?

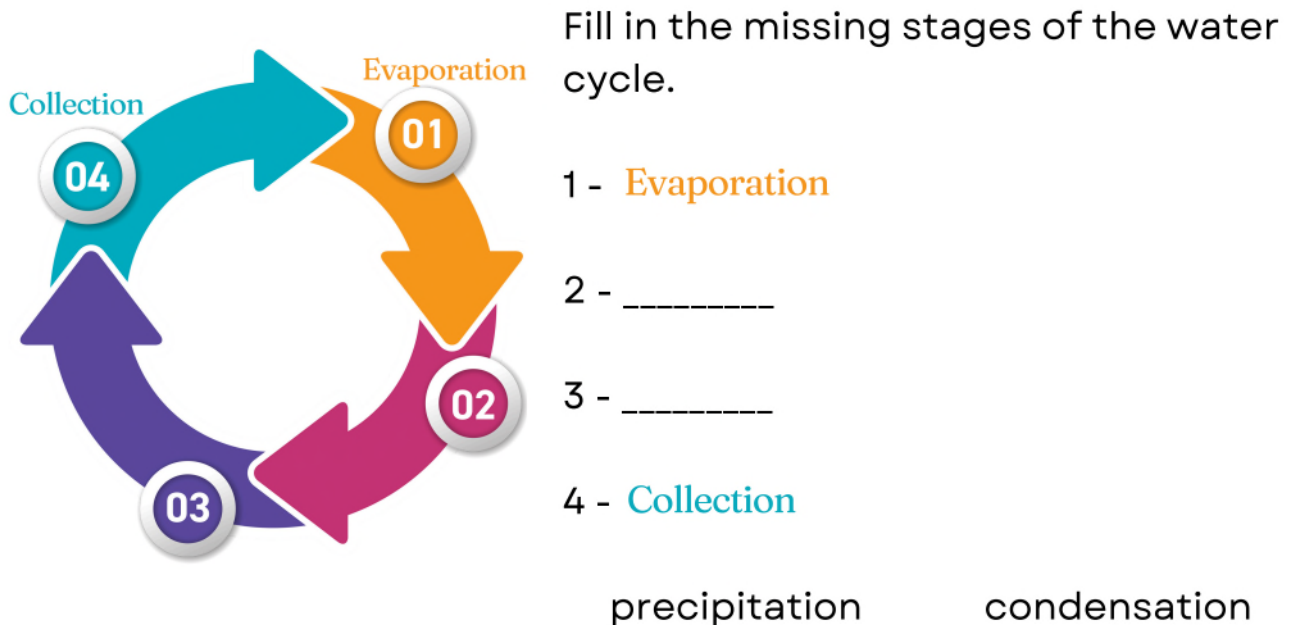
a) 15% b) 30% c) 45% d) 60%

What is the least commonly used heating method?

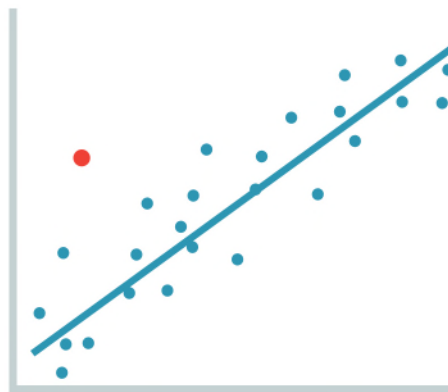
Approximately what percentage of respondents heat with oil?

a) 15% b) 35% c) 45% d) 60%

5. The Water Cycle



6. Impact of Sunlight on Plant Growth



a. What term is used to describe the data highlighted in red?
a) outsider b) outlier c) oddity d) outstanding

b. What relationship is shown between the two variables?
a) no correlation b) weak correlation c) strong correlation

c. The solid blue line is called “the line of best ...
a) average b) agreement c) correlation d) fit

Identifying Flaws and Limitations

Common Flaws in Scientific Research

Scientific research aims to discover new knowledge and answer questions through experiments and observations. However, sometimes research can have flaws that affect its reliability and validity. Learning to identify these flaws helps ensure that conclusions are accurate and trustworthy.

Sample Size Issues

- Description: A small sample size (number of subjects or observations) may not represent the entire population accurately.
- *Flaw Example: Testing a new drug on only 10 people might not show how it affects the larger population.*

Bias

- Description: Bias occurs when the researcher's expectations or preferences influence the outcome of the research.
- *Flaw Example: If a researcher only publishes studies that support their own theories, this can lead to skewed results.*

Lack of Control Group

- Description: A control group is a group that does not receive the experimental treatment, allowing for comparison with the experimental group.
- *Flaw Example: Testing a new teaching method without a control group to compare it against may not show whether the method is truly effective.*

Inaccurate Data Collection

- Description: Using incorrect methods or tools to collect data can lead to inaccurate results.
- *Flaw Example: Measuring temperatures with a broken thermometer will produce unreliable data.*



CAEC Science

Identifying Flaws and Limitations

Talking Point

Why do you think it is important for scientists to recognize flaws/limitations in their own research?

Common Flaws in Scientific Research

Poor Experimental Design

- Description: The way an experiment is set up may affect the results and their interpretation.
- *Flaw Example: Not keeping all conditions the same except for the variable being tested can lead to misleading results.*

Confounding Variables

- Description: These are other factors that might influence the results but are not controlled or accounted for in the experiment.
- *Flaw Example: In a study on plant growth with different fertilizers, differences in soil quality not accounted for could skew the results.*

Lack of Replication

- Description: Failing to replicate results in different studies or experiments can mean the findings are not reliable.
- *Flaw Example: A single study showing a new drug is effective needs to be replicated in other studies to confirm the results.*

Identify problems in the following scenarios.

A survey on health habits is conducted on a college campus.

A study tests a new drug on only 10 patients.

A scientist is testing a drug for a company that has promised a large funding increase if their results are positive.



Identifying Flaws and Limitations Activity

Experiment: Does adding more fertilizer enhance plant growth?

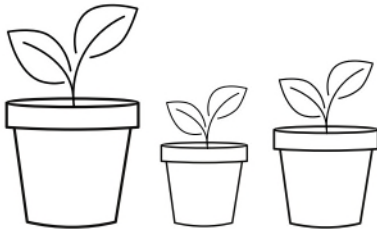
Method: Plant A is given 1 tsp of liquid fertilizer, Plant B is given 2tsp liquid fertilizer, Plant C is given 3tsp of liquid fertilizer at start of experiment.

A



What's wrong with this experiment?

B



What's wrong with this experiment?

C



What's wrong with this experiment?

D



What's wrong with this experiment?

A - Using different kinds of plants which may require more/less fertilizer
 B - Using different size containers - more/less soil amount may impact results
 C - Amount of sunlight exposure is not consistent.
 D - Inconsistent watering of plants (should be measured and distributed accurately)

Understanding the Impact of Scientific Research and Technologies on Society

Scientific research and technological advancements have profound effects on society. These effects can be observed from various perspectives, including social, cultural, economic, ethical, political, safety, and environmental viewpoints. Understanding these impacts helps us appreciate the broader implications of scientific progress and technology on our daily lives and the world.

1

Social Perspective

- Impact: Scientific advancements can change social behaviors, improve quality of life, and create new social norms.

Example:

- Medical Research: Development of vaccines and treatments that improve public health.

2

Cultural Perspective

- Impact: Technology and research can influence cultural practices and values.

Example:

- Media and Entertainment: Advances in digital media impact cultural expressions and entertainment choices.

3

Economic Perspective

- Impact: Research and technology drive economic growth, create job opportunities, and influence market trends.

Example:

- Innovation: New technologies lead to the creation of new industries and business opportunities.

4

Ethical Perspective

- Impact: Scientific and technological developments raise ethical questions about their use and consequences.

Example:

- Genetic Engineering: Ethical concerns about modifying genes in humans, animals, or plants.



Understanding the Impact of Scientific Research and Technologies on Society

Scientific research and technological advancements have profound effects on society. These effects can be observed from various perspectives, including social, cultural, economic, ethical, political, safety, and environmental viewpoints. Understanding these impacts helps us appreciate the broader implications of scientific progress and technology on our daily lives and the world.

5

Political Perspective

- Impact: Scientific research and technology can influence political decisions, policies, and international relations.

Examples:

- Environmental Policies: Research on climate change informs policies and agreements like the Paris Accord.

6

Safety Perspective

- Impact: The development and implementation of new technologies come with safety considerations to protect users and the public.

Example:

- Regulations: Safety standards for new drugs, medical devices, and industrial machinery.

7

Environmental Perspective

- Impact: Technology and research can have both positive and negative effects on the environment.

Example:

- Sustainable Technologies: Development of renewable energy sources like solar and wind power.



Understanding the Impact of Scientific Research and Technologies on Society

Consider what perspective(s) each of the examples relates to and why?

Social, Cultural, Economic, Ethical, Political, Safety, or Environmental.

- Advances in medicine affect public health policies and funding.

Perspective(s) _____

- The rise of social media platforms is altering how people interact and communicate.

Perspective(s) _____

- Ensuring the protection of data and systems from cyber threats.

Perspective(s) _____

- Technology like digital archiving helps preserve cultural heritage and traditions.

Perspective(s) _____

- Industrial processes and waste products that can harm the environment if not managed properly.

Perspective(s) _____

Q Critical Thinking Questions

- How has social media changed the way we communicate and interact with others?
- What are some ethical dilemmas associated with genetic engineering?
- In what ways has technology impacted job markets and employment opportunities?
- How can governments balance the benefits of technological innovation with safety concerns?
- What role does scientific research play in shaping environmental policies?

Answers

Economic, Social, Safety, Cultural, Environmental. Additional perspective may also apply - for example social media can also be viewed from cultural and safety perspectives.



Intended and Unintended Consequences of Scientific Solutions and Technologies

Scientific solutions and technologies can bring about significant changes in our world. These changes can have both intended (expected) and unintended (unexpected) consequences.

Understanding these consequences is essential to making informed decisions and ensuring that scientific advancements benefit both humans and the environment.

1

Intended Consequences

- Definition: Intended consequences are the outcomes that scientists and engineers plan for and expect when creating a new solution or technology.
- *Example: When developing a new medicine, the intended consequence is to cure or alleviate symptoms of a specific disease.*

2

Unintended Consequences

- Definition: Unintended consequences are outcomes that were not anticipated or planned for. These can be positive, negative, or neutral.
- *Example: The development of plastic provided many benefits but also led to unintended consequences like environmental pollution.*

E.g.

Antibiotics

Intended Consequence: To treat bacterial infections and save lives.

- Outcome: Antibiotics effectively kill or inhibit the growth of bacteria, leading to improved health and reduced mortality from infections.

Unintended Consequence: Antibiotic resistance.

- Description: Overuse or misuse of antibiotics can lead to bacteria evolving resistance, making infections harder to treat and increasing the risk of severe illness.

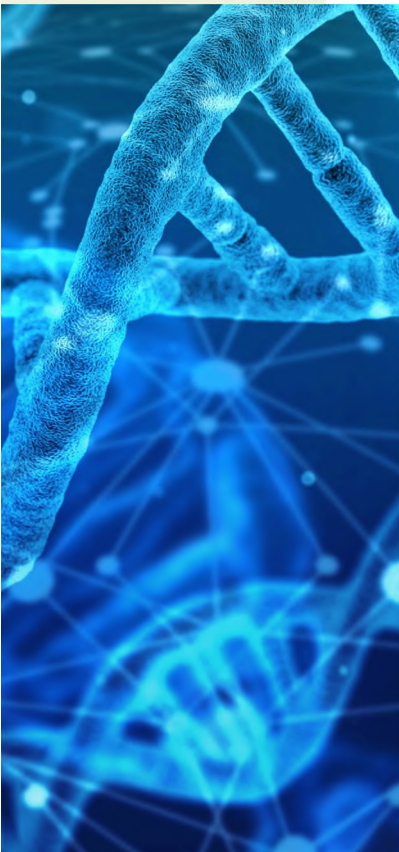
Genetically Modified Organisms (GMOs)

Intended Consequence: To increase crop yields and improve resistance to pests and diseases.

- Outcome: GMOs can lead to higher food production and reduced use of chemical pesticides.

Unintended Consequence: Environmental impact and loss of biodiversity.

- Description: GMOs may crossbreed with wild plants, potentially leading to unintended changes in local ecosystems and reducing the diversity of plant species.



CAEC Science

- connect the technology to a matching intended and unintended consequence.

Solution/ Technology

Intended Consequence

Unintended Consequence

Nuclear
Power

To preserve food,
enhance
convenience, and
reduce spoilage

Environmental
pollution.

Plastic
Packaging

To diagnose and
monitor diseases
with high precision.

Nuclear accidents
and radioactive
waste.

Medical Imaging
Technologies
(e.g., MRI, CT
Scans)

To protect crops
from pests and
increase agricultural
productivity.

Exposure to
radiation (for CT
scans).

Pesticides

To provide a large
amount of
electricity with
relatively low
greenhouse gas
emissions.

Harm to non-
target species
and potential
health risks.

CAEC Practice Science Quiz

1. Which of the following descriptions are NOT characteristics of science?

- a. Can be used to study the supernatural
- b. Investigates the natural world.
- c. Relies on evidence that can be observed and measured.
- d. Relies on personal feelings and opinions.
- e. Does not change

2. Which statement is an observation?

- a. The high number of deer in the forest is affecting the plant population.
- b. The deer population has increased because the forest has fewer predators.
- c. There are 50 deer in the forest.
- d. The plants are growing slower due to deer grazing.

3. Which of the following is an example of an inference?

- a. The plant leaves are green.
- b. The water boils at 100°C under standard atmospheric pressure.
- c. The plant is growing faster because it receives more sunlight.
- d. The sky is blue on a clear day.

4. Which of the following is an example of a scientifically investigable question?

- a. What is the best way to achieve happiness?
- b. How does the concentration of a solution affect the rate of a chemical reaction?
- c. What is the meaning of life?
- d. How do people perceive beauty?

CAEC Practice Science Test

5. What is the main goal of using "double- blind testing" in experiments?

- A) To increase the number of subjects.
- B) To prevent subjects from knowing the expected outcome.
- C) To ensure the experimenter and subject remain unaware of who is getting treatment and who is getting a placebo.
- D) To confirm a hypothesis by avoiding peer review.

6. In an experiment to test how different amounts of sunlight affect plant growth, what is the independent variable?

- A) The height of the plant.
- B) The type of plant used.
- C) The amount of water given.
- D) The amount of sunlight the plant receives.

7. What is the appropriate unit of measurement for the length of a running track?

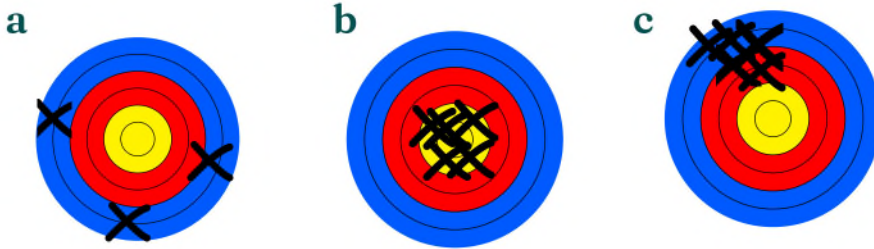
- a) Millimeters (mm)
- b) Centimeters (cm)
- c) Meters (m)
- d) Kilometers (km)

8. What hazards are represented by these pictograms?



CAEC Practice Science Test

9. Which of the following target boards shows a result that is reliable and valid?



10. Which of the following is a scatter plot?



11. Which of the following is an example of a safety perspective?

- a. A business wants to improve recycling practices at their offices.
- b. A company is developing a new car technology to increase their profits.
- c. A workplace has improved its training to prevent workplace accidents.
- d. MPs are voting to create a new law to ban microplastics.

12. Thalidomide was developed in 1953 and was widely used to treat nausea in pregnancy. Many babies born to mothers who took thalidomide during their pregnancy had severe birth defects.

- a. What was the intended consequence of the drug?
- b. What was the unintended consequence of the drug?

Answers: 1: a,d,e 2: c, 3: c, 4: b, 5: c, 6: d, 7: c, 8: flammable, corrosive, 9: b, 10: c, 11: c, 12a: reduce nausea, 12b: birth defects