

Chapter X - Guided Notes Answer Key

Three Most Important Concepts

Concept 1: Biology is the scientific study of all living things — from microscopic bacteria to the largest animals — and it includes the study of the human body.

Concept 2: The scientific method is a structured, repeatable process that scientists use to ask questions, form hypotheses, run experiments, and draw conclusions based on evidence.

Concept 3: Variables are the building blocks of a fair experiment — the independent variable is what is changed, the dependent variable is what is measured, and controlled variables are kept the same throughout.

Fill-in-the-Blank

- 1. **organisms**
- 2. **reproduce**
- 3. **testable**
- 4. **independent**
- 5. **same**

Matching

Independent Variable	D
Scientific Method	A
Hypothesis	E
Dependent Variable	C
Controlled Variables	B

True / False

- 1. **F** — The article states that biology covers organisms of all sizes, from single-celled bacteria to blue whales, and includes human body systems.
- 2. **T** — The article explains that a hypothesis is not a guess; it is a specific, testable prediction backed by prior knowledge or observation.
- 3. **F** — The article defines the independent variable as what the scientist deliberately changes; the dependent variable is what is measured.
- 4. **T** — The article states that controlled variables are everything else held constant to keep the experiment a fair test.
- 5. **T** — The article explains that a researcher in Brazil and one in Japan running the same experiment should reach the same results.

Chapter X - Guided Notes Answer Key

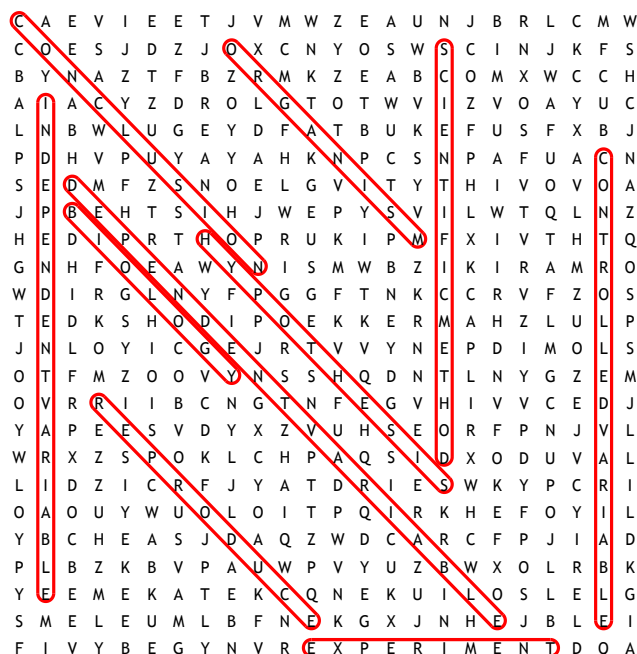
Fill in the Table

Variable Type	What It Means in an Experiment
Independent Variable	The one factor a scientist deliberately changes in an experiment
Dependent Variable	What the scientist measures as the result; it depends on the independent variable
Controlled Variable	Everything kept the same throughout the experiment to ensure a fair test
Hypothesis	A specific, testable prediction backed by prior knowledge or observation — not a guess
Scientific Method	A structured, repeatable process used to investigate questions and reach trustworthy conclusions

Application Question

Controlled variables must stay the same so that any change in the dependent variable can be linked directly to the independent variable. If other factors change at the same time, scientists cannot tell what actually caused the result. In the Semmelweis case study, controlled conditions were essential — only handwashing changed, which made the drop in death rates meaningful.

What Is Biology?

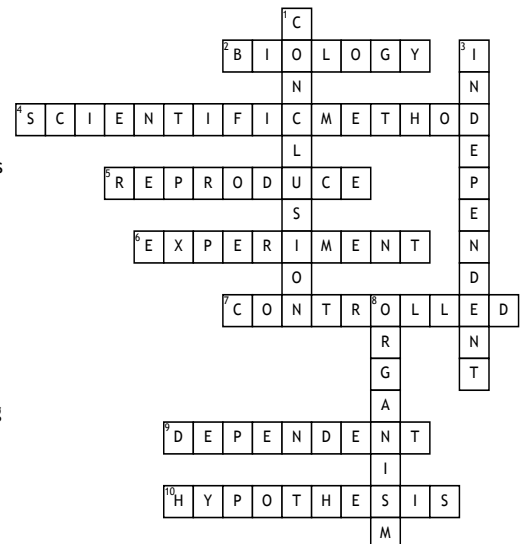


Independent Variable	Dependent Variable	Controlled Variable
Scientific Method	Reproduce	Organism
Hypothesis	Experiment	Conclusion
Biology		

Across

- The scientific study of living organisms and the processes that sustain life.
- A structured, repeatable process used by scientists to ask questions, test hypotheses, and draw conclusions based on evidence. (Two words)
- To produce offspring; one of the key characteristics shared by all living things.
- A test designed to investigate a hypothesis by changing one variable while keeping all others constant.
- A factor that is kept the same throughout an experiment so it does not affect the outcome. _____ Variable
- The factor that is measured in an experiment; it changes in response to the independent variable. _____ Variable
- A specific, testable prediction about the expected outcome of an experiment, based on prior knowledge or observation.

What Is Biology?



Down

- A judgment or decision reached after analyzing the results of an experiment.
- The one factor a scientist deliberately changes in an experiment. _____ Variable
- Any living thing, from a single-celled bacterium to a complex multicellular animal.

Chapter X - Hypothetical & DV/IV Answer Keys

What Is Biology? — Hypotheticals Answer Key

Sample answers — accept other reasonable responses grounded in the article.

Hypothetical 1 — The Energy Supplement

- a) IV: whether students received the supplement or not.
- b) Using energy is one of the six characteristics of living things, making it a biologically meaningful outcome to track.
- c) Keeping both groups identical in all other ways ensures that any difference in energy levels can be linked to the supplement, not other lifestyle factors.

Hypothetical 2 — Is It Really Science?

- a) There was no controlled experiment — no independent variable was deliberately changed, nothing was measured consistently, and no controlled variables were maintained. One person's experience is an observation, not a tested conclusion.
- b) A proper hypothesis: "If a person drinks more water daily, then their skin hydration will improve, because water supports cellular processes."
- c) Diet, sleep, or skincare products used during the week — any of these could affect skin appearance and are difficult to hold constant.

What Is Biology? — IV/DV Activity Answer Key

Accept other reasonable CVs and predicted outcomes grounded in the article.

Scenario 1 — Handwashing and Patient Health

IV: Handwashing (chlorine solution) / DV: Patient death rate / CV 1: Hospital procedures / CV 2:

Patient type

Predicted Outcome: The handwashing ward will have a lower death rate.

Scenario 2 — Sunlight and Plant Growth

IV: Hours of daily sunlight / DV: Plant height in centimetres (inches) / CV 1: Amount of water / CV 2:

Soil type and pot size

Predicted Outcome: The plant with more sunlight will grow taller.

Design Your Own — Sample Answer

Hypothesis: "If a person gets fewer than 7 hours of sleep, then their concentration score will be lower, because living things need energy and recovery time to function."

IV: Hours of sleep / DV: Concentration score on a morning focus test / CV 1: Time of day tested /

CV 2: Physical activity the day before

Measurement: Administer the same short test each morning and record the score.

Chapter X - Reflection Questions & Data Analysis Answer Keys

What Is Biology? — Reflection Questions Answer Key

Sample answers — accept any response that shows thoughtful engagement with article concepts.

Reflection 1 — Personal Relevance

Sample Answer: I never thought of sleep as a biology issue, but the article explains that living things need energy and must respond to their environment to function. When I skip sleep, I am disrupting something my body genuinely needs. Knowing that makes me take it more seriously than just feeling tired.

Reflection 2 — Future / Career

Sample Answer: I want to go into healthcare, and the scientific method applies directly — instead of guessing why a patient is not improving, forming a hypothesis and testing it leads to better decisions. The article helped me see that evidence-based thinking is a skill, not just a science class requirement.

What Is Biology? — Data Analysis Answer Key

Accept other reasonable answers that reference the data and connect to article concepts.

IV: Whether participants exercised 30 minutes daily / DV: Resting heart rate (beats/min)

Q1: Group A: 82 beats/min at Week 1, dropping to 67 beats/min by Week 6.

Q2: Group A decreased steadily — 15 beats/min total, roughly 3 beats/min per week. Group B stayed flat, rising slightly from 81 to 83 beats/min.

Q3: Regular exercise is associated with a lower resting heart rate. Living things respond to their environment — the body adapts to exercise demands and becomes more efficient over time.

Teacher Note: Students may assume correlation equals causation. Remind them diet, sleep, and genetics were not fully controlled. Extension: “If you compared running vs. swimming, what would your new IV be?”

Teacher Lecture Notes — What Is Biology?

Lesson Overview

This is the introductory lesson for the course. Students are encountering formal biology vocabulary and scientific reasoning for the first time. The goal is to build confidence, not complexity. Keep the tone accessible and connect every concept to something students already experience in their daily lives.

Core Concept 1: Biology as the Study of Life

- Biology is the scientific study of living organisms and the processes that keep them alive.
- Living things share six key characteristics: made of cells, use energy, grow and develop, respond to their environment, reproduce, and maintain internal balance.
- Organisms range from microscopic bacteria (less than 1 micrometre / 0.00004 inches) to blue whales at 27 metres (about 90 feet).
- Biology is not abstract — it includes the student's own body, their food, their immune system, and their local environment.
- Anchor point: Ask students what they think “biology” means before defining it. Most will say “plants and animals.” Build from there.
- Connect to careers: medicine, nursing, environmental science, agriculture, public health, biotechnology, and lab science all require biology fundamentals.
- The human body contains approximately 37 trillion cells — each one carrying out life processes right now.

Key teacher note: Many students arrive thinking biology is memorizing names. Reframe it early: biology is about understanding systems and asking why things happen.

Core Concept 2: The Scientific Method

- The scientific method is a structured, repeatable process for investigating questions and drawing evidence-based conclusions.
- Steps in order: Observation → Question → Hypothesis → Experiment → Data Collection → Analysis → Conclusion.
- A hypothesis is not a guess — it is a specific, testable prediction grounded in prior knowledge. Stress this distinction early and often.
- The method is self-correcting: unexpected results lead to new questions, not failure.
- Repeatability is the hallmark of reliable science — results must be reproducible by independent researchers anywhere in the world.
- Real-world anchor: Every vaccine, antibiotic, surgical procedure, and food safety standard was developed through the scientific method.
- Case study anchor: Semmelweis (1840s) — a Hungarian doctor who used structured observation and a controlled experiment to show that handwashing by physicians dramatically reduced patient death rates in maternity wards.

Key teacher note: Students often conflate “theory” (a well-tested scientific explanation) with “guess.” Address this directly if it comes up.

Chapter X - Lecture Notes

Core Concept 3: Variables

- A variable is any factor in an experiment that can change.
- Independent Variable (IV): what the scientist deliberately changes — the cause being tested.
- Dependent Variable (DV): what is measured — the effect or outcome.
- Controlled Variables (CV): everything kept the same to ensure the experiment is a fair test.
- Simple memory aid: IV → “I change it.” DV → “It depends on what I changed.”
- Example: Sunlight and plant height. IV = hours of sunlight, DV = plant height in centimetres (inches), CV = water, soil type, pot size.
- Variable thinking extends beyond labs — it applies to evaluating news headlines, health claims, and product advertising.

Key teacher note: Students frequently confuse IV and DV. Use multiple concrete examples and have them practice labeling before moving to hypotheticals or data activities.

Pacing Suggestions

- Opening hook (5 min): Ask: “What do you think makes something alive?” Take 3–4 responses before revealing the six characteristics.
- Core Concept 1 (10 min): Characteristics of life, scale of biology, connection to careers.
- Core Concept 2 (12 min): Walk through scientific method steps using Semmelweis case study as the anchor.
- Core Concept 3 (12 min): Introduce IV/DV/CV with the plant-sunlight example. Have students identify variables in one practice scenario before moving on.
- How to Apply review (3 min): Briefly review the four bulleted takeaways at the end of the article.
- Guided notes / activity (remaining time).

Discussion Questions

1. What is one example from your own life where you changed one thing to see what would happen? What were you actually doing without knowing it?
2. Why do you think scientists require experiments to be repeatable before accepting the results as reliable?
3. In the Semmelweis case study, what do you think would have happened if the hospital had changed two things at once — handwashing AND patient diet — instead of just one?
4. A news headline says: “People who drink green tea live longer.” What questions would you ask before deciding whether to believe that claim?
5. If living things all share the same six characteristics, why do a bacterium and a blue whale seem so different from each other?