Warm-Up | Hypotheses, Laws, and Theories

Lesson Objectives

By the end of this lesson, you should be able to:

- Differentiate scientific hypotheses, theories, and laws.
- Identify the _____ of consensus and retesting in the development of theories.
- Give examples of how hypotheses lead to new _____.

Science Practice: Create a chart comparing hypotheses, theories, and laws.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

	a hypothesis or group of related hypotheses that can be accepted as true based on observation and repeated experimentation with similar results
	a statement of fact that is generally accepted to be true and universal because it has always been observed to be true; describes relationships in nature, but does not provide explanations for them
	a testable explanation of a scientific problem that is based on research and observation

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Hypothesis

Hypothesis Testable explanation of a scientific problem that is based on _____ and observation

- Is usually an "if/then/because" statement
- Must be testable through a _____ investigation
- Must be _____
- Can be supported or refuted by _____

Example: If the chemicals react, then their mass will not change because matter cannot be created or destroyed in chemical reactions.

Theory

Theory Well-supported, widely _____ explanation for many observations

- Must be _____
- Must be falsifiable
  - Requires many confirmed data to overturn or modify
- Can be used to make _____
- Can explain _____

Example: Dalton's atomic theory

- **All matter is composed of atoms.**
- **Chemical reactions occur through the rearrangements of atoms.**
- **Atoms cannot be made or destroyed during chemical reactions.**

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Law

Law Description of a naturally occurring process or _____

- Can be used to _____ events or experimental _____
- Is supported by all available observations and _____
- Does not explain observations

Example: Matter cannot be created or destroyed in a chemical.

Total mass of reactants = Total mass of products

Scientific Hypotheses, Theories, and Laws

Hypothesis	Law	Theory
• Makes prediction based on existing _____	• Describes _____	• Explains observations
• Is testable	• Is used to make predictions	• Is used to make predictions
• Is falsifiable	• Is supported by data	• Is supported by data
	• Is testable	• Is _____
	• Is falsifiable	• Is falsifiable

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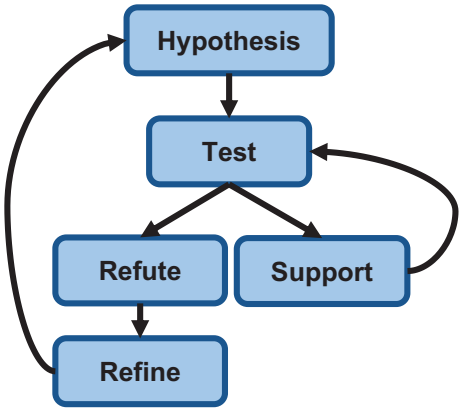
How Scientists Work with a Hypothesis

- Make a hypothesis:
  - Attempt to explain an observation or [ ] a question.
- Test the hypothesis through experimentation.
- Support the hypothesis:
  - See if data [ ] with the hypothesis.
- Refute the hypothesis:
  - See if there is some data available that do not support the hypothesis.
- New data lead to a new hypothesis.
- Continue to [ ] as new data become available.



The Phlogiston Hypothesis

- Phlogiston hypothesis – Materials contain phlogiston, which is released when material [ ].
  - Mass of ashes < [ ] of wood
- Test: Lavoisier heated mercury.
  - Mass of product > Mass of mercury

Lavoisier's [ ] refuted the phlogiston theory, leading to [ ] hypotheses to be tested.

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Trying to Prove a Hypothesis

- Lavoisier showed mercury gained weight when heated, which refuted the phlogiston [ ].
- New hypothesis: Something is added to [ ] when burned.
  - Leads to new [ ]
- Another experiment is always possible.

You never know what the results of the next experiment will be, so you can never know that a hypothesis is proved.

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Dalton's Atomic Theory (1803)

- All matter is composed of [ ].
- Atoms cannot be made or destroyed during chemical reactions.
- All atoms of an element are identical.
- Different elements have different kinds of atoms.
- Chemical [ ] occur through rearrangements of atoms.

The atomic theory explains the law of [ ] of mass.

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Supporting Atomic Theory

Atomic theory was not always accepted:

- Needed more _____ to be valid
- Needed to explain a large fraction of the observations from the experiments

Evidence for atomic theory:

- Development of a periodic table showing that different elements have different _____
- Chemical analysis showing that all atoms in starting material are found in _____ of reaction

Reproducibility Leads to Reliability

- A theory must be supported by all available evidence.
- Other scientists should get similar _____ when they perform the same experiment.
- All experiments must be _____.

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Scientific Consensus

- Scientists share their _____ and ideas with others through talks and publications.
  - _____ Dalton presented his ideas about the atomic theory to the Royal Institution in 1803.
- Peer review allows for further _____ and testing of a theory.

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Lesson Question

What words do scientists use to classify their ideas?

Answer

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Determining Hypothesis, Theory, or Law

Scientific hypothesis:

- Explanation based on existing _____

Scientific law:

- Description of how systems behave under certain circumstances
- Does not explain why things happen

Scientific theory:

- Well-tested, widely accepted explanation for natural phenomena

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Differentiating Hypotheses, Theories, and Laws

	Hypothesis	Law	Theory
Testable	✓	✓	✓
Falsifiable	✓	✓	✓
Supported by many [ ]		✓	✓
Explains observations	✓		✓
Used to make [ ]		✓	✓

How Hypotheses Lead to New Experiments

All hypotheses must be testable.

- Testing often involves experimentation.
- Results support or [ ] a hypothesis.
- The refuted hypothesis is refined.
- The refined hypothesis is [ ].

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Developing a Theory

_____ and retesting are important in the development of a theory.

- Reproducibility
- Reliability

Use this space to write any questions or thoughts about this lesson.

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