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Warm-Up | Scientific Methods

Lesson Objectives

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

- Describe how scientists perform experiments and gather data.
- Explain the importance of controlled [ ] in scientific investigations.
- Show how scientists communicate, share information, and support the importance of peer review.
- Describe the function of models in science, and recognize the usefulness and limitations of [ ] as representations.

Words to Know

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

conclusion	the overall [ ] of the results of an investigation and their meaning
control sample	the sample in a controlled experiment whose variables [ ] change
controlled experiment	an experiment in which only one [ ] is changed
data	the [ ] that results from a scientific investigation
dependent variable	a variable that is [ ] by another variable

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Words to Know

experimental sample	the sample in a _____ experiment in which one variable changes
independent variable	a variable that _____ a change to another variable
model	a _____ of a result or idea
observation	the act of using your _____ to recognize something; a piece of information gathered using the senses or tools
peer review	evaluation done by scientists on the work and conclusions of _____ scientist
qualitative	a word describing subjective observations or data that _____ based on numbers or precise measurements
quantitative	a word describing objective observations or data that are _____ on numbers or precise measurements
results	the _____ of a scientific investigation
scientific inquiry	the process of using observations, investigations, and experiments to _____ about natural phenomena

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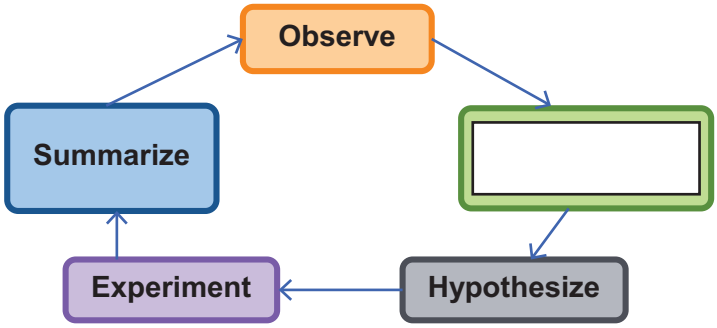
Slide 1

Lesson Question

Slide 2

Scientific Inquiry

Scientific inquiry is the process of using _____ and experiments to learn about _____ events.



Making Observations

Observation is the act of using your senses to gather information. An observation can also be a piece of information gathered using the senses or tools.

Temperature (°C)	Pressure (psi)
10	42
20	44
30	46
40	48

_____: subjective, not based on numbers

_____: objective, based on numbers and measurements

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Asking a Question and Developing a Hypothesis

Remember that an _____ question can be structured like this:

What is the effect of X on Y?

And the hypothesis is often structured like this:

_____ **. . . then . . . , because . . . .**

Slide 7

Setting Up and Performing Experiments

Research and design experiment | Gather supplies | Perform experiment | Record data

_____ are pieces of information obtained and _____ during an experiment.

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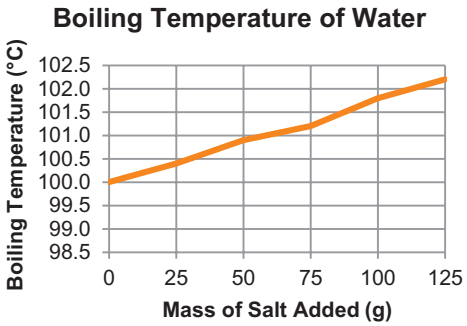
Slide 7

Summarizing and Displaying Data

The _____ of an experiment are the outcomes of a _____ investigation.

Mass of Salt Added (g)	Boiling Temperature (°C)
0	100.0
25	100.4
50	100.9
75	101.2
100	101.8
125	102.2



Drawing Conclusions and Communicating Results

The **conclusion** of an investigation is a general _____ of the results and what they mean.

Sample conclusion: The data support the hypothesis. As more salt was added to the water, the boiling temperature of the water _____. Therefore, we can conclude that dissolving salt in _____ increases the boiling temperature of the water.

Draw a conclusion.

Communicate results.

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Controlled Experiments

Controlled experiment – an experiment in which [ ] variable is changed

Control sample – a [ ] in a controlled experiment with variables that do not change

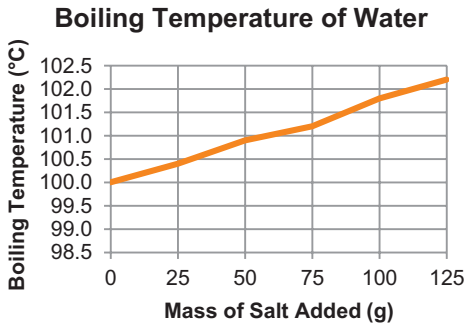
[ ] – a sample in a controlled experiment in which one variable changes

Slide 12

Types of Variables

The [ ] causes a change to another variable.

The [ ] is changed by another variable.



What is the [ ] of X (independent) on Y (dependent)?

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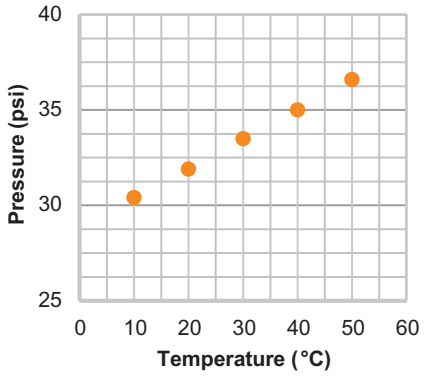
Slide 16

Analyzing Experimental Data

Temperature (°C)	Pressure (psi)
10	30.4
20	31.9
30	33.5
40	35.0
50	36.6



In this example, we have _____ on our x-axis and _____ on our y-axis.

Representing Results with Models

A **model** can be a:

- _____.
- idea.
- picture.
- equation.
- method.
- diagram.

Models help scientists present _____ results.

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Writing Lab Reports

A lab report includes:

- a _____.
- a hypothesis.
- the materials needed for the experiment.
- the experimental procedure.
- an analysis of the results.
- a _____.


Lab Report Guide

e2020

Directions

Write a lab report for this lesson's lab. Be sure that your report:

- includes all major elements of a lab report.
- meets your teacher's content and format expectations.
- is clearly organized and formatted.
- demonstrates strong scientific reasoning and writing.

While writing, you can revisit previous parts of the lesson by returning to the course map. Be sure to refer to the lab's student guide, which you can find on the first page of the lab experiment activity. You may also find it helpful to refer to the remaining pages of this guide, which provide general guidelines for writing lab reports.

You can upload your completed report with the upload tool in formats such as OpenOffice.org, Microsoft Word, or PDF. Alternatively, your teacher may ask you to turn in a paper copy of your report or to use a web-based writing tool.

Lab Report Checklist

Introduction

- Did you title your lab report?
- Did you state the purpose of the experiment?
- Did you state the question you posed before the experiment?
- Did you restate the hypothesis (or prediction) you formulated before the experiment?
- Did you list all variables and label the independent and dependent variables? Did you indicate any controlled variables?

Materials and Procedure

- Did you make a list of materials? Did you include quantities and SI units?
- Did you present the steps of the procedure as a numbered list? Did you note any changes to the original procedure?
- Did you identify your experimental and control groups?

Data Collection and Organization

- Did you organize all data in a clearly labeled table and/or graph?
- Did you check that your data is accurate and complete?
- Did you title any tables and graphs? Did you label rows, columns, axes, etc., and include units?

Analysis and Conclusion

- Did you interpret your data and graphs in the analysis rather than just restate your findings?
- Did you determine whether your data supported or refuted the hypothesis?
- Did you describe possible sources of errors?
- Did you suggest ways to improve or further your lab investigation?

Overall

- Did you make sure that your writing is precise, unbiased, and concise?
- Did you meet your teacher's content and format expectations?

Peer Review

A **peer review** is an _____ done by scientists on the work and conclusions of another _____.

Presentation of Data

Scientists may communicate results by presenting _____ to other individuals and/or scientists.

- Large setting
  - Conference
- Small setting
  - _____ session

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Summary | Scientific Methods

Lesson Question

What methods do scientists use to gather new knowledge?

Answer

Slide 2

Performing Controlled Experiments

Controlled experiments are the experiments in which only one variable is changed.

Controlled experiments contain:

- an experimental [ ].
- a control sample.

The variables in a controlled experiment may be:

- independent (cause another variable to change).
- [ ] (changed by another variable).

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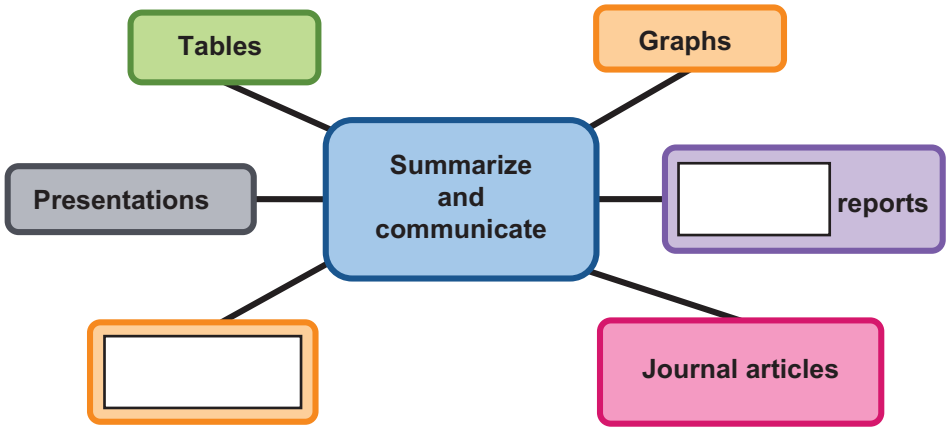
Summary | Scientific Methods

Slide 2

Summarizing and Communicating Experimental Results



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

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