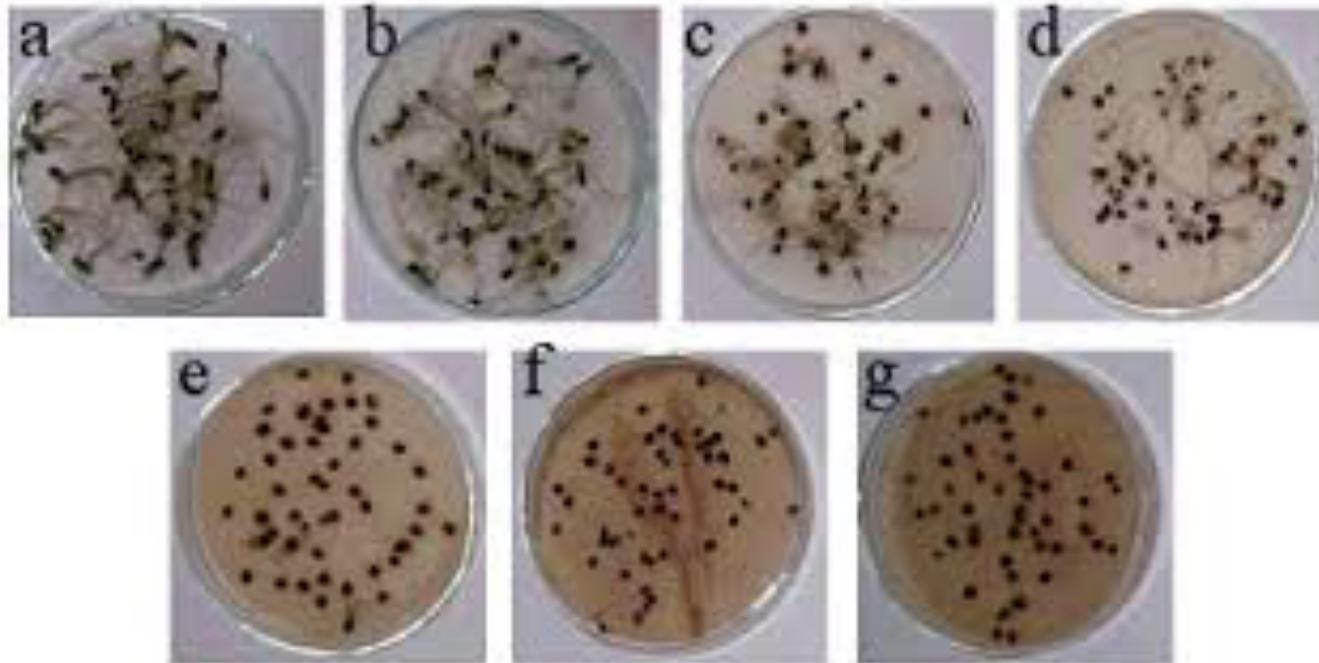


EXPERIMENTAL DESIGN

- ▶ Science answers questions with experiments.



Define the Problem

- ▶ Begin by asking a question about your topic
- ▶ Represented by a problem statement



- ▶ What is a good question for an experiment?
- ▶ One that is testable with the materials at hand.
- ▶ Question about the possible relationship between manipulated and responding variables.

Now we need a hypothesis to guide our investigation.

- ▶ What is a hypothesis?
- ▶ No, It is **NOT** an educated guess!
- ▶ Prediction of possible specific relationship between the cause (IV) and responding effect (DV) that provides a testable answer to the problem.
- ▶ Your best thinking about how the change you make might affect another factor.
Tentative or trial solution to the question.
An if then statement.





Variables

Variables are things that change.

- ▶ The **independent variable** is the variable that is purposely changed. It is the manipulated variable.
- ▶ The **dependent variable** changes in response to the independent variable. It is the responding variable or what is measured.
- ▶ Be sure to **operationally define** each variable.

Constants in an Experiment

- ▶ What are constants in an experiment?
- ▶ Factors that are kept the same and not allowed to change



The Control in an Experiment

- ▶ What is a control?
- ▶ The part of the experiment that serves as the standard of comparison.
- ▶ Why is a control necessary?
- ▶ It is the unchanged part of the experiment that detects the effects of hidden variables.

Materials and Procedures

- ▶ A description of what you will use for your experiment, and how you will do it.
- ▶ Be sure to include:
 - Levels of the Independent Variable
 - Repeated Trials
 - Drawing of Apparatus

Levels of the Independent Variable

How many different levels of the independent variable should we test?



3 ? 5? 10? The more the better?

Repeated Trials



- ▶ What are repeated trials?
- ▶ The number of times that a level of the independent variable is tested.
- ▶ Why are repeated trials necessary?
- ▶ They reduce the possibility of chance errors affecting the results.

Qualitative Observations and Results vs. Quantitative Observations & Results

- ▶ What are qualitative observations?
- ▶ They are what you perceive that occurred during the course of your experiment. They are identification of trends in the data.
- ▶ What are quantitative observations?
- ▶ Numbers in the form of raw data displayed in data tables and graphs

Sample Data Table

Title: The Effect of the independent variable on the dependent variable

Column for independent variable	Column for dependent variable			Column for derived quantity
Label - with units if necessary	Label - with units if necessary - multiple trials included			Label - with units if necessary. Example = average of trials
	1	2	3	
0	0	1	0	0
1	3	5	4	4
2	6	4	7	6
3	7	6	8	7
4	9	9	8	9

What's wrong with this table?

Number scoops of calcium chloride	Temp. Change of water (°C) Trials			Average temp. change (°C)
	1	2	3	
0	0	1	0	0
2	3	5	4	4
4	6	8	7	7
6	11	11	8	10
8	14	15	14	14
10	17	18	16	17

What's wrong with this table?

The Effect of Various Amounts of Calcium Chloride
on the Temperature of Water

Number scoops of calcium chloride	Temp. Change of water Trials			Average temp. change
	1	2	3	
0	0	1	0	0
2	3	5	4	4
4	6	8	7	7
6	11	11	8	10
8	14	15	14	14
10	17	18	16	17

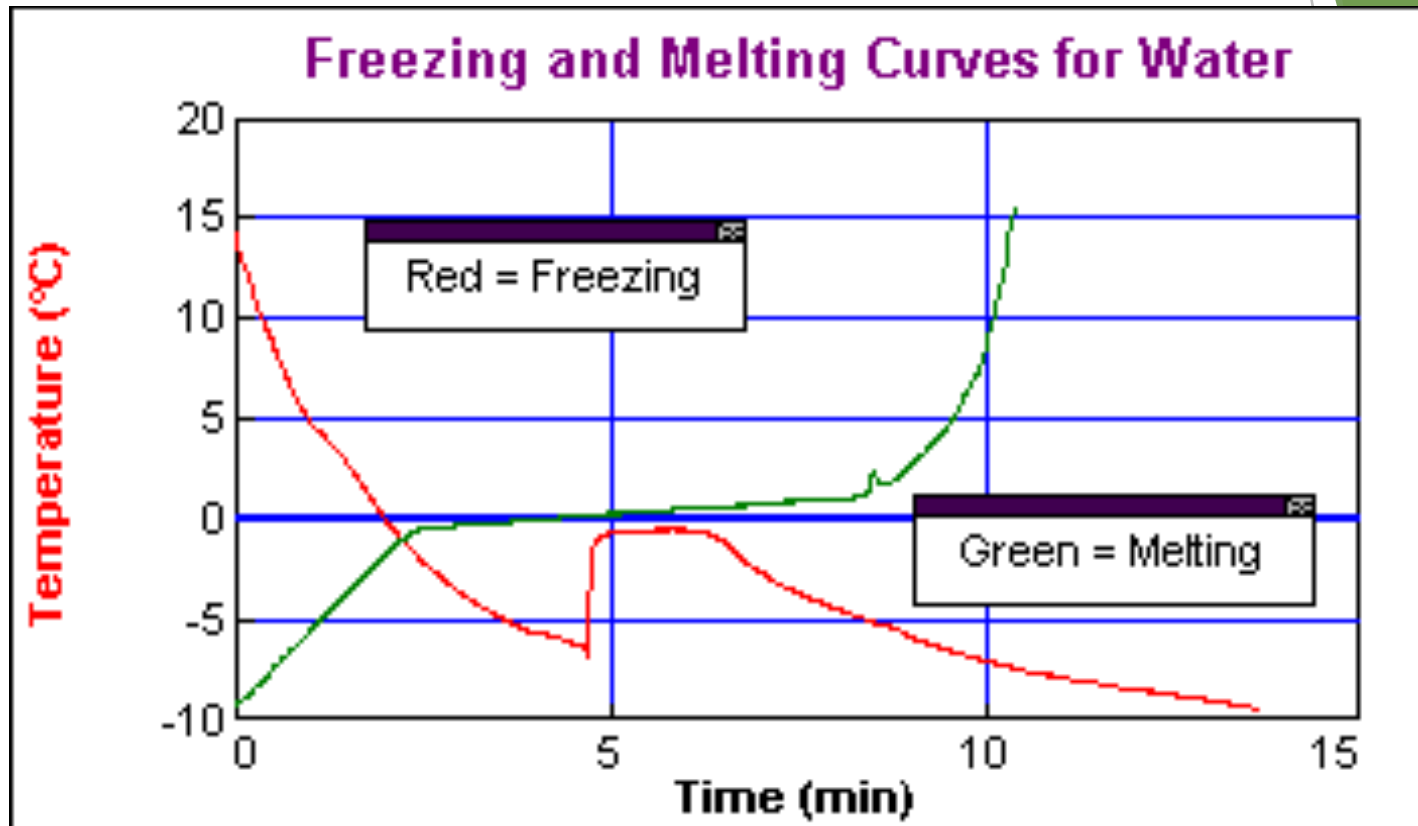
What's wrong with this table?

The Effect of Various Amounts of Calcium Chloride
on the Temperature of Water

Number scoops of calcium chloride	Trials			Average temp. change (°C)
	1	2	3	
0	0	1	0	0
2	3	5	4	4
4	6	8	7	7
6	11	11	8	10
8	14	15	14	14
10	17	18	16	17

Constructing a Graph

What is the purpose of a graph?



Graphs communicate in pictorial form the data collected in an experiment

Graphs

Title: The Effect of the independent variable on the dependent variable

Dependent Variable -
include units and an
appropriate scale



Independent Variable - include
units and an appropriate scale

Bar vs. Line Graphs - Which Should I Use?

The type of graph to use depends on the type of data collected.

Two kinds of data: **Discrete** and **Continuous**

Discrete data are categorical like days of the week, color, and brand of battery. Intervals between the data have no meaning.

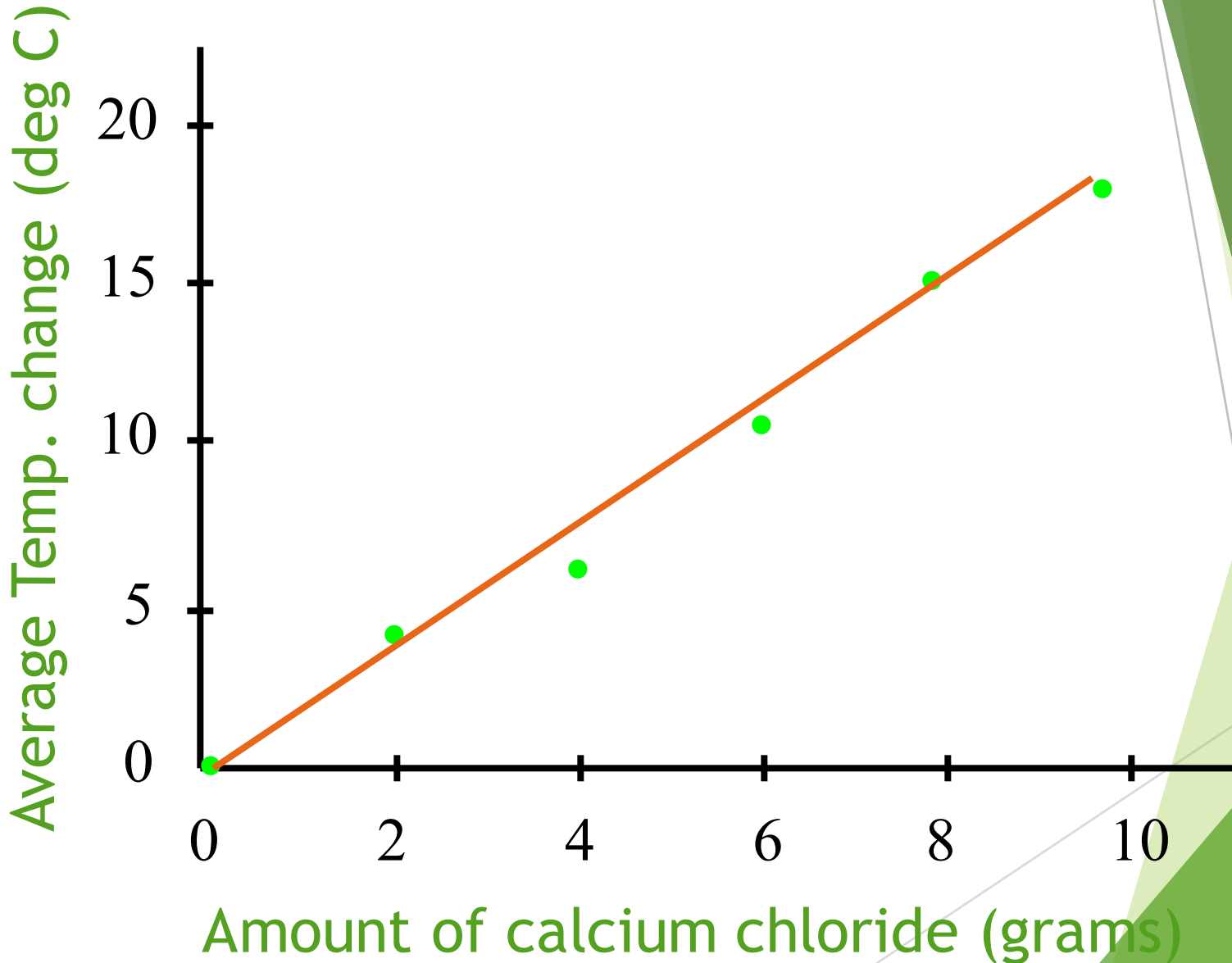
USE A BAR GRAPH

Continuous data are associated with measurements involving a standard scale. Measurements should be able to show a trend or relationship. Intervals between data have meaning.

USE A LINE GRAPH

Constructing a Line Graph:

DRAW A LINE-OF-BEST-FIT



Analysis and Interpretation of Results

This is where you describe in words what is illustrated by your data as shown in your table and graph.

You also describe the meaning of the results.

Possible Experimental Errors

What factors in your materials or procedure might have had an impact on your results?

Conclusion

Why or why not your results supported or did not support the hypothesis.

Hypotheses are never “wrong”. They are either supported or not supported.

Include reasons for the hypothesis to be supported or unsupported.

Recommendations for Further Experimentation

What are some practical applications of your results?

What other questions that could be tested arise from your results?