



SCIENTIFIC METHOD

Steps to solve problems

What are Scientific Methods?

Scientific Methods are a series of steps scientists follow to solve problems.

Observation



- Something that you see, hear, taste, smell or touch.

Make Observations

Using your “senses” to collect information.

Observations can take many forms.

They may be measurements.

They may describe shape or behavior.

Observations are only useful if they are accurate!

Ask a Question

Identify the Problem

When scientists observe something out of the ordinary or difficult to explain, they ask a question!



Inference

- An attempt to explain your observations.
- The “likely” reason.



Making Predictions

- Before scientists can test a hypothesis, they must first make predictions.
- A prediction is a statement of cause and effect that can be used to set up a test for the hypothesis.



Form a Hypothesis

- A hypothesis is a possible explanation or answer to a question.



- A good hypothesis is based on observation and must be able to be tested (testable).
- Predict a possible answer to the problem or question AFTER researching.

Example: If soil temperatures rise, then plant growth will increase because

Create an Experiment to Test the Hypothesis

- Once scientists make a prediction and form a hypothesis, they **create an experiment to test the hypothesis** to see if they are correct.



Collecting Data & Analyzing Results



- Scientists keep accurate records of their experiments so that the experiment can be **repeated** by themselves or **replicated** by other scientists to verify the results.
- After scientists finish their tests, they must organize their data and **analyze** the results.

Qualitative Data

- Deals with descriptions.
- Data that can be observed but not measured.
- Colors, textures, smells, tastes, appearance, beauty, etc.



Quantitative Data

- Deals with numbers.
- Data which can be measured.
- Length, height, area, volume, weight, speed, time, temperature, humidity



Draw Conclusions

- After scientists have analyzed the data from several experiments they can draw conclusions.
- They decide if the results of the experiment support their hypothesis.



Modify the experiment

If the data is inaccurate or the experiment is flawed, modify and repeat the experiment



COMMUNICATE RESULTS

- Scientists form a global community. After they communicate their investigations, they communicate their results to other scientists.



Independent Variable

- – Something that is changed by the scientist
 - What is tested
 - What is manipulated
 - I am the scientist
 - I change the Independent variable
 - I need to know the values before I start the experiment

Dependent Variable

- Something that might be affected by the change in the independent variable
- What is observed
- What is measured
- Data collected during the investigation
- Don't know what it is until you perform the experiment

Control Variables

- The variables that stay the same
- There are most always more than 1
- Also called constants
- Allow for a “fair test”

Control Group

The group that serves as the standard of comparison.

May be a “no treatment” group.

Placebo: Substitute for the real thing



Let's put our knowledge of the Scientific Method to a realistic example that includes some of the terms you'll be needing to use and understand.

Problem/Question

John watches his grandmother bake bread. He asks his grandmother what makes the bread rise.

She explains that yeast releases a gas as it feeds on sugar.



Problem/Question

- John wonders if the amount of sugar used in the recipe will affect the size of the bread loaf?



Formulate a Hypothesis

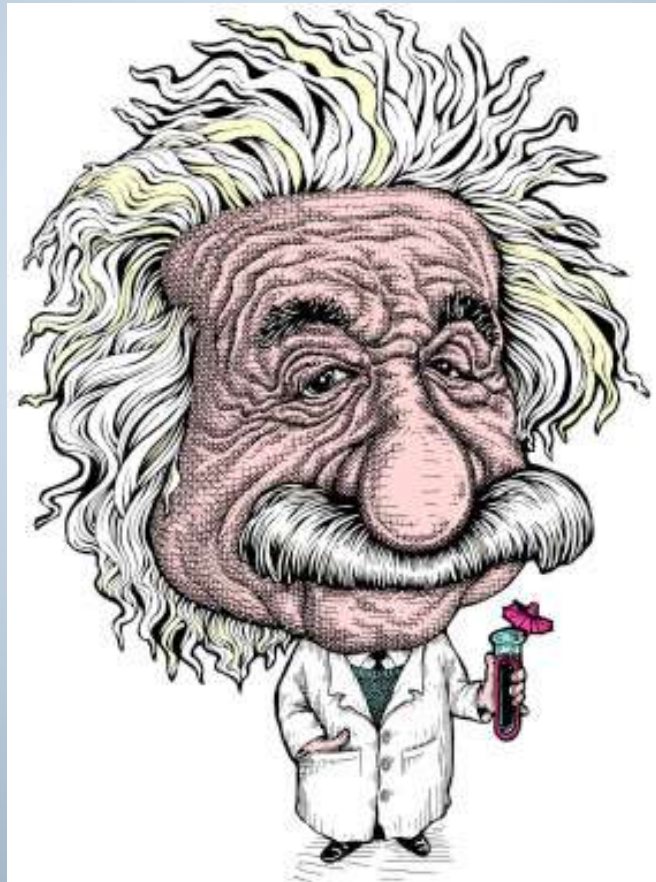
After conducting further research, he comes up with a hypothesis.

“If more sugar is added, then the bread will rise higher because...”

•



Do you know the difference between a dependent and an independent variable?????



Independent Variable

The independent, or manipulated variable, is a factor that's intentionally changed by the scientist.

John is going to use 25g., 50g., 100g., 250g., and 500g. of sugar in his experiment.

Dependent Variable

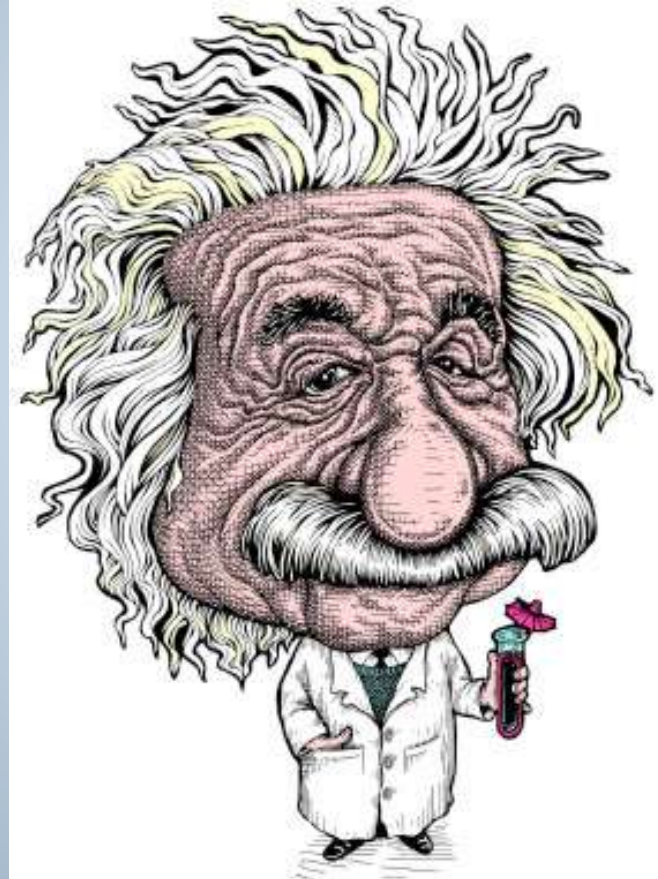
The dependent variable is the factor that may change as a result of changes made in the independent variable.

In this case, it would be the size of the loaf of bread.

Control Variable

The variables that stay the same
There are most always more than 1

Can you think of some control variables (constants) for this experiment?



Control Group

The group that serves as the standard of comparison.

The control group may be a “no treatment” or an “experimenter selected” group.



Control Group

The control group is exposed to the same conditions as the experimental group, except for the variable being tested.

What do you think the control group for this experiment is?

Control Group

Because his grandmother always used **50g. of sugar** in her recipe, John is going to use that amount (50 g) in his control group.

Trials

Trials refer to repeated groups that are exposed to the same conditions in an experiment.

John is going to test each sugar variable 3 times.



Size of Baked Bread (LxWxH) cm³

TRIALS

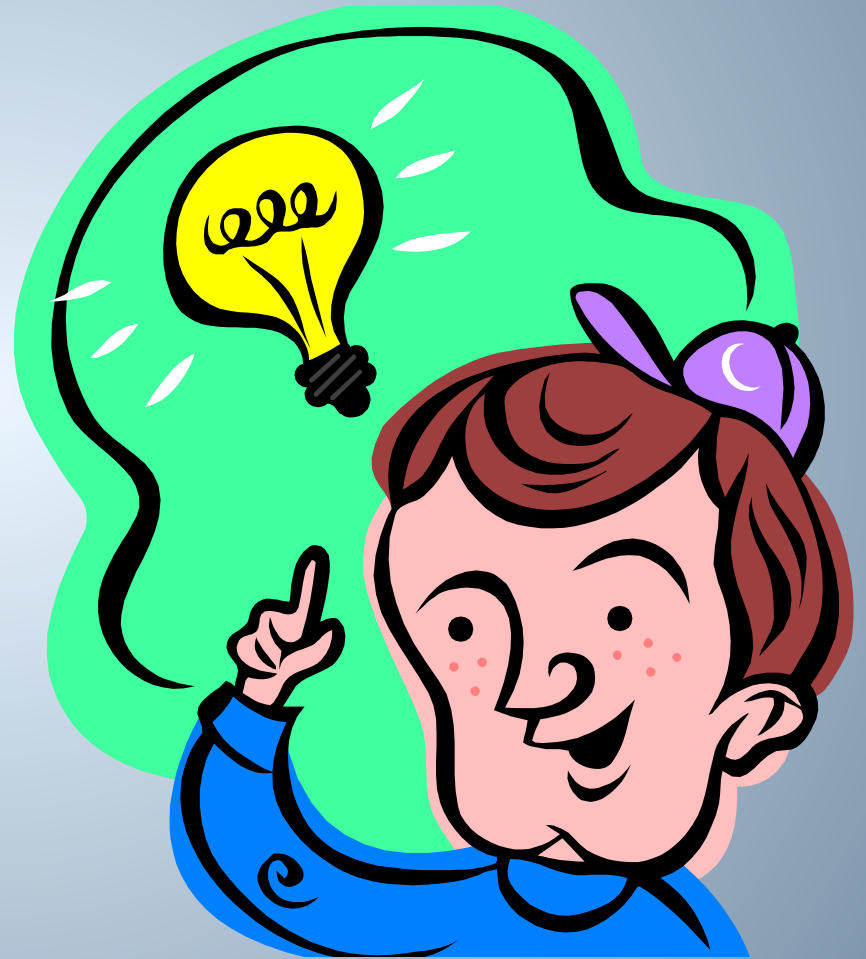
Amt. of Sugar (g.)	1	2	3	Average Size (cm ³)
25	768	744	761	758
50	1296	1188	1296	1260
100	1188	1080	1080	1116
250	672	576	588	612
500	432	504	360	432

Collect and Analyze Results

John examines his data and notices that his control worked the best in this experiment, but not significantly better than 100g. of sugar.

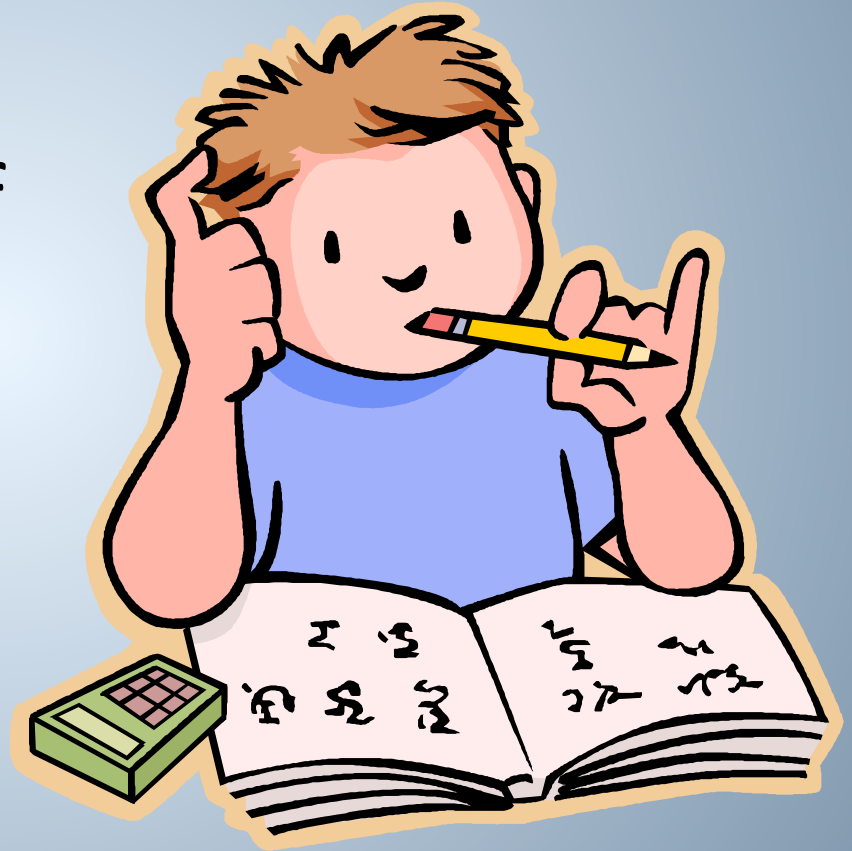
Conclusion

John rejects his hypothesis, but decides to re-test using sugar amounts between 50g. and 100g.

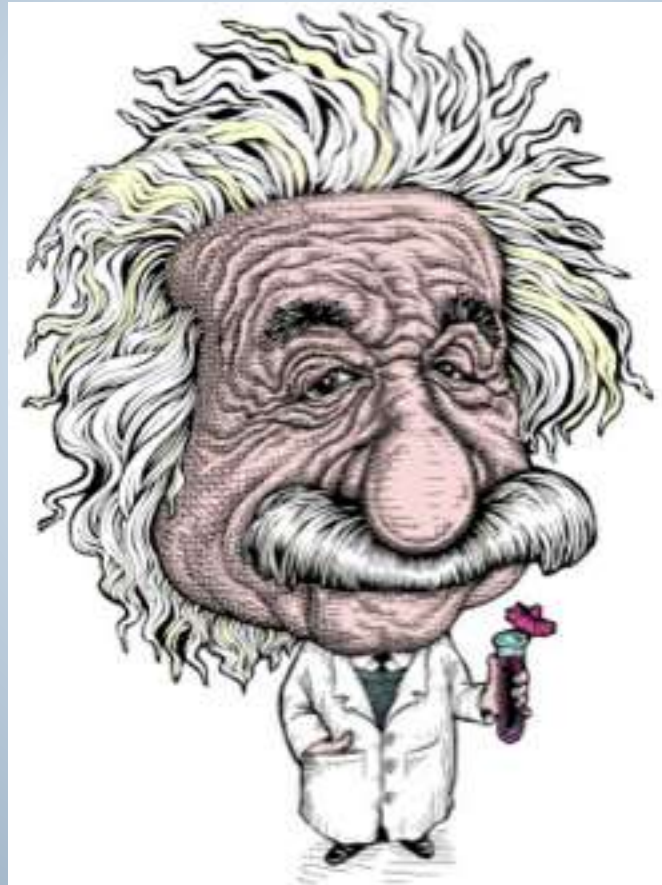


New hypothesis

If I add 70 g of sugar to the bread it will make a bigger loaf because there wasn't much difference in size between 50g and 100 g.



Can you tell which group did the best?



Size of Baked Bread (LxWxH) cm³

Size of Bread Loaf (cm³)

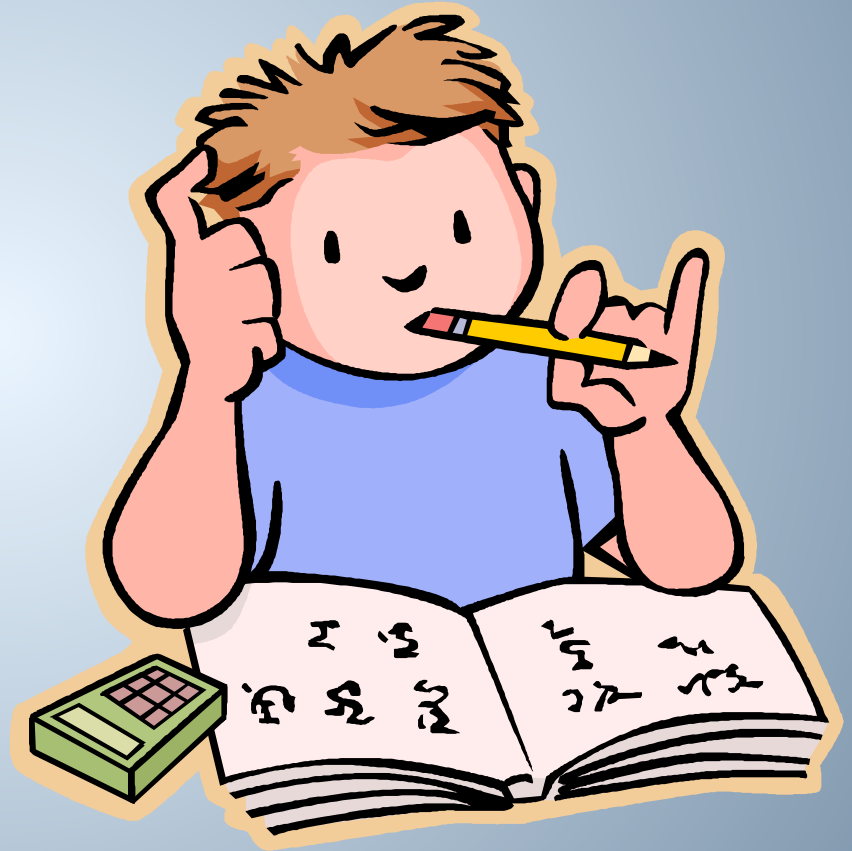
Trials

Amt. of Sugar (g.)	1	2	3	Average Size (cm ³)
50	1296	1440	1296	1344
60	1404	1296	1440	1380
70	1638	1638	1560	1612
80	1404	1296	1296	1332
90	1080	1200	972	1084

Conclusion

John finds that
70g. of sugar
produces the
largest loaf.

His hypothesis
is accepted.



THE END

