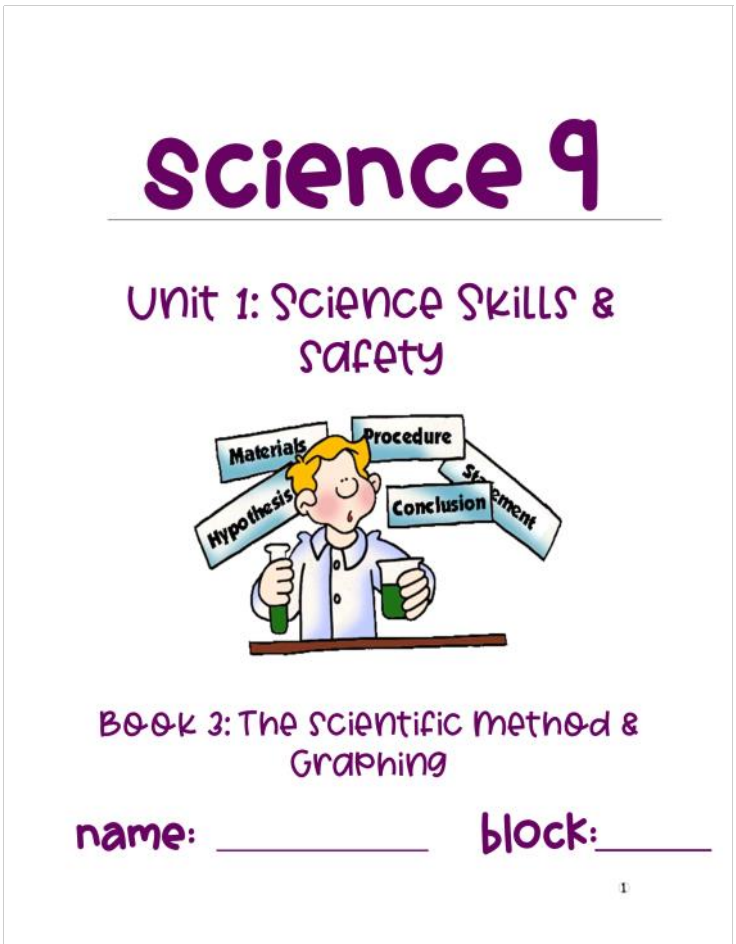
Book 3 - The Scientific Method & Graphing

February 6, 2019 5:48 PM

The Scientific Method: Steps, Examples, Tips and Exercise

https://www.khanacademy.org/science/high-school-biology/hs-biology-foundations/hs-biology-and-the-scientific-method/v/the-scientific-method

The scientific method



PART A: SCIENTIFIC INQUIRY VOCAB

How do we use science in everyday life?

1. observe - use our 5 senses
2. Research - use reliable (trustworthy) sources
   - Question: our topic to investigate
3. Hypothesis - prediction based on research.
4. Test (Experiment) - gather data + information
5. Form a conclusion - answer your research question with evidence

Key terms for the scientific method

Key Term	Definition	Example
Hypothesis	• a proposed explanation for an observation or problem • must be testable!	If I drink coffee, then my alertness will increase because of caffeine
Variable	a factor that can change	• amount of coffee • alertness
Independent Variable (manipulated variable) "changed"	the variable that is being changed by the experimenter.	• amount of coffee/caffeine
Dependent Variable (responding variable)	the variable that you measure to gather data/results.	• alertness
Control (constant/controlled variable) "keep the same"	• something that doesn't change in the experiment. • things we purposely keep exactly the same to have a "Fair Test" *"control group"	• time of wake up • same brand of coffe

Feb 7 Homework:
- Assignment #1
- Study for safety Quiz (blue book)

Homework

ASSIGNMENT #1: Simpson's Experiments

This assignment is to be completed below in the space provided.

hypothesis

Scenario A. Smithers thinks that a special juice will increase the productivity of workers. He creates two groups of 50 workers each and assigns each group the same task (in this case, they're supposed to staple a set of papers). Group A is given the special juice to drink while they work; Group B is not given the special juice. After an hour, Smithers counts how many stacks of papers each group has made. Group A made 1,587 stacks, Group B made 2,113 stacks.

control

variables

control group

data/results.

Identify the:

1. Control group: Group B
2. Independent (manipulated) variable: special juice (amount)
   change
3. Dependent (responding) variable: productivity (how many stacks of paper)
   "measure"
4. What should Smithers' conclusion be?
   The special juice did not increase the productivity, may have slowed.
5. How could this experiment be improved?
   • test different amounts of special juice

Scenario B.

Homer notices that his shower is covered in a strange green slime. His friend Barney tells him that coconut juice will get rid of the green slime. Homer decides to check this this out by spraying half of the shower with coconut juice. He sprays the other half of the shower with water. After 3 days of "treatment" there is no change in the appearance of the green slime on either side of the shower.

hypothesis

Identify the:

1. Control group: water side of shower
2. Independent (manipulated) variable: coconut juice
   change
3. Dependent (responding) variable: amount of slime
   measure
4. What should Homer's conclusion be?
   the coconut juice did not get rid of the slime.

answer

Scenario C.

Bart believes that mice exposed to radiowaves will become extra strong (maybe he's been reading too much Radioactive Man). He decides to perform this experiment by placing 10 mice near a radio for 5 hours. He compared these 10 mice to another 10 mice that had not been exposed. His test consisted of a heavy block of wood that blocked the mouse food. he found that 8 out of 10 of the radiowaved mice were able to push the block away. 7 out of 10 of the other mice were able to do the same.

Identify the:

1. Control group:
2. Independent (manipulated) variable:
3. Dependent (responding) variable:
4. What should Bart's conclusion be?
5. How could Bart's experiment be improved?

Scenario D.

Krusty was told that a certain itching powder was the newest best thing on the market, it even claims to cause 50% longer lasting itches. Interested in this product, he buys the itching powder and compares it to his usual product. One test subject (A) is sprinkled with the original itching powder, and another test subject (B) was sprinkled with the Experimental itching powder. Subject A reported having itches for 30 minutes. Subject B reported to have itches for 45 minutes.

Identify the:

6. Control group:
7. Independent (manipulated) variable:
8. Dependent (responding) variable:
9. Explain whether the data supports the advertisements claim about its product.

PRACTICE

Identify the Independent and Dependent Variables with the MythBusters
https://www.youtube.com/watch?v=l0jTMDtX4WY

Problem 1: Does adding dimples to a car increase its gas mileage?

What was the independent variable?

A. The dimple car
B. The normal car
C. Dimples or not

What is the dependent variable?

A. The number of dimples
B. The gas mileage
C. The speed

It was thought that the gas mileage (the dependent variable) would depend on whether the car had dimples or not. (the independent variable).

Problem 2: Are elephants afraid of mice?

What was the independent variable?

A. Whether or not there was a mouse
B. The dung with the mouse
C. The elephant's reaction

What is the dependent variable?

A. The number of times the experiment was repeated
B. The elephant's reaction
C. The number of elephants scared

Problem 3: Can a rock thrown from a lawn mower have the same force as a bullet shot from a gun?

What was the independent variable?

A. The measured force
B. The object tested
C. The air gun/rock group

What is the dependent variable?

A. The angle the rig arm went up
B. The distance the object was shot
C. The force created by the object

INTERACTIVE: Part 1: Identify the Independent and Dependent Variables with the MythBusters!

PART B: HYPOTHESIS BUILDING

Review: What is a hypothesis? A statement that proposes a possible explanation to a phenomenon. It must be testable, and may include a prediction.

Remember - the key word is **testable**. That is, you could perform a test of how two variables might be related. When you conduct an experiment you are testing variables. Usually, a hypothesis is based on some previous observation or problem.

→ Then we develop the experimental question

How to Write a Good Hypothesis

Use the "**If**..., **then**..., **because**..." format.

independant variable — scientific knowledge — dependant variable

Example:

If there is less oxygen in the water, (independant variable is Oxygen amount)

then the rainbow trout will have more sea lice (dependant variable amount of sea lice)

because their systems are stressed and more vulnerable to parasites.

Experimental/Problem Question:

How can I make my dog's coat shinier?

Hypothesis: If I feed the dog fish oil treats then the coat will be shinier because the fish oil contains omega-3 fatty acids.

Independent variable = fish oil treats (1 dog gets treats, other none)

Dependent variable = shininess of coat.

Controlled variable/s = other treats/food must be the same, the amount of food, exercise, water, brushing, etc.

"everything else, that you aren't testing must be kept the same to be FAIR!"

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HW: Feb 14

① Finish Cricket Lab p. 10-11

② Assignment #2 Questions p. 7-8

Homework

ASSIGNMENT #2: Hypothesis & Variable Practice

This assignment is to be completed below in the space provided.

A. Experimental/Problem Question – How does fertilizer affect plant growth?

Hypothesis: If Fertilizer is added to the plants then They will grow *more/bigger/faster* because of the increase in nutrients

Independent variable = Fertilizer amount *(either have some, or none)*

Dependent variable = Plant growth

Controlled variable/s = Amount of water, light, dirt, heat, etc *(everything OTHER than fertilizer must be kept the exact same between the plants)*

B. Chris wanted to test the effect of diet pills on how tall the tomato plants in his garden would grow. He took two pots, filled them with dirt from the same bag, and planted four tomato plants in each. He watered one planter with tap water, and he watered the other planter with tap water mixed with dissolved diet pills. The plants were in the same location to ensure they got the same amount of sunlight, and the water was measured so that each pot received the same amount of water. He measured their height at the end of each week for eight weeks, and averaged the height of the four plants in each pot. He then graphed the results to show how the diet pills affected the height of the plants.

1. What is the independent variable of this experiment?
   Diet pills given to plants *(dissolved in the water)*
2. What is the dependent variable of this experiment?
   Plant growth
3. What is the control?
   Plant with no diet pills *(control group)*
4. List the constants in this experiment.
   Dirt, amount of water, sunlight
5. How many trials were ran for this experiment?
   1
6. Write a hypothesis for this experiment in the **if/then/because** style.

   IF the plants are given diet pills THEN they will grow more slowly BECAUSE of decreased nutrients

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C. During gym class Sally noticed that her friend Melissa always ran faster than her. Sally knew that they exercised equally, so she wondered what could cause Melissa to run so fast.

Sally began to compare herself and Melissa to see what could cause the difference in speeds. She noticed that Melissa was taller and wondered if height affected speed. Sally predicted that taller people were able to run faster, but wanted to check her prediction. She asked her gym teacher if she could test her idea.

Sally measured all of her classmates' height in centimeters and recorded it in her chart. Each classmate then ran one kilometer while Sally timed them with a stopwatch and recorded the data in seconds. She then began to review her data and look for the answer to her question.

1. What question is Sally trying to answer?

   Why do some people run faster than her?

2. What made her want to answer this question?

   She thought she should be able to keep up with her friend

3. What is being measured or observed in this experiment?

   Height (cm) and time to run 1km (seconds)

4. Are the observations recorded in words or numbers?

   numbers (height in cm and time in seconds)

5. What factor does Sally think might cause the measurement to change?

   A persons height

6. What parts of the experiment were kept the same throughout?

   The distance they had to run

7. Is there a standard of comparison in this experiment (something she compared everyone to)?

   Yes, to herself.

8. How many times was the experiment completed?

   Once for each classmate

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PART C: PROCEDURES

So you have a hypothesis, how do you test it?
···With a well designed procedure!

Unit Test (this booklet) Friday!

Great Procedures Have Details

The Procedure is a key component of your experimental design.

"valid"; to confirm

Validity is important in science, so scientists Repeat their experiments to see if they can get the same results each time. => Believable

For this reason, a well designed experiment is one that can be replicated by other scientists, and the procedure tells them what to do.

How?

↳ enough detail for someone else to follow.

PRACTICE ▸ ***Write your OWN procedure:***

Think of something that you enjoy doing. How would you describe the **procedure** for that activity to someone else. For example if you are really good at mini golf how would you describe to me, a mini golf newbie, how to make a shot. Or if you are really good at drawing cats how would you describe that to someone trying to replicate your drawing. Develop a procedure in the space below.

Activity: How to do a scratch spin.

Procedure:

1. Put on skates, be sure to lace up on each hook on both feet.
2. Step onto the ice
3. Execute a left FWD inside 3-turn by pushing forwards on the left foot, and backwards with the right.
4. Pull both arms into your chest tightly, and cross your free right foot over your left foot.

INDEPENDANT STUDY LAB:

https://www.biologycorner.com/worksheets

INDEPENDANT STUDY LAB: The Cricket Experiment

Some say that if you listen to the sound of a cricket chirping, you can determine the temperature. Is this true or is it just an urban (science) legend? Do any other factors affect how fast a cricket will chirp, such as humidity, wind, atmospheric pressure, or nearby crickets?

Website: biol.co/cricketsci

1. **Complete the *tutorial*** and fill in the blanks below as you go:

   A. When scientists set out to solve a problem, the follow a series of steps frequently referred to as the _____.

   B. There are three important points to remember when stating or defining a problem:
      i.
      ii.
      iii.

   C. A hypothesis must be the best explanation, _____.

   D. Once you have made a hypothesis, you must _____.

   E. When you test a hypothesis, only _____
   That condition should be the same condition that was identified in the problem. This factor is called the independent variable.

   F. No matter how many times your hypothesis is proved right, it is never _____.

2. Now proceed through the ***cricket experiment,*** recording data and key observations.

   A. State the research problem (question):

   B. What are two pieces of information that you collected?

   C. State the hypothesis using an if...then...because... statement:

https://www.biologycorner.com/worksheets/crickets_chirp.html

http://webapp.gccaz.edu/academic/biology/scientific_method/

Biol.co/cricketsci

Done.

D. List your independent variable:

Dependent variable:

Constants (controlled variables):

E. Observations:
Describe what you observed during your experiment. Record any data that you collected (you can use the table below to organize your data):

Independent Variable: _____	Dependent Variable:_____

F. State your conclusions.
Indicate whether your experiment has supported or rejected your hypothesis. Be clear in your analysis about what factor(s) affected cricket chirps and exactly how chirps were affected (i.e. Did they increase, decrease or remain the same?).

PART D : MAKING OBSERVATIONS

Observation: the act of noticing and recording a object or event. Describing the characteristics using our 5 senses (sight, smell, hear, touch, taste)

Types of Observations

	Quantitative (= quantity)	Qualitative (quality)
Definition	description using Numbers	description using Letters (words)
Examples	• 21 students • record height • temperature outside • time *measured	• describe colour, sounds, smells, texture, etc. *5 senses

EXAMPLE

A student dissolved 30 grams of Epsom salts in water, poured the solution into a dish, and let the dish sit out uncovered overnight. The next day, she made the following observations of the Epsom salt crystals that grew in the dish.

Table 1. Observations of Epsom Salt Crystals

Quantitative Observations	Qualitative Observations
• mass = 30 g • mean crystal length = 0.5 cm • longest crystal length = 2 cm	• Crystals are clear. • Crystals are long, thin, and rectangular. • White crust has formed around edge of dish.

Photographs or sketches are useful for recording qualitative observations.

Epsom salt crystals

Numbers / measured values. / *data recorded in the lab.

"Letters" / colour / looks/shape / colours

- Make quantitative observations whenever possible. That way, others will know exactly what you observed and be able to compare their results with yours.
- It is always a good idea to make qualitative observations too. You never know when you might observe something unexpected.

PRACTICE

Qualitative vs. Quantitative

Read the following examples and then decide if each statement is Qualitative (QL) or Quantitative (QNT).

1. _____ The candy was sour.
2. _____ The bug was 5 cm long.
3. _____ The flower is red.
4. _____ The mass of the beaker was 122 g.
5. _____ My fingernail is 2 cm long.
6. _____ The slug was slimy.
7. _____ The laptop is white.
8. _____ She is 150 cm tall.
9. _____ His hair is black.
10. _____ You have 3 sisters.

Use the cartoon to the right to answer below:

Make your own Quantitative Observation -

Make your own Qualitative Observation -

Inference - what is the dog thinking? Write it in the speech bubble above.

What are three quantitative and three qualitative observations you could make of lemurs?

Quantitative:
- 3 lemurs
- mass/weight
- how tall / long tail

*Things we can measure

Qualitative:
- striped tails
- black + white
- gold / brown eyes

... inference: they are from Madagascar

we think/conclude based on our observations + knowledge

ANSWER KEY

Qualitative vs. Quantitative

Read the following examples and then decide if each statement is Qualitative (QL) or Quantitative (QNT).

1. QL The candy was sour.
2. QNT The bug was 5 cm long.
3. QL The flower is red.
4. QNT The mass of the beaker was 122 g.
5. QNT My fingernail is 2 cm long.
6. QL The slug was slimy.
7. QL The laptop is white.
8. QNT She is 150 cm tall.
9. QL His hair is black.
10. QNT You have 3 sisters.

Use the cartoon to the right to answer below:

Make your own Quantitative Observation - there is 1 man · 1 dog · 1 treat

Make your own Qualitative Observation - the man's shirt is black + white, the dog is white/big

Inference - what is the dog thinking? Write it in the speech bubble above. why can't I just eat it?

(various answers accepted.)

Observations vs. Inferences:

Observation	Inference
• using our 5 senses to make QUALitative descriptions	• a logical explanation based on our observation and evidence.
• taking measurements to make QUANTitative descriptions	• Lead us to a conclusion.

Example: A student observing a set of acorns noticed something unexpected about one of them. They noticed a white, soft-bodied insect eating its way out of the acorn.

Observations
- There is a hole in the acorn, about .05 cm in diameter, where the insect crawled out.
- There is a second hole, which is about the size of a pinhole, on the other side of the acorn.
- The inside of the acorn is hollow.

Inferences (explanation)
- The insect formed from the material inside the acorn, grew to its present size, and ate its way out of the acorn.
- The insect crawled through the smaller hole, ate the inside of the acorn, grew to its present size, and ate its way out of the acorn.
- An egg was laid in the acorn through the smaller hole. The egg hatched into a larva that ate the inside of the acorn, grew to its present size, and ate its way out of the acorn.

When you make inferences, be sure to look at all of the evidence available and combine it with what you already know.

MORE ABOUT INFERENCES

Inferences depend both on observations and on the knowledge of the people making the inferences. Ancient people who did not know that organisms are produced only by similar organisms might have made an inference like the first one. A student today might look at the same observations and make the second inference. A third student might have knowledge about this particular insect and know that it is never small enough to fit through the smaller hole, leading her to the third inference.

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PRACTICE – work on in class.

Complete the following inferences and observations. There may be more than one logical answer for these. Try and give the most likely explanation!

Problem #1

Observation: I am sitting in my bedroom working on the computer at night. Suddenly the lights and computer go off leaving me in darkness. My iPod is still going though.

Inference: _____

Problem # 2

Observation: I am in the lab seeing if adding sugar to water affects how long it takes the water to boil. In the first test I boil 100 mL of **water only** in a beaker over a Bunsen burner and observe it takes 5:15 mins to boil. Next I add **2 grams of sugar** to 100 mL of water and stir to dissolve, then boil making sure everything is the same. This time it takes 7:05 mins to boil the sugar-water mix. Next I add **4 grams of sugar** to 100 mL of water. This time it takes 10:35 mins to boil the sugar-water mix.

What could we infer about the effect sugar has on the boiling time of water?_____

_____

_____

Problem # 3

Use the picture of the boy in the water to determine if the following statements are observations or if the statements are inferences.

Place an "I" in the blank for inference and an "O" in the blank for observation.

___ 1. The boy is in the water
___ 2. The weather is cold
___ 3. The tree branch is broken
___ 4. If the boy crawled out of the water, the goat would push him
___ 5. The boy fell off the branch
___ 6. The goat is standing by the pond
___ 7. The branch will fall on the boy's head
___ 8. The boy fell off the rocks
___ 9. There is a sailboat in the water
___ 10. The sailboat belongs to the boy
___ 11. The goat will soon leave the pond
___ 12. The tree by the pond has no leaves
___ 13. There are three rocks in the pond
___ 14. The tree by the pond is dead
___ 15. If it rains, leaves will grow on the tree
___ 16. The goat pushed the boy into the pond

PRACTICE – Key

Complete the following inferences and observations. There may be more than one logical answer for these. Try and give the most likely explanation!

Problem #1

Observation: I am sitting in my bedroom working on the computer at night. Suddenly the lights and computer go off leaving me in darkness. My iPod is still going though.

Inference: The power has gone out *(we are assuming this is a desktop computer plugged into the wall)*

Problem # 2

Observation: I am in the lab seeing if adding sugar to water affects how long it takes the water to boil. In the first test I boil 100 mL of **water only** in a beaker over a Bunsen burner and observe it takes 5:15 mins to boil. Next I add **2 grams of sugar** to 100 mL of water and stir to dissolve, then boil making sure everything is the same. This time it takes 7:05 mins to boil the sugar-water mix. Next I add **4 grams of sugar** to 100 mL of water. This time it takes 10:35 mins to boil the sugar-water mix.

What could we infer about the effect sugar has on the boiling time of water?_____

Adding sugar to water increases the boiling point of the water, meaning the water will take longer to boil

Problem # 3

Use the picture of the boy in the water to determine if the following statements are observations or if the statements are inferences.

Place an "I" in the blank for inference and an "O" in the blank for observation.

O 1. The boy is in the water
I 2. The weather is cold
O 3. The tree branch is broken
I 4. If the boy crawled out of the water, the goat would push him
I 5. The boy fell off the branch
O 6. The goat is standing by the pond
I 7. The branch will fall on the boy's head
I 8. The boy fell off the rocks
O 9. There is a sailboat in the water
I 10. The sailboat belongs to the boy
I 11. The goat will soon leave the pond
O 12. The tree by the pond has no leaves
O 13. There are three rocks in the pond
I 14. The tree by the pond is dead
I 15. If it rains, leaves will grow on the tree
I 16. The goat pushed the boy into the pond

HW Feb 19th

Homework **ASSIGNMENT #3: Observations & Inferences Worksheet**
This assignment is to be completed below in the space provided.

Observations and Inferences

Directions:

1. Refer to each of the scenarios/pictures and list any *observations*.
2. Once you have listed your observations, try to come up with some *inferences*.

A. After Sue walked out of her house she heard a siren and smelled smoke

Observations	Inferences

B. You come across this scene:

Observations	Inferences

C. I am in the lab seeing if adding sugar to water affects how long it takes the water to boil. In the first test I boil 100 mL of water only in a beaker over a Bunsen burner and observe it takes 5:15 mins to boil. Next I add 2 grams of sugar to 100 mL of water and stir to dissolve, then boil making sure everything is the same. This time it takes 7:05 mins to boil the sugar-water mix. Next I add 4 grams of sugar to 100 mL of water. This time it takes 10:35 mins to boil the sugar-water mix.

Observations	Inferences

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Answers:

Homework **ASSIGNMENT #3: Observations & Inferences Worksheet**
This assignment is to be completed below in the space provided.

Observations and Inferences

Directions:

1. Refer to each of the scenarios/pictures and list any *observations*.
2. Once you have listed your observations, try to come up with some *inferences*.

A. After Sue walked out of her house she heard a siren and smelled smoke

Observations	Inferences
• siren (fire truck?) • smoke	There is something on fire nearby

B. You come across this scene:

Observations	Inferences
• tears • cut on knee • boy	The boy tripped + skinned his knee.

C. I am in the lab seeing if adding sugar to water affects how long it takes the water to boil. In the first test I boil 100 mL of water only in a beaker over a Bunsen burner and observe it takes 5:15 mins to boil. Next I add 2 grams of sugar to 100 mL of water and stir to dissolve, then boil making sure everything is the same. This time it takes 7:05 mins to boil the sugar-water mix. Next I add 4 grams of sugar to 100 mL of water. This time it takes 10:35 mins to boil the sugar-water mix.

Observations	Inferences
• water boiling • time taken to boil • sugar (amount)	when sugar is added the the water it takes longer to boil.

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PART E: SCIENTIFIC PROCEDURES PRACTICE

Read through the procedure below:

Procedure:

1. Gather your materials.
2. Set up 10 rye grass plants in individual pots under a light source.
3. Number the plants 1 through 10.
4. Plants 1, 2, 3, 4, and 5 will receive 50 mL of 1% Miracle Gro solution. (This is the experimental group)
5. Plants 6, 7, 8, 9 and 10 will not receive Miracle Gro. (This is the control group)
6. Add 50 mL of water to each control plant daily. Add 50 mL of 1% Miracle Gro solution to each experimental plant daily.
7. Measure the height of the rye grass in cm every 3 days and record results in data table.
8. Repeat steps 6 and 7 for two weeks.
9. Clean up your materials.

Do you think this a good procedure? Why or why not?

HW: Feb 19th

GROUP Activity

Scientific Method - Scenarios

1. With a partner draw an experimental question from the hat.
2. Read through the question.

My question is: (various answers)

Which battery lasts longer, energizer or duracell?

3. Identify a control group, a dependent variable and an independent variable.

Control group: no flashlight? measure on voltmeter?

Dependent variable: (what you're measuring) How long the battery lasts in a flashlight.

Independent variable: (what you're changing/testing) Type of battery.

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*Experiment - put in flashlight, see how long the light lasts.

4. Write an hypothesis using an if...then...because.... statement

Hypothesis:

Students are working in partners on DIFFERENT experimental questions...answers here will vary

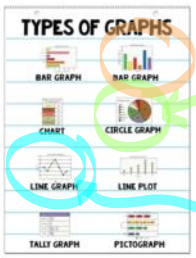
5. Write out a detailed procedure for how you would set up your experiment to test your hypothesis (you will not actually have to do this experiment!). Think about what type of information will you need to collect and how will you collect it? ***Remember: Provide details and be specific!***

6. Prediction: What do you think the results of this experiment will be?

pg. 19

PART F: GRAPHING & ANALYZING SCIENTIFIC DATA

Graphing is an important procedure used by scientists to display the data that is collected during an experiment.



There are three main types of graphs that we will study:

Pie/circle graphs: Used to show parts of a whole

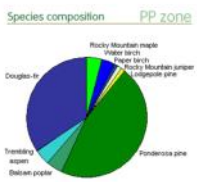
- data as a percentage

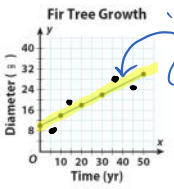
Bar graphs: Used to compare amounts

- often used for non-numerical data

Line graphs: Used to show the change of one piece of information as it relates to another. It shows the relationship between the variables

independant dependant





"best-fit line" (shows the pattern)

Bar Graph

non-numerical (not numbers)

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Parts of a Graph (Numbered)

Title: Summarizes information being represented in ANY graph. -> descriptive

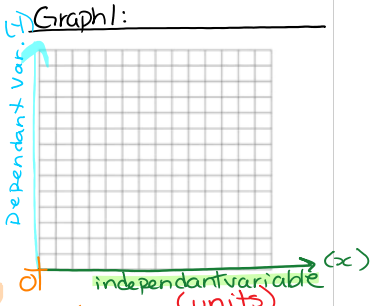
Independent variable:
The variable that is controlled/manipulated by the experimenter, such as time, temperature, amount of fertilizer etc.
This is placed on the ___X___ axis.

Dependent variable: (measure)
The variable that is directly affected by the independent variable. It is the result of what happens when we manipulate the independent variable.
This is placed on the ___Y___ axis.

Scales for each variable:
When you make a graph you need to know where to plot the points representing the data.
In order to do this a scale is needed that includes all of the data points. You should try to make => BIG the graph take up as much of the graph paper as you can. Scales should usually start with ___zero___ and climb in ___regular___ intervals. eg. 5, 10, 15, etc. ✓ 5, 7, 8, 10, 25 X

Legend: A short description of any colours or patterns used to represent/describe different features on a graph. ex. on a line graph { one type / and type ..... ▲▲▲

Graph 1:



starts at 0 zero

title

PRACTICE

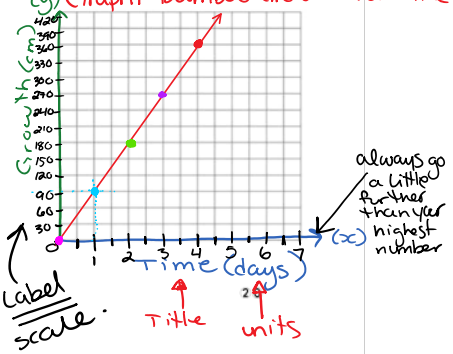
Making a line graph using the data below.

Table 1. Bamboo Growth Over Time

Time (days) (x)	Growth (cm) (y)
0	0
1	90
2	180
3	270
4	360

Time is ALWAYS the independant variable.

(y) Graph 1: Bamboo Growth Over Time



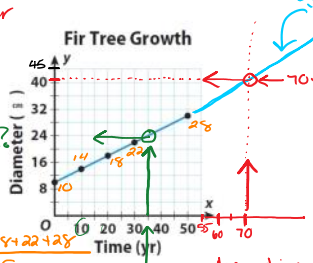
what is diameter after 70 yrs? approx 41cm

Extrapolate: make the graph bigger so we can estimate EXTRA (beyond graph.

Interpolate: estimate within the graph (inside)

what is the diameter after 35 yrs? approx 24cm

draw "Extra" graph



How do you calculate an average?
add #'s together and ÷ by how many there are.
eg. $\frac{10+14+15+22+28}{5} = 69.6\text{cm}$

What is a trend?
A general pattern the data shows ... use "increasing", "decreasing", "no trend"

*As time increases, so does diameter.

PRACTICE

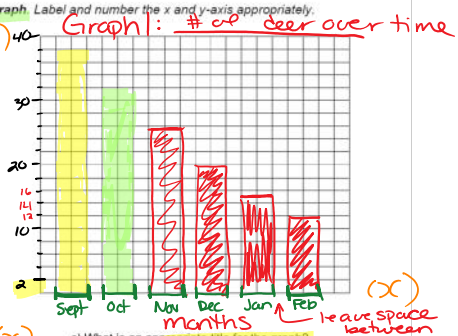
Graphing Practice:

1. *Graph the following information in a **BAR graph**. Label and number the x and y-axis appropriately.*

Month	# of deer
Sept	38
Oct	32
Nov	26
Dec	20
Jan	15
Feb	12

Non-numerical data

Graph 1: # of deer over time



a) What is the independent variable? (x) months

b) What is the dependent variable? (y) # of deer

c) What is an appropriate title for the graph? # of deer over time

d) What is the average number of deer per month?

$\frac{38+32+26+20+15+12}{6} = \frac{143}{6}$

$= 23.83 \cong 24$ deer

- Title
- label x and y-axis
- units + scale
- dot point + Line of best fit.

2. *Graph the following information in a **LINE graph**. Label and number the x and y-axis appropriately.*

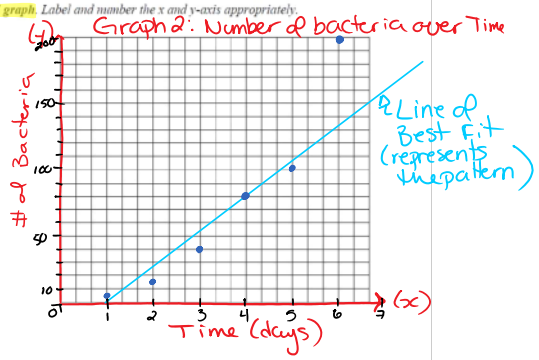
(y) Graph 2: Number of bacteria over Time

- units + scale
- dot point + Line of best fit.

2. *Graph the following information in a LINE graph. Label and number the x and y-axis appropriately.*

Graph 2: Number of bacteria over Time

# of Days	# of Bacteria
1	4
2	16
3	40
4	80
5	100
6	200



a) What is the independent variable?
# of days

b) What is the dependent variable?
# of bacteria

c) What is an appropriate title for the graph?
"Graph 2: Number of Bacteria over Time"

Tables and Trends

3. What trend does the data in the table on the right show?

variables: • how much weight pressed (kg)
• Number of reps

Weight Bench Pressed (kg)	Number of Reps
100	32
115	24
130	16
145	8

+15, +15 increase
-8, -8 decrease

Trend:

* *Every time the weight of the bench press* increases *the number of reps* decreases.

Can we be more specific?

Every time the weight of the bench press increases *by* 15 kg, *the number of reps* decreases *by* 8.

conclusion: The mass of the object does not affect the time it takes to fall.

4. What trend does the data in the table on the right show?

Every time the Mass of Object increases the time it takes to fall does not change (stays the same)

Mass of Object (kg)	Time it takes to fall in a vacuum (seconds)
2	4.9
42	4.9
82	4.9
122	4.9

increase
zero gravity
no change

explain what the results show.

5. What conclusion can you make based on the information below? *(what time of day are you most alert?)*

=> conclusion: Level of alertness changes during the day, but you are most alert at 12:00 noon.

What Time Of Day Are You Most Alert?

Assumption: The ability to sort playing cards is an indication of alertness.

Procedure:
1. Shuffle a deck of playing cards four times
2. Time how long it takes to sort the cards into the four suits
3. Repeat the activity at the same time for five days

Time of Day	Ave. Sorting Time (s)
8:00 am	130
12:00 noon	105
4:00 pm	122
8:00 pm	127

alert
Fastest
increase

Feb 21st
① Journal
② Graphing Notes
③ Practice Test

Making Predictions from Data

6. Find out how much each variable changes between lines in the table. What is the trend?

increase

independent var. dependant var.

Amount of water (liters)	Tree Growth (meters)
2	5
4	10
6	15
8	20

Changes by +2 each time
Changes by +5 each time

detail

Conclusion: (describe trend) The tree grows 5m for every 2 L increase in water.

7. Estimate how much dissolved oxygen there would be if the temperature was 45 °C based on the information to the right:

Temperature (°C)	Amount of Dissolved Oxygen (mg/L)
10	1000
15	950
20	900
25	850
30	800
35	750
40	700
45	650

Estimate: 650 mg/L of dissolved oxygen

+5 −50; +5 −50; continue the pattern

Making Tables

8. Rashawn wants to test if the mass of a ball influences how far he could throw it.

a) Identify the independent variable: mass of the ball (kg)
b) Identify the dependent variable: distance thrown (m)
c) What are three things Rashawn should keep constant: # times thrown, warm-up time, size + shape same
d) What is your hypothesis (write using an If/Then/Because statement): If the mass of ball is increased then it will NOT be thrown as far, because objects with more mass require a greater force to throw.
e) In the results, Rashawn would measure distance thrown and record it in a data table.

Findings: Rashawn finds that he can throw a 10 kg basketball 50 meters, a 20 kg shotput 40 meters, a 30 kg shotput 30 meters, and he can throw a 40 kg shot 20 meters. Make a table showing these results.

How to set up a table - include a title, label the categories *(what is the independent and dependent variable?)*, input the data under the appropriate headings.

Title: Table 1: Mass of ball and Distance thrown

Independent variable: Mass of ball (kg)	Dependent variable: Distance thrown (m)
10	50
20	40
30	30
40	20

+10; −10

f) What is the trend? when the mass of the ball increases by 10kg, the distance thrown decreases by 10 m. (detail)

g) Did the data support or disprove your hypothesis? The hypothesis is supported by the results.

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Homework

ASSIGNMENT #4: Worksheet 2.3 "Showing Data: Graphs"
This assignment is to be completed below in the space provided.

2.3 Showing data: graphs

Bar graphs

A **bar graph** is used to show parts or fractions. For example, we can graph the amounts of the main gases in clean air.

Amount of gases in air

Gas	Percentage %
Nitrogen	78
Oxygen	21
Other gases	1

A bar graph shows these amounts as different colours or patterns in a bar.

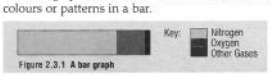


Figure 2.3.1 A bar graph

- Make your bar graph 10 cm long—that makes 1 mm equal to 1%.
- Include a key that shows which parts of the graph stand for the different gases.

Column and line graphs

A **column graph** shows the data in a series of columns. A **line graph** has a line joining the points where the middle of the tops of the column would be. These points are called **data points**. Most graphs used in science are line graphs.

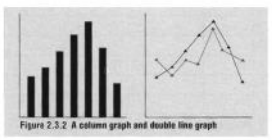


Figure 2.3.2 A column graph and double line graph

Double graphs

You don't have to draw two graphs to show two sets of data. You can use the same graph with two different lines or two different sets of columns. Using the same graph is important if you want to compare data.

Pie graphs

Pie graphs present information using a circle that has been divided into sections. Each section represents a fraction of a whole circle or pie.

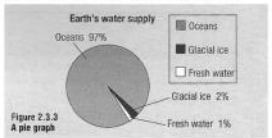


Figure 2.3.3 A pie graph

Questions

1. What points should you include in your checklist when drawing a line graph?
   - Numbered Title
   - independant variable
   - dependant variable
   - x and y axis numbered scale
   - dot points
   - Line of best fit.

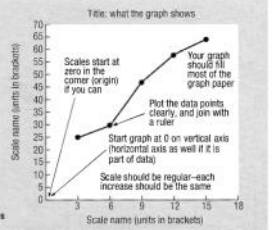


Figure 2.3.4 Hints for drawing line graphs

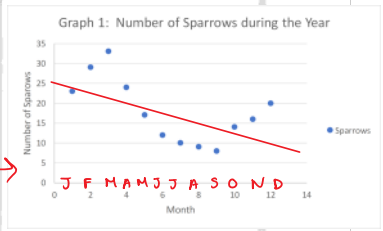
2 What is a key on a graph?

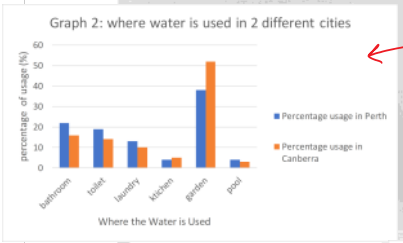
same as a legend, describes different parts.

3 Draw a line graph to show the following data:

Number of sparrows counted on 15th day of each month

Month	Sparrows	Month	Sparrows
January	23	July	10
February	29	August	9
March	33	September	8
April	24	October	14
May	17	November	16
June	12	December	20



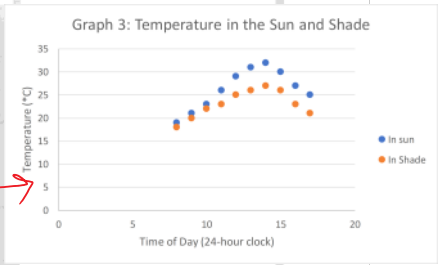


5 Show the following information in a **double column graph**, with the columns for Perth and Canberra drawn beside each other for each place where water is used.

Where water is used	Percentage usage in Perth (%)	Percentage usage in Canberra (%)
Bathroom	22	16
Toilet	19	14
Laundry	13	10
Kitchen	4	5
Garden	38	52
Pool	4	3

4 Draw a **double line graph** using the two sets of data below.

Time	In sun (°C)	In shade (°C)
8 a.m.	19	18
9 a.m.	21	20
10 a.m.	23	22
11 a.m.	26	23
12 noon	29	25
1 p.m.	31	26
2 p.m.	32	27
3 p.m.	30	26
4 p.m.	27	23
5 p.m.	25	21



Homework

ASSIGNMENT #5: Scientific Method & Graphing Review

This assignment is to be completed below in the space provided.

Review questions

1 Rosemary recorded the following information in her diary. It concerns the time she spent doing her science assignment, and the time she spent on homework for other subjects.

On Monday, I worked for 2 hours on science and then had time for half an hour for other homework before watching television. On Tuesday, I went to hockey and did some maths homework. This took 1.5 hours, and I copied up some notes for my science for 30 minutes. On Wednesday I spent 1.5 hours on both homework and the science assignment, a total of 3 hours. The next day was a disaster. I was sick and did no science and only 1 hour of homework. Friday is the end of the school week, but I copied up some notes for the science assignment for 1 hour. On Saturday I did some English and maths homework but I forget how much, and I spent 2 hours finishing the science assignment.

Record this information in the table below.

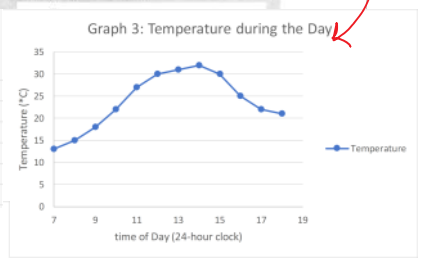
Time Rosemar

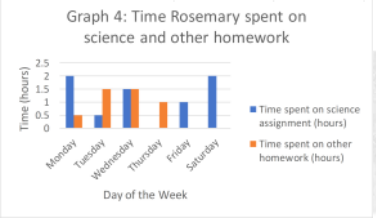
Day	Time spent on science assignment (hours)	Time spent on other homework (hours)
Monday	2	0.5
Tuesday	0.5	1.5
Wednesday	1.5	1.5
Thursday	0	1
Friday	1	0
Saturday	2	

2 Draw a line graph of this data. Remember to follow the hints given in section 2.3.

Temperature during the day

Time of day	Temperature (°C)
7.00 a.m.	13
8.00 a.m.	15
9.00 a.m.	18
10.00 a.m.	22
11.00 a.m.	27
12.00 noon	30
1.00 p.m.	31
2.00 p.m.	32
3.00 p.m.	30
4.00 p.m.	25
5.00 p.m.	22
6.00 p.m.	21





3 A Year 7 science class has students with the following hair colour: 40% brown, 28% black, 24% blonde and 8% red. Draw this information in a bar graph below.

Hair colour by percentage in Year 7 science class

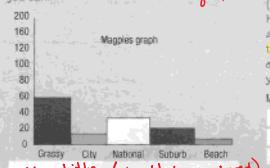
40%
Key: Brown
28%
Black
24%
Blonde
8%
Red

4 Match each word with its meaning.

Word	Meaning	Answer
A hypothesis	1 something you notice with your senses	B
B observation	2 a comparison so that a fair experiment is done	C
C control	3 a project or experiment you do to answer a question	F
D graph	4 an explanation of what you observed	G
E data	5 a guess at an answer you can check by experiment	A
F investigation	6 another name for information	E
G inference	7 a way of showing information in a visual form	D
H table	8 a way of showing information in columns and rows	H

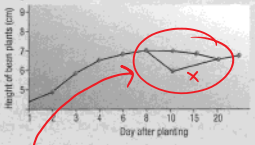
5 List as many faults with this histogram as you can.

(bar graph)



- No title (should be numbered)
- y-axis is not labelled (units)
- x-axis has no title

6 List as many faults with this line graph as you can.



- should use a line of best fit
- No numbered title
- what units are the x-axis?

Thinking question

(This is a big question that has many answers.) How can you make a beaker of hot water go cold as quickly as possible? List your ideas and test them by experiment. Use a control in your experiment. Write up your experiment properly in your notebook.

Ideas:

Research questions

1 Who was M.C. Escher? Find one of his drawings and explain what is unusual about it.

2 When researchers test new medicines, they use a control. Some people are given the new drug and some people are given a placebo. What is a placebo and why don't all the people in the experiment get the drug to see how it works?

Word check

Write the meanings of these words in your notebook.

bar graph	histogram	line graph
column graph	hypothesis	observant
control	inference	observation
data	information	prediction
double graphs	investigation	table

Mind map

Draw a mind map in your notebook using all the ideas about investigating in this chapter.