Kickoff

Boiling Point of Salted Water

Amount of Salt Added (grams)	Boiling Point of Water (degrees Celsius)
0	100.0
30	100.5
60	101.0
90	101.5
120	102.0

Elena wants to test the effect of the addition of salt to a pot of boiling water. She adds 30 grams of salt to one kilogram of water and then reads the temperature of the water when it boils. She then repeats the experiment several more times, increasing the amount of salt by 30 grams each time. The table above represents her results. What conclusion can Elena make about adding salt to water?

1. Sketch a graph of the data.

2. What conclusion can be made regarding the data?

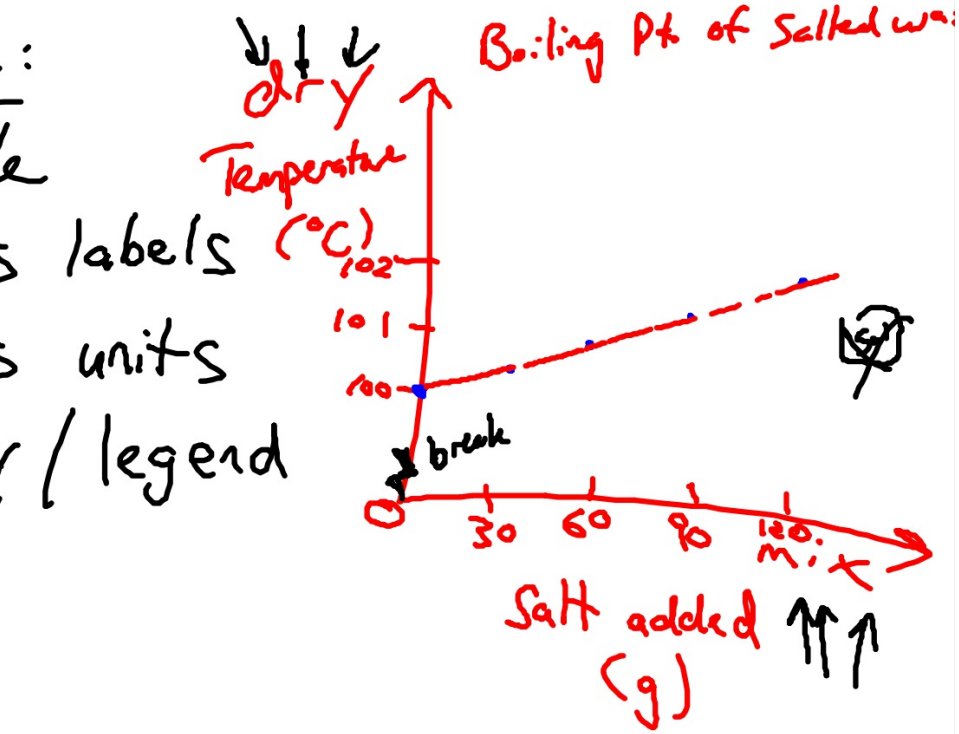
3. What percent salt solution was made at the end of the experiment?

When Graphing Data, ALWAYS:

- Title the graph
- Axis labels
- Axis units
- Key/legend

Graph:

1. Title
2. Axis labels
3. Axis units
4. Key / legend



VISUAL VOCAB

1. The **independent variable** is a condition that is manipulated, or changed, by a scientist.

2. **Dependent variables** are observed and measured during an experiment; they are the experimental data.

Variable - anything that changes in experiment

X-axis

Controlled variable

Constant

Y- axis

results

Draw a scientist

The scientific method:

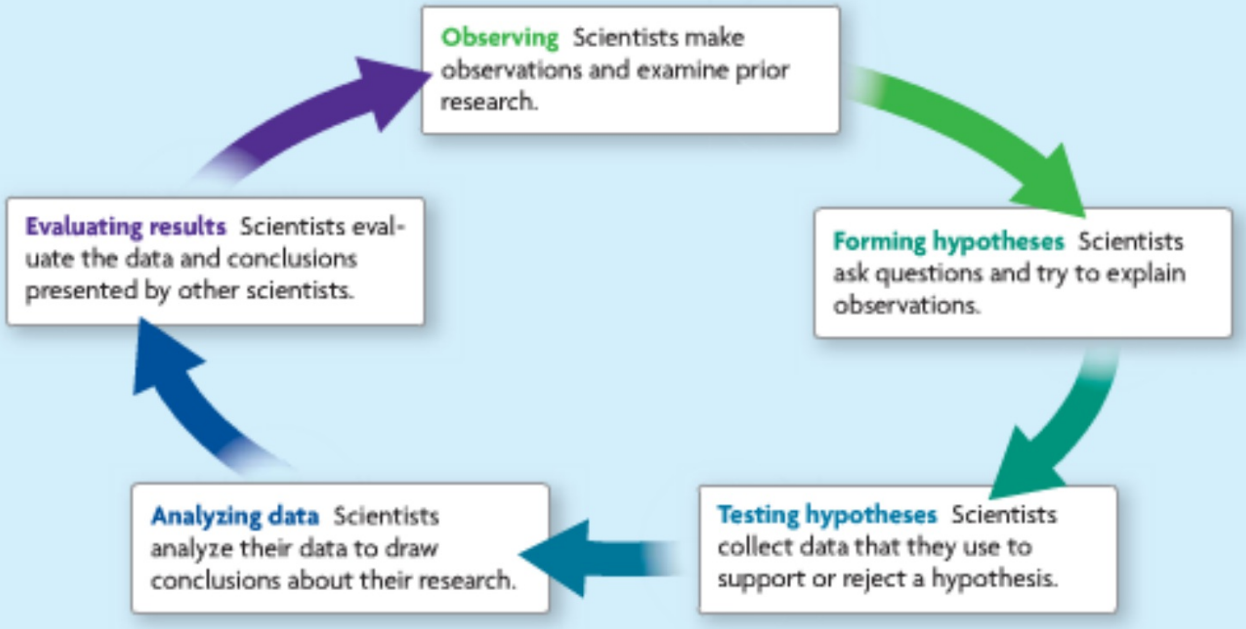
1. Observe/Question
   - senses (touch, sight, sound, smell, taste)
2. Hypothesis - educated guess/stat

What makes a good experiment?

- Clear purpose
- Testable hypothesis
- Well-defined variables (control all others)
- Multiple trials (>3) (repeatable)
- Free from bias/error
- Reliable sources (research)

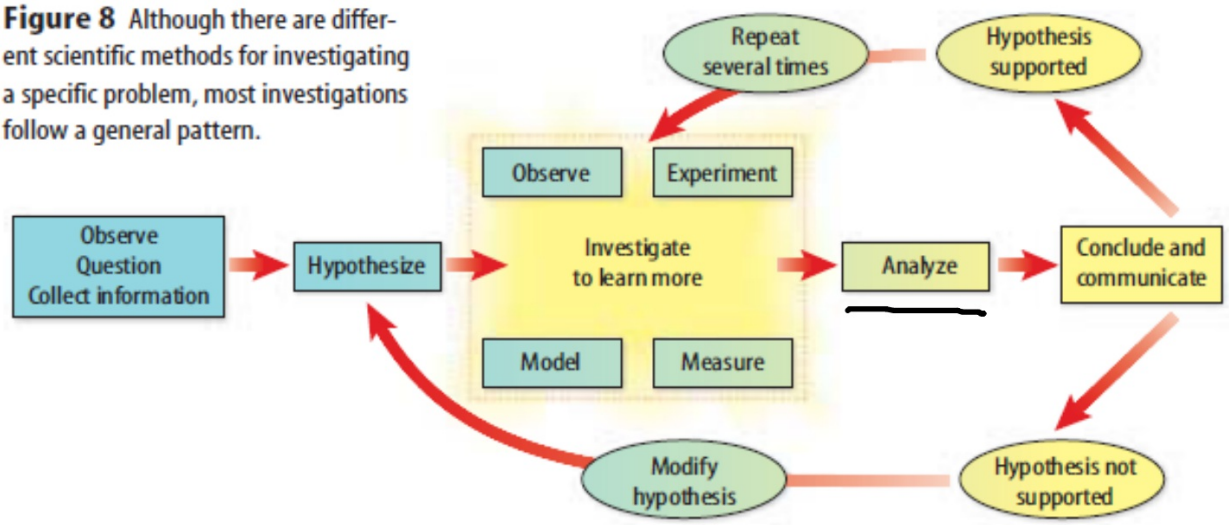
FIGURE 1.10 Scientific Thinking

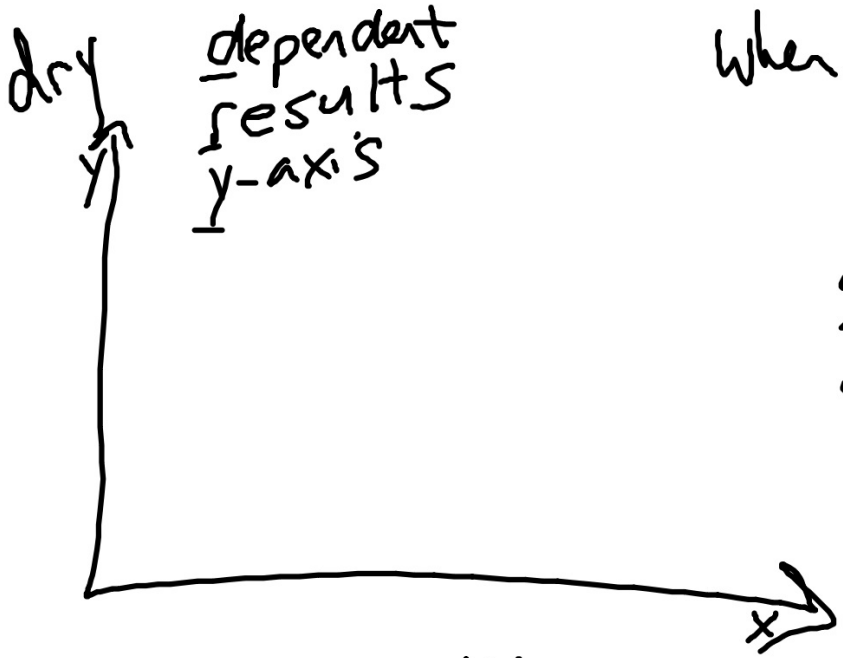
Science is a cycle. The steps are shown in a certain order, but the cycle does not begin or end at any one point, and the steps may take place in various orders.



Synthesize **Where in the cycle would retesting a hypothesis fit? Explain.**

Figure 8 Although there are different scientific methods for investigating a specific problem, most investigations follow a general pattern.





dependent
results
y-axis

mix
modify
independent
x-axis

When graphing, always

1. Title Graph
2. Axis labels
3. Axis units

Controlled experiment –
- planned
- test 1 variable (independent)
- look at the effect (dependent)
- compare it against controls

Variable – the thing that changes in an experiment
- Independent – you change this
- Dependent – result or effect

Control – the one you don't mess with (compare everything to it.)

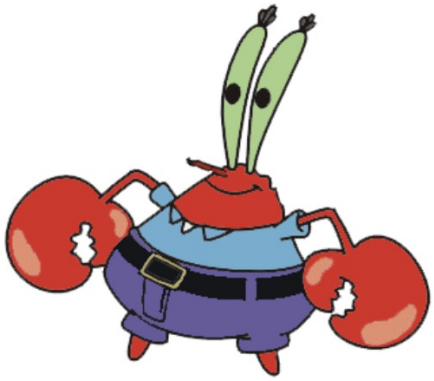
Let's practice:

Scientific Method Name _____
Controls and Variables – Part 1

SpongeBob and his Bikini Bottom pals have been busy doing a little research. Read the description for each experiment and answer the questions.

1 - Patty Power

Mr. Krabbs wants to make Bikini Bottoms a nicer place to live. He has created a new sauce that he thinks will reduce the production of body gas associated with eating crabby patties from the Krusty Krab. He recruits 100 customers with a history of gas problems. He has 50 of them (Group A) eat crabby patties with the new sauce. The other 50 (Group B) eat crabby patties with sauce that looks just like new sauce but is really just mixture of mayonnaise and food coloring. Both groups were told that they were getting the sauce that would reduce gas production. Two hours after eating the crabby patties, 30 customers in group A reported having fewer gas problems and 8 customers in group B reported having fewer gas problems.



Which people are in the control group?

What is the independent variable?

What is the dependent variable?

What should Mr. Krabs' conclusion be?

Why do you think 8 people in group B reported feeling better?

(1) Flower Power

SpongeBob loves to garden and wants to grow lots of pink flowers for his pal Sandy. He bought a special Flower Power fertilizer to see if will help plants produce more flowers. He plants two plants of the same size in separate containers with the same amount of potting soil. He places one plant in a sunny window and waters it every day with fertilized water. He places the other plant on a shelf in a closet and waters it with plain water every other day.

What did SpongeBob do wrong in this experiment? Explain.

What should SpongeBob do to test the effectiveness of Flower Power fertilizer? Write an experiment.

(2) Super Snails

Gary is not the smartest snail in Bikini Bottom and believes he can improve his brain power eating Super Snail Snacks. In order to test this hypothesis, he recruits SpongeBob and several sn friends to help him with the experiment. The snails ate one snack with each meal every day for thr weeks. SpongeBob created a test and gave it to the snails before they started eating the snacks as well after three weeks.

Based on the data provided, do the Super Snail Snacks work? Explain your answer.

Test Results

Snail	Before	After
Gary	64%	80%
Larry	78%	78%
Barry	82%	84%
Terry	72%	70%

(3) Bubble Time

Patrick loves bubble gum and would like to be able to blow bigger bubbles than anyone else in Bikini Bottom. To prepare for the Bikini Bottom Big Bubble Contest, he bought five different brands of bubble gum and needs your help to find the brand that creates the biggest bubbles. Write an experiment to test the bubble power of the bubble gum brands and help Patrick win the contest.

Krusty Krabs Breath Mints

Mr. Krabs created a secret ingredient for a breath mint that he thinks will "cure" the bad breath people get from eating crabby patties at the Krusty Krab. He asked 100 customers with a history of bad breath to try his new breath mint. He had fifty customers (Group A) eat a breath mint after they finished eating a crabby patty. The other fifty (Group B) also received a breath mint after they finished the sandwich, however, it was just a regular breath mint and did not have the secret ingredient. Both groups were told that they were getting the breath mint that would cure their bad breath. Two hours after eating the crabby patties, thirty customers in Group A and ten customers in Group B reported having better breath than they normally had after eating crabby patties.

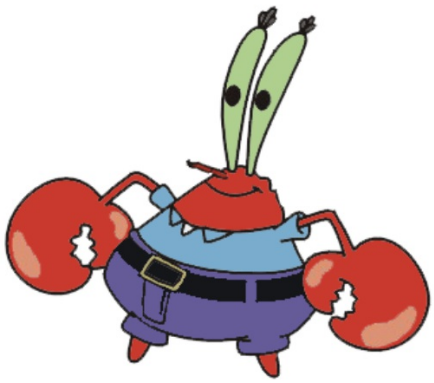
1. Which people are in the control group?

2. What is the independent variable?

3. What is the dependent variable?

4. What should Mr. Krabs' conclusion be?

5. Why do you think 10 people in group B reported fresher breath?



SpongeBob Clean Pants

SpongeBob noticed that his favorite pants were not as clean as they used to be. His friend Sandy told him that he should try using Clean-O detergent, a new brand of laundry soap she found at Sail-Mart. SpongeBob made sure to wash one pair of pants in plain water and another pair in water with the Clean-O detergent. After washing both pairs of pants a total of three times, the pants washed in the Clean-O detergent did not appear to be any cleaner than the pants washed in plain water.

6. What was the problem SpongeBob wanted to investigate?

7. What is the independent variable?

8. What is the dependent variable?

9. What should Sponge Bob's conclusion be?

Squidward's Symphony

Squidward loves playing his clarinet and believes it attracts more jellyfish than any other instrument he has played. In order to test his hypothesis, Squidward played a song on his clarinet for a total of 5 minutes and counted the number of jellyfish he saw in his front yard. He played the song a total of 3 times on his clarinet and repeated the experiment using a flute and a guitar. He also recorded the number of jellyfish he observed when he was not playing an instrument. The results are shown in the chart.

Number of Jellyfish/Instrument

Trial	No Music	Clarinet	Flute	Guitar
1	5	15	5	12
2	3	10	8	18
3	2	12	9	7

10. What is the independent variable?

11. What is the dependent variable?

12. What should Squidward's conclusion be?

13. Are the results reliable? Why or why not?

Super Bubbles

Patrick and SpongeBob love to blow bubbles! Patrick found some Super Bubble Soap at Sail-Mart. The ads claim that Super Bubble Soap will produce bubbles that are twice as big as bubbles made with regular bubble soap. Patrick and SpongeBob made up two samples of bubble solution. One sample was made with 5 oz. of Super Bubble Soap and 5 oz. of water, while the other was made with the same amount of water and 5 oz. of regular bubble soap. Patrick and SpongeBob used their favorite bubble wands to blow 10 different bubbles and did their best to measure the diameter of each one. The results are shown in the chart

Bubbles

(Diameter in centimeters)

Bubble	Super Bubble	Regular Soap
1	15	10
2	10	5
3	12	16
4	18	14
5	22	11
6	13	12
7	16	11
8	18	15
9	15	15
10	12	6

14. What did the Super Bubble ads claim?

15. What is the independent variable?

16. What is the dependent variable?

17. Look at the results in the chart.
    a. Calculate the average diameter for each bubble solution.

       Super Bubble = _____ cm Regular Soap = _____ cm

    b. What should their conclusion be?

Billy wants to know how different fertilizers affect the growth of Bermuda grass before he seeds his lawn. Billy buys five different types of fertilizer. Billy also grows five one-gallon containers full of Bermuda grass. How should Billy run his experiment? What are the different variables?

What is the independent variable in this experiment?

What is the dependent variable in this experiment?

Create a graph and label the two axis' .

Heather is getting ready to do an experiment for her biology science fair. She wants to know if Honeysuckle vines will grow the same under all different colors of light. To set up the experiment, she uses the following colors of light bulbs: green, blue, red, black, and regular white bulbs.

1. How should Heather set up this experiment so that there is a control? (What is the control?)

2. What will be the constants Heather will use in this experiment?

3. What is Heather's problem in this experiment?

4. What might be Heather's hypothesis for this experiment?

5. Explain how Heather should set this experiment up so that it will work correctly.

6. What data will Heather be collecting during this experiment??

7. What is the independent variable in this experiment?

8. What is the dependent variable?

GHOST SHRIMP LAB

You would like to know if feeding ghost shrimp different colors of shrimp flakes will
their shells to turn different colors.

-What you need to know:

1. Ghost shrimp are naturally clear.
2. Shrimp live in aquatic environments
3. Shrimp eat shrimp flakes
4. Food coloring will dye the shrimp flakes the color you want.
5. You have blue, green and orange food coloring

Using scientific method, devise an experiment using the ghost shrimp and food to con
an experiment to see if dyed shrimp flakes cause shrimp's shells to turn different colo

1.You will need to follow the six steps of scientific method.
2. You will need an independent variable and dependent variable.
3. You will need to set up the experiment where you have a control.
4. Be very specific about the set up of this experiment.
5. Please explain the independent and dependent variables in the set up of the experiment.

Samantha wants to know what will happen if she takes ghost shrimp and feeds them different colors of food. Ghost shrimp's shells are naturally clear. Samantha uses red food, blue food, green food and plain food that the shrimp normally eats. She runs her experiment for four weeks.

1. What is the hypothesis for Samantha's experiment?
2. What would be the independent variable for the experiment?
3. What would be the dependant variable for the experiment?
4. What would be the control in this experiment?

Another experiment:
John wants to test whether a peanut-butter cracker at the end of a mouse maze will help the mouse run faster through the maze. He gets a mouse and lets it smell the peanut-butter cracker before it enters the mouse maze. He then places the peanut-butter cracker at the end of the maze.

1. What is the hypothesis for this experiment?
2. What is the independent variable in the experiment?

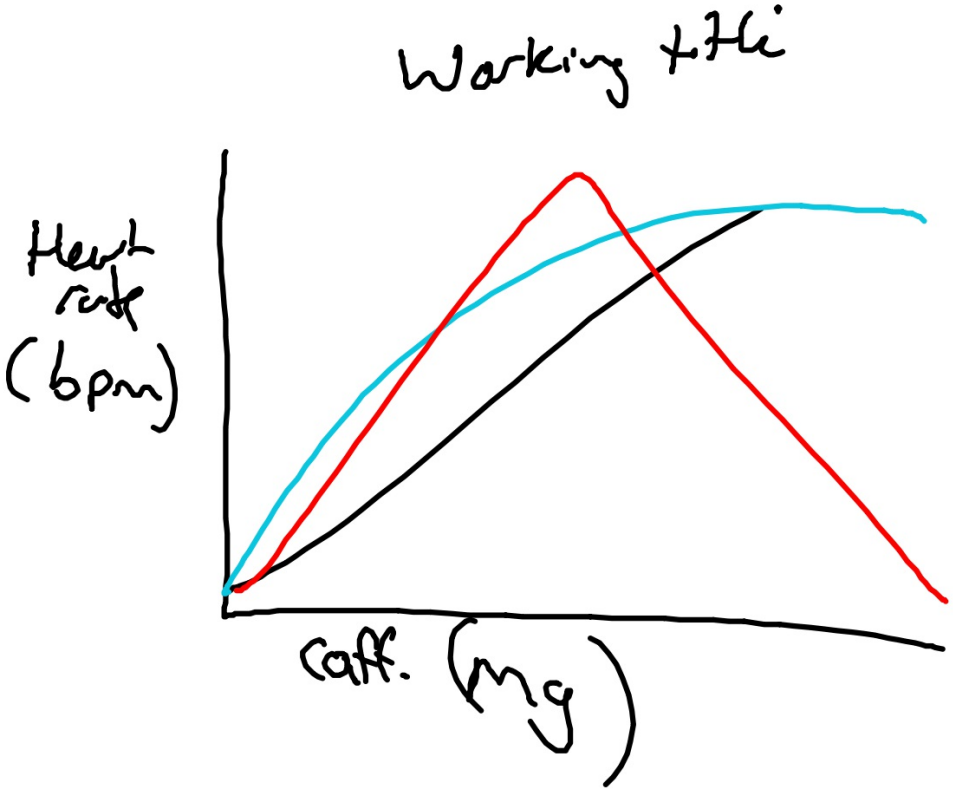
Get out Homework
Kickoff: 8/5/14

1. Emily wants to know how caffeine will affect the heart rate of a daphnia. Daphnia are small freshwater protists that look like microscopic shrimp. You can see their hearts beat under a microscope. Emily will give some daphnia 10 mg of caffeine from a caffeine pill to test the daphnia.

    a. Set this experiment up so that it runs correctly. Describe what steps you would take to set it up.

    b. List the independent and dependant variable.
    c. What would you use as the experimental control?
    d. What would a graph of the experimental data look like?

http://www.youtube.com/watch?v=2g-04Uk0ut0


Working the
Heart rate (bpm)
caff. (mg)

3210 Inq.1	Select a description or scenario that reevaluates and/or extends a scientific finding.
3210 Inq.2	Analyze the components of a properly designed scientific investigation.
3210 Inq.3	Determine appropriate tools to gather precise and accurate data.
3210 Inq.4	Evaluate the accuracy and precision of data.
3210 Inq.5	Defend a conclusion based on scientific evidence.
3210 Inq.6	Determine why a conclusion is free of bias.
3210 Inq.7	Compare conclusions that offer different, but acceptable explanations for the same set of experiment data.

Kickoff (8/6/14):

2. Marcus wants to know if air pollution has an effect on the growth of lichens . Lichens are fungi/algae that grow on trees in the GSMNP.

    a. Describe how you would set this experiment up.

    b. What would be the independent and dependant variables?
    c. What would be the experimental control?
    d. What would a graph of this experimental data look like?

Kelly wanted to know if ants are attracted to different types of "tastes". She went and gathered up 100 ants from her yard. Then she put three small bowls on her kitchen table. She filled one bowl with sugar water. She filled another bowl with salt water. The last bowl was filled with plain tap water. She put all the ants in the center of the table with the three bowls surrounding the ants. She found and recorded that 75 ants went to the sugar water. 5 ants went to the salt water. 20 ants went to the tap water.

1. What is the problem of this experiment?

2. Write a testable hypothesis for this experiment.

3. What is the independent variable of the experiment?

4. What is the dependant variable of the experiment?

5. What is the control in the experiment?

6. Name at least one constant in the experiment.

7. What is the conclusion to the experiment?

Jonathon Richman loves to shoot objects out of his sling shot. He would pick up just about anything and sling it into the woods (never at anyone). One day, on the radio, Jonathon heard that Aliens from the planet Q were going to try and take over the earth, starting with HIS farm. Jonathon had to defend his farm, he had to find out which object he could sling the furthest so that he could kill the Aliens before they landed on the ground. He had 4 objects at his house that his parents would let him use. He had a cork, a penny, a Coke can (full), and an egg. Jonathon thought that the penny would probably travel the furthest. In order to practice and see if he was correct, Jonathon went and shot all of the objects out of his sling shot. He found that the Cork flew 100 meters, the penny flew 123 meters, the Coke can flew 46 meters, and the egg flew 72 meters.

1. What is the problem?

2. What is Jonathon's hypothesis?

3. What is the independent variable?

4. What is the dependent variable?

5. On the back of this sheet please graph the results. (Remember that there are 4 items and that the distance should be in meters.

6. What are some new questions that could be asked after this experiment?

Kickoff (8/12/14):

Mr. Jones has been reading about cholesterol recently and wants to know if exercise affects a person's cholesterol level. Mr. Jones thinks that regular exercise will lower a person's cholesterol level. He has read in a book that the cholesterol level of a healthy person should be around 180. He finds 6 volunteers to exercise for 6 weeks. He measures their cholesterol both at the beginning and at the end of the 6 week period. The beginning cholesterol levels were as follows: subject A (35 yrs.) - 240; subject B (37 yrs.) - 190; subject C (39 yrs.) - 255; subject D (39 yrs.) - 250; subject E (40 yrs.) - 245; and subject F (41 yrs.) - 200. The subjects then exercised 30 minutes, 4 times a week for 6 weeks. The ending cholesterol levels were as follows: subject A - 200; subject B - 185; subject C - 205; subject D - 190; subject E - 200; and subject F - 180.

mg/d

1. What is the problem?

2. What is the hypothesis?

3. What is the independent variable?

4. What is the dependent variable?

5. What is the control?

6. Graph the results in the space below or on the back of this sheet. (REMEMBER that the cholesterol was measured 2 times and there were 6 subjects.)

7. List any information that may not be relevant Mr. Jones' experiment.

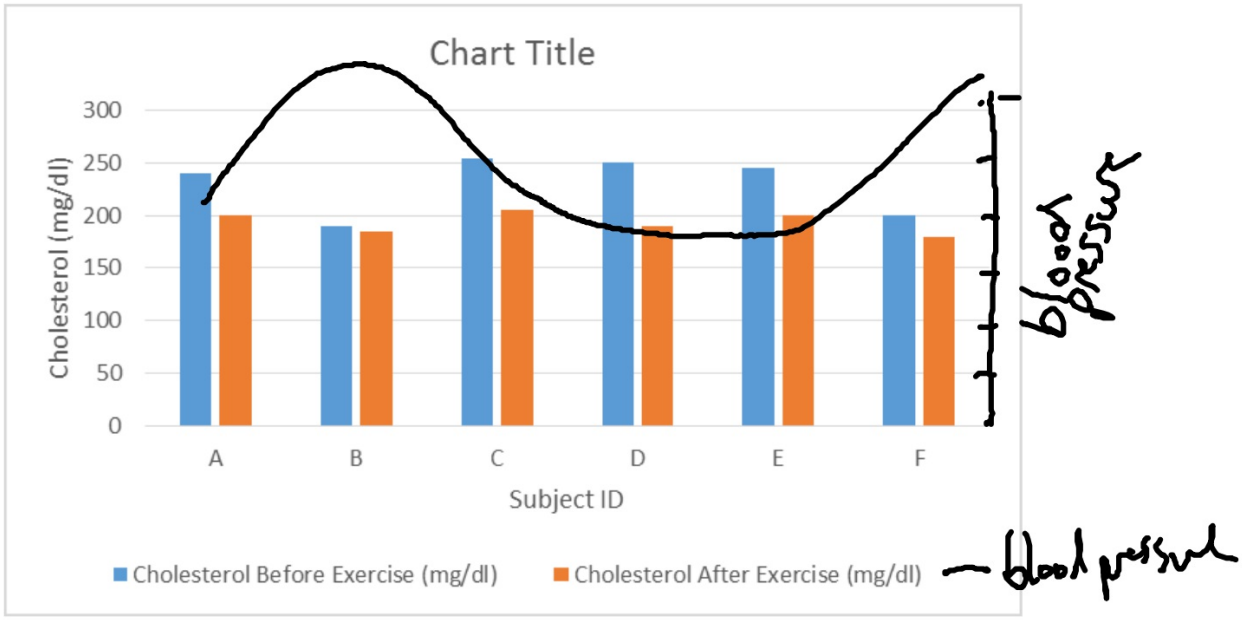


Chart Title
Cholesterol (mg/dl)
300
250
200
150
100
50
0
A
B
C
D
E
F
Subject ID
Cholesterol Before Exercise (mg/dl)
Cholesterol After Exercise (mg/dl)
blood pressure
blood pressure

10. Students are assessing the degree of biodiversity of mammal species in an enclosed forest ecosystem undergoing ecological succession. Some confused students were counting individual mammals instead of *species* of mammals. Each student tried three separate times to count the number of mammals. It was determined that there were 12 different animal species within the enclosed area.

Number of Mammal Species Present			
Student	**Trial 1**	**Trial 2**	**Trial 3**
Student 1	**32**	**33**	**32**
Student 2	**29**	**29**	**29**
Student 3	**10**	**15**	**13**
Student 4	**11**	**12**	**11**

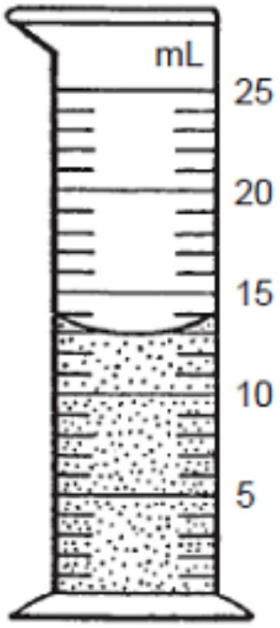
Which of the following students recorded the number of mammal species with the greatest degree of accuracy and precision?

F. Student 1
G. Student 3
H. Student 4
J. Student 2

27. A bioengineer wants to synthesize a new polymer that would replace existing soft contact lense The new semi-permeable membrane would allow for greater oxygen penetration across the membrane to the eye. Which of the following actions should be the first step in designing the polymer?

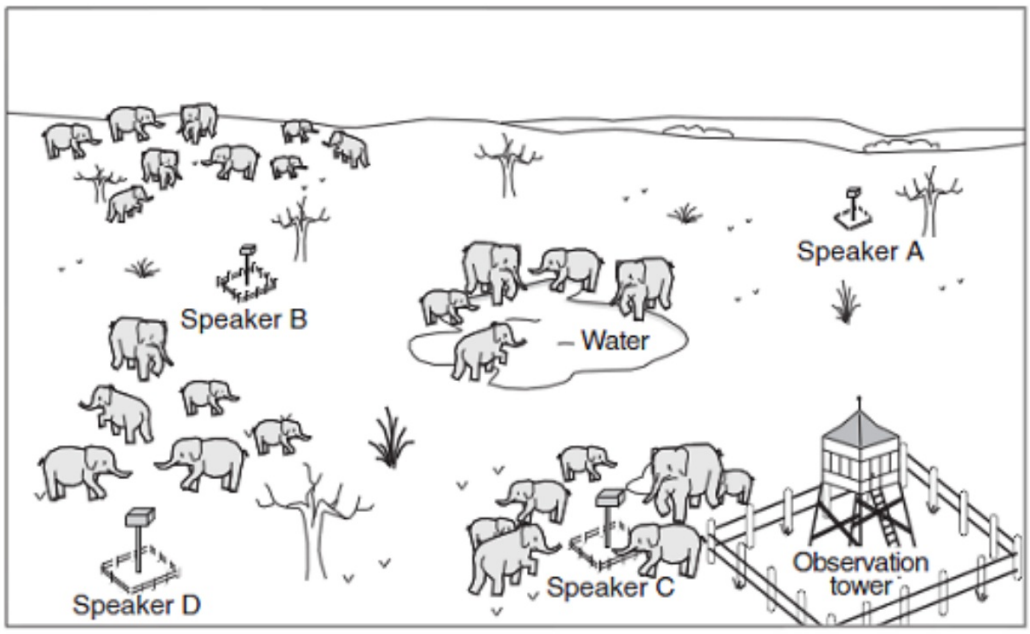
A. contact optometrists to determine if there is a need for new contact lenses.
B. write a research proposal that communicates the initiative of the project.
C. make several new polymers and examine their permeability
D. research existing polymers and examine their oxygen permeabilities

7. What is the volume of water in the graduated cylinder shown below?



A. 10.3 mL
B. 13 mL
C. 13.5 mL
D. 14 mL

16. The diagram below shows the results of a field study on the effect of low-pitched sounds on elephan behavior. Four speakers were placed on the elephant range and different low-pitched sounds were transmitted from each speaker.



If speaker *A* was moved to the edge of the waterhole, what change in elephant behavior, if any, would most likely occur?

F. The elephants would go to the waterhole only when they needed water.
G. A larger number of elephants would gather at the waterhole.
H. All the elephants would gather around speaker *C*.
J. No change would occur, because elephant behavior cannot be modified.

2. **Sarah wants to know if putting a peanut-butter cracker at the end of a mouse maze will help the mouse run through the maze faster. She fixes a peanut-butter cracker, lets the mouse smell it, and then she times it's run through the maze.**

What is the experimental problem?

What is a hypothesis for this experiment?

How should Sarah set up this experiment?

What is the independent variable in the experiment?

What is the dependent variable in the experiment?

What is the experimental control?

If there are constants in the experiment, list some…

The Strange Case of BeriBeri

In 1887 a strange nerve disease attacked the people in the Dutch East Indies. The disease was beriberi. Symptoms o disease included weakness and loss of appetite, victims often died of heart failure. Scientists thought that the disease might be caused by bacteria. They injected chickens with bacteria from the blood of patients with beriberi. The injecte chickens became sick. However, so did a group of chickens that were not injected with bacteria.

One of the scientists, Dr. Eijkman, noticed something. Before the experiment, all the chickens had eaten whole-grain rice, but during the experiment, the chickens were fed polished rice. Dr. Eijkman researched this interesting case. he found that polished rice lacked thiamine, a vitamin necessary for good health.

1. State the Problem

2. What was the hypothesis?

3. How was the hypothesis tested?

4. Should the hypothesis be supported or rejected based on the experiment?

5. What should be the new hypothesis?

How Penicillin Was Discovered

In 1928, Sir Alexander Fleming was studying Staphylococcus bacteria growing in culture dishes. He noticed that a mold called Penicillium was also growing in some of the dishes. A clear area existed around the mold because all the bacteria that had grown in this area had died. In the culture dishes without the mold, no clear areas were present.

Fleming hypothesized that the mold must be producing a chemical that killed the bacteria. He decided to isolate this substance and test it to see if it would kill bacteria. Fleming transferred the mold to a nutrient broth solution. This solution contained all the materials the mold needed to grow. After the mold grew, he removed it from the nutruient broth. Fleming then added the nutrient broth in which the mold had grown to a culture of bacteria. He observed that the bacteria died.

6. Identify the problem.

7. What was Fleming's hypothesis?

8. How was the hypothesis tested?

9. Should the hypothesis be supported or rejected based on the experiment?

10. This experiment lead to the development of what major medical advancement?

ions: The following is an experimental scenario. Read the experiment and then identify nponents of the scientific method by completing the questions that follow.

imental Scenario #1

ent investigated whether ants dig more tunnels in the light or in the dark. She thought that ed the filtered light that penetrated the upper layers of earth and would dig more tunnels the daytime. Ten ant colonies were set up in commercial ant farms with the same number e of ants per ant farm. The same amount of food was given to each colony, and the s were in the same temperature. Five of the colonies were exposed to normal room light e were covered with black construction paper so they did not receive light. Every other day e weeks the length of the tunnels was measured in millimeter using a string and a ruler. es for the light and dark groups for each measured were then computed. The averages are the following chart.

Length of Tunnels (mm) Constructed by Ants in Different Light Conditions

Day	Light	Dark
1	5	7
3	10	15
5	20	25
7	26	32
9	32	47
11	50	62
13	61	93
15	66	110
17	90	115
19	95	120
21	103	136

What is the hypothesis for this experiment?

What is the independent variable?

What is the dependant variable?

What is the control?

What type of graph should be used to analyze this data? Sketch a graph of the data.

Was the student's hypothesis correct? Explain.

Experimental Scenario #2

A student investigated the effect of microwave radiation on the germination of bean seeds. He thought that exposure to radiation would limit the seeds ability to germinate (grow) much like ultra-violet light causing skin cancer. Three hundred seeds were soaked in distilled water for one hour. They were then divided into three groups. One group was placed in a microwave oven on high for three seconds. Another group was microwaved on high for six seconds. The last group was not microwaved. The seeds were then planted in three separate, but identical pots and given the same amount of water. The pots were placed in a location with a constant temperature of approximately 27 degrees Celsius. Each day for two weeks the number of seeds that germinated each group was recorded.

Total Number of Bean Seeds Germinated after Microwave Radiation

Three Seconds of Radiation	Six Seconds of Radiation	No Radiation
54	26	88

1. What is the hypothesis for this experiment?

2. What is the independent variable?

3. What is the dependant variable?

4. What is the control?

5. What type of graph should be used to analyze this data? Sketch a graph of the data.

6. Was the student's hypothesis correct? Explain.

Experimental Scenario #3

A student investigated the effect of aged-grass compost (fertilizer made from decaying plant material) on the growth of bean plants. She thought that the compost would provide extra nutrients and make plants grow faster. Thirty bean seeds were divided into three groups and planted in different boxes. All seeds germinated after 12 days and were allowed to grow for five days. The boxes were each given the same amount of water and the same amount of light. Box A was then fertilized with 3-month old compost; Box B was given 6-month old compost; and Box C was given no compost. At the end of 14 days the height of each plant was measured in centimeters. Fill in the graphic organizer that follows

Final Heights of Bean Plants

3-month old Compost	6-month old Compost	No Compost
7.6	10.1	6.5
5.4	9.5	7.2
8.2	12.1	8.4
9.3	13.0	11.0
8.2	8.5	6.9
6.9	13.1	6.8
7.3	12.4	6.3
9.4	11.6	10.7
10.2	14.8	9.9
12.0	10.8	10.6
8.8	11.4	8.3

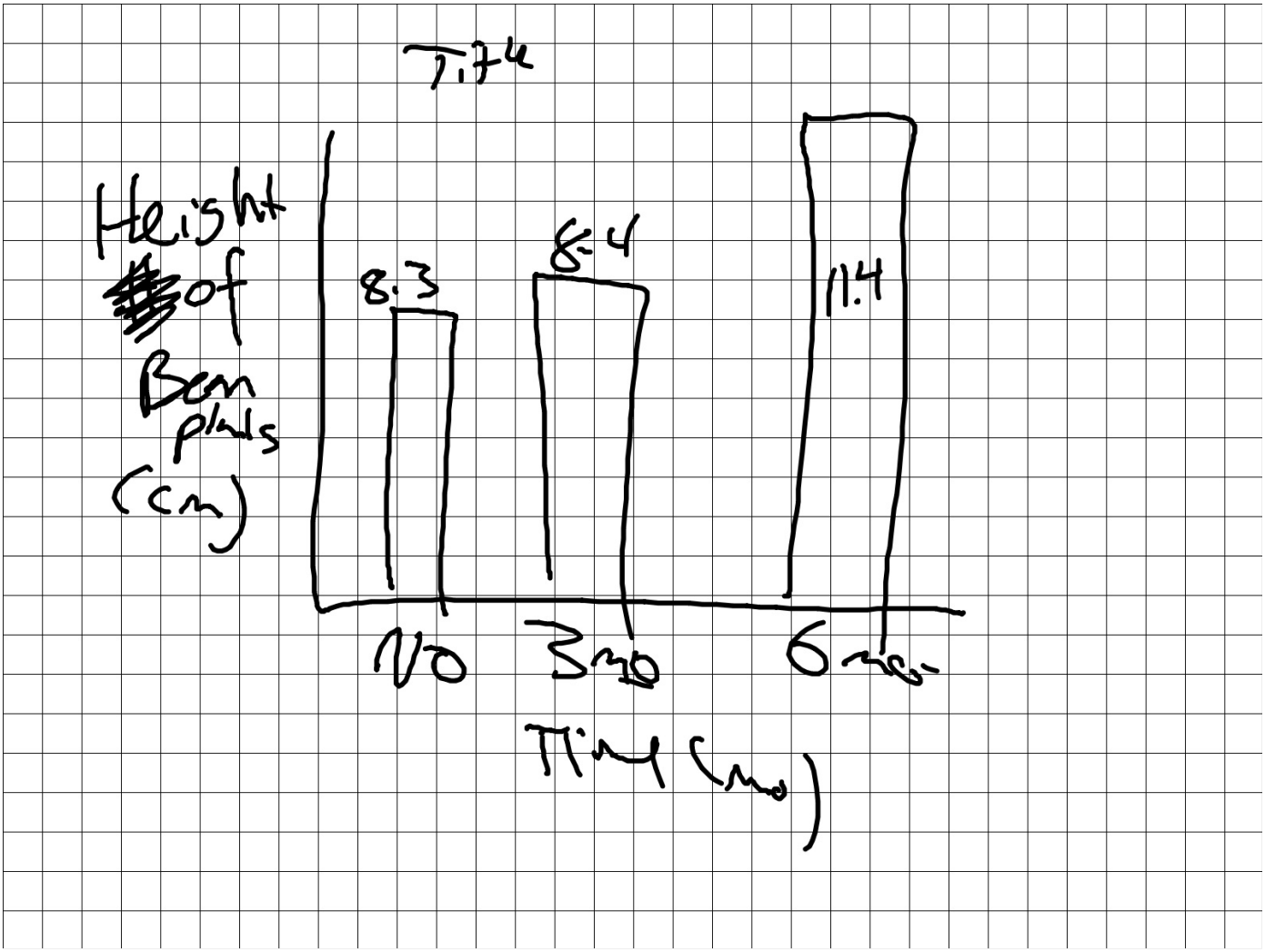


Fig 4
Height of Bean plants (cm)
8.3
8.4
11.4
No
3mo
6mo
Time (mo)

Kickoff: 8/6/14

Understanding Bias

Read the following report:

> Pigeons are dirtier than you think. They eat trash and leave their droppings wherever they go. Pigeons also carry diseases. One time, I was bitten by a pigeon when I tried to shoo it away. I had to get a shot because the pigeon might have given me a disease.

Does the passage have bias?

Intentional & Unintentional

- Missing information
- Past experience
- influence

What Is Bias?

One kind of bias is a strong *opinion* about something. You can be biased in favor of something or biased against it. In either case, you may have some facts to support your position, but a bias is based mo on feelings and opinions than on facts. In some cases, bias results from a person's past experiences. That may be what happened to the student who was bitten by the pigeon.

Bias Can Be Intentional or Unintentional

Sometimes people use bias on purpose. For example, if you want to persuade someone, you present facts that support your position while leaving out points that don't. If you want your parents to order pizza for dinner, you might remind them that they wouldn't have to cook. However, you probably *wouldn't* mention that healthier, less expensive dinner options might be available.

Another kind of bias is unintentional. It occurs when a person tries to be accurate but does not have complete information. For example, scientists used to think atoms looked like little solar systems. As more information about atoms was discovered, scientists realized their description of atomic structure was wrong. They changed their theories and models based on new information.

Look out for both kinds of bias. In the pigeon example, we get the feeling that the report is not accurate because most of us know from personal experience that pigeons are usually not vicious. In the example about the structure of atoms, though, it is more difficult to detect bias. We have to depend on experts for information about atomic structure. If the experts have incomplete or inaccurate information, that is what we get, even if there is no intent to give wrong information.

Detecting Bias

Three of the many possible sources of bias are listed below. Try matching these sources with the paragraphs that follow. There may be more than one answer.

A. The writer has received incomplete information.

B. The writer is trying to influence or convince the reader.

C. The writer's past experience is influencing his or her thinking.

1. The pollution in our river is caused by the big factory upstream. The people who own the factory are only interested in making money. They don't care about the environment at all. I heard about them from my friend Barry, and he knows what he's talking about.

_____

2. Every morning, my grandfather's rooster crows when it is still dark. About five minutes later, the sun comes up. I don't know how it works, but my grandfather's rooster is responsible for the sunrise!

_____

3. On the Internet, I learned about a place where aliens have secretly landed a spaceship on Earth. They're going to take over the world, and when they do, they'll put all of the redheaded people like me in charge. You'd better be nice to me!

_____

Kickoff: 8/6/14

Identifying Bias

Suppose that while researching nutrition, you run across the following:

> Vitamin A is an important nutrient. It is used to make rhodopsin, a pigment in our eyes. Thus, Vitamin A is necessary for healthy vision. People can develop night blindness if they do not get enough of it. Carrots are an excellent source of vitamin A. Carrots should be a part of your daily diet.

Does the passage have bias?

Bias Is Everywhere

Bias is a subjective way of thinking that tells only one side of a story, sometimes leading to inaccurate information or a false impression. When you research, it is crucial that you identify the level of bias in potential sources. Below are some possible sources of bias.

- The writer is relying on incomplete information.
- The writer is trying to deceive the reader.
- The writer wants to believe what he or she is saying.
- The writer's past experience is influencing his or her thinking.
- The writer is trying to persuade the reader.

In the passage above, the writer does not mention that ingesting too much vitamin A can make people sick. The writer fails to tell the reader that eggs and sweet potatoes are also good sources of vitamin A.

Bias Rating

When reading information, think about what possible bias might be distorting the facts. You might use a scale such as the following:

1 = almost totally unbiased; highly objective; accurate
2 = mostly unbiased; fairly reliable
3 = somewhat biased; accuracy is questionable
4 = fairly biased; distorted; probably unreliable
5 = totally biased; highly subjective; inaccurate

Bias Begone!

As you read the following paragraphs, determine the kind of bias being used. Explain your reasoning.

1. Returning wolves to their native habitats is critically important. The wolf is an original top predator in the natural ecosystems of North America. If these ecosystems are out of balance, they may collapse. If that happens, millions of organisms will go extinct. Even humans are in danger if we do not do something soon. We must make sure that there are wolves in all of North America's remaining natural areas.

   _____

   _____

   _____

2. Scientists use powerful computers to study the Earth's atmosphere. These computers help scientists predict changes in world climate. For instance, scientists use computers to study what might happen if pollution increases or decreases. Computers can also help scientists make recommendations to businesses, individuals, and other polluters. Eventually, we will know enough about climate changes to be able to control them.

   _____

   _____

   _____

Accuracy and Precision

Accuracy = closest to actual value

Precision = repeatability of a measurement

Accuracy and precision instructions:

1. Each member from each team tosses a bag three times

2. Distance from closest edge to center gets measured for all three bags (accuracy).

3. Distance from closest edge of the farthest bag to closest edge of farthest bag gets measured in cm (precision)

4. Record all results for every team member. Calculate individual mean, and team mean for both accuracy and precision.

A group of students in a biology class measured the length of 5 earthworms and recorded their measurements in the table below.

Worm Number	Actual Length (cm)	Student 1	Student 2	Student 3	Student 4
1	8.5	8.0	8.5	8.6	8.5
2	5.5	5.5	6.0	4.8	5.5
3	7.0	7.0	7.1	7.0	6.9
4	6.8	7.0	7.0	6.5	7.0
5	8.3	8.0	8.3	8.5	8.3

Which student was most accurate
Which was most precise?

**At the beginning of an experiment, students measured the height of a plant three time
Their measurements are shown in the table below.**

Plant Height Measurements

Student	Trial 1	Trial 2	Trial 3
1	15.1 cm	15.9 cm	15.3 cm
2	17.2 cm	17.0 cm	17.1 cm
3	13.7 cm	18.4 cm	15.0 cm
4	16.5 cm	11.9 cm	20.2 cm

It was determined that the actual height of the plant was 15.6 cm. Which student's measurements are the most accurate and precise to the actual height of the plant?

- **A** Student 1
- **B** Student 2
- **C** Student 3
- **D** Student 4

Students counted the population of trees in a forest to determine the numbers of four species. The actual number of trees in the forest area and each student's count are in the table.

Tree	Actual Population	Student 1	Student 2	Student 3	Student 4
Cedar	62	60	65	20	75
Pine	253	200	252	230	235
Oak	124	100	127	75	93
Walnut	168	200	170	175	121

Which student had the <u>most</u> accurate count of tree species?

- **A** Student 1
- **B** Student 2
- **C** Student 3
- **D** Student 4

SCIENTIFIC METHOD VOCABULARY & DEFINITIONS

1. temperature scale used in the metric system
2. experiment group without a variable
3. amount of mass per unit of volume
4. what you think will happen in an experiment
5. instrument used for measuring mass
6. basic unit of volume in the metric system
7. basic unit of mass in the metric system
8. amount of matter in an object
9. basic unit of length in the metric system
10. common system of measurement, especially among scientists
11. display of a scientific model that simply shows how something works
12. instrument used to measure volume of liquids and irregularly shaped objects
13. basic steps used by scientists in solving problems
14. most logical explanation for events that occur, althougl unproven
15. factor being tested in an experiment
16. measure of the gravitational pull on an object
17. information gathered during an experiment
18. scientific information gathered through observations, surveys, etc.
19. amount of space an object occupies
20. scientific test in which data is gathered/compared with the use of a variable and often a control

Celsius	experiment	mass
control	graduated cylinder	meter
data	gram	metric sys
demonstration	hypothesis	research
density	liter	scientific

Scientific Inquiry and Technology/Engineering

I. Designing Experiments

A. **Scientific Method**: A series of steps that a scientist follows in order to _____ a problem or answer a question.

1. 6 Steps: State the problem, gather research, form a hypothesis, perform and experiment, analyze the data, and draw a conclusion

a. Steps may _____depending on the problem trying to be solved

b. **Hypothesis**: a possible, _____ answer or explanation, an educated guess

c. **Experiment**: a _____ designed to test a hypothesis

d. **Data**: information in the form of _____ or observations – to analyze, put this is a read form like a chart, graph, or table

e. **Conclusion**: a statement that sums up the experimental _____ and states whether the experiment supports the hypothesis

i. Cause and effect relationships – charts, graphs, tables

B. Experimental Design

1. **Procedure**: the written _____ plan for an experiment. This contains what you will do and the materials needed. This must be very detailed so that other scientist can reproduce your experiment.

2. **Variable:** any factor that can _____ the results of an experiment

    a. **Independent variable**: the factor that you deliberately _____ in order to find out what will happen

    b. **Dependent variable**: a variable affected by the changes in the independent variable. This variable is always _____.

    c. You should only test _____variable at a time.

3. **Control Group**: group used as a _____ of comparison in an experiment. This group stays the same.

4. **Experimental Group**: the group that is _____ to changes in the independent variable. The conditions are identical to those of the control group in every way, except for the difference in the variable you are testing.

Experimental Design and Analysis

A student performed 2 studies to investigate the factors that affect the germination of peony seeds.

Study 1

Peony seeds were placed in dry containers. Some of the containers were stored at 5°C for either 4, 6, 8, or 10 weeks. The temperature and time periods were defined as the *storage temperature* and the *storage period*, respectively. The peony seeds were divided evenly so that there were 20 sets of 25 seeds. Twenty petri dishes were then prepared. Each contained damp paper. Each set of seeds was placed in a separate petri dish. Each petri dish was maintained at of 4 temperatures for 30 days. The temperature and time periods were defined as the *germinati temperature* and the *germination period*, respectively. Table 1 shows the number of seeds that germinated in each dish.

Table 1

Storage period (weeks)	Number of peony seeds that germinated when maintained at a germination temperature of:			
	13°C	18°C	23°C	28°C
0	0	0	0	0
4	0	2	0	0
6	3	8	6	0
8	7	22	18	0
10	15	24	21	1

Study 2

Peony seeds were placed in dry containers. The containers were stored at various temperatures for 10 weeks.The peony seeds were divided evenly so that there were 20 sets of 25 seeds. Twenty petri dishes were then prepared. Each contained damp paper. Each set of seeds was placed in a petri dish. The petri dishes were maintained at 1 of 4 temperatures for 30 days. Table 2 shows the number of seeds that germinated in each dish.

Table 2

Storage temperature (°C)	Number of peony seeds that germinated when maintained at a germination temperature of: 13°C	18°C	23°C	28°C
0	15	24	21	1
5	16	23	21	1
10	0	6	4	0
15	0	0	0	0
20	0	0	0	0

Tables adapted from Joel Beller, *Experimenting with Plants*. ©1985 by Joel Beller.

1. In general, the results of Study 1 suggest that peony seeds that are placed in a petri dish containing damp paper are most likely to germinate when they are maintained at which temperature?

2. Suppose another set of 25 peony seeds had been included in Study 2 and these seeds had a storage temperature of 25°C and a germination temperature of 18°C. Based on the information provided, the number of seeds that would have germinated after being maintained for 30 days would most likely have been closest to what value?

3. In Study 2, at the storage temperature of 5°C, as germination temperature increased from 13°C to 28°C, how did the number of seeds that germinated change?

4. Which of the following sets of seeds were exposed to the same conditions prior to being placed in the petri dishes?

   F. The seeds from Study 1 that were stored for 8 weeks and the seeds from Study 2 that were stored at 5°C

   G. The seeds from Study 1 that were stored for 8 weeks and the seeds from Study 2 that were stored at 15°C

   H. The seeds from Study 1 that were stored for 10 weeks and the seeds from Study 2 that were stored at 5°C

   J. The seeds from Study 1 that were stored for 10 weeks and the seeds from Study 2 that were stored at 15°C

5. A student stored 100 peony seeds at a constant temperature for 10 weeks. The student then divided the seeds into 4 sets and maintained them as described in Study 2. The results were as follows:

Germination temperature (°C)	Number of seeds that germinated
13	1
18	6
23	3
28	0

What storage temperature did these seeds most likely have?

6. How did the experimental designs of Study 2 and Study 1 differ?

7. Plot the results of both studies (Tables 1 and 2) on two different charts either electronically or on graph paper. Do not forget to label your axes, units on each axis, and title.