Scientific

Method

Name: _____Period_____

Scientific Method I Can Statements

_____I can formulate a question to be answered by direct observation in a controlled experiment.

_____ I can state the difference between independent and dependent variable.

_____I can design a controlled experiment to investigate a question.

_____ I can analyze the results of a controlled experiment.

_____I can correctly formulate a hypothesis using an "if", "then", statement.

Goals

My goal for this packet is……..

_____

_____

_____

This is my goal because…….

_____

_____

_____

4 things I can/will do to accomplish this goal.

_____

_____

_____

_____

What are some challenges that will prevent me from accomplishing my goal?

_____

_____

_____

Scientific Method

Scientific Method- A process used to investigate natural phenomena; includes:

1. State the Problem/ Question
2. Gather information on the problem
3. Form a hypothesis
4. Design an experiment
5. Record the results
6. Data analysis
7. State a conclusion

Hypothesis- A proposed explanation for something that is testable; a proposed explanation that tries to explain an observation. **An Educated guess**

Evidence- Any type of data that may be used to test a hypothesis.

Experiment- A test to see if a hypothesis is right or wrong; a test to obtain new data.

Observe- To watch and study attentively using one's five senses.

Observations- Significant details you notice using your five senses.

Conclusion- The answer to the proposed question; the meaning of the result or outcome of the experiment based on the evidence.

Bias- Prejudice in favor of or against one thing, person, or group compared with another, usually in a way considered to be unfair.

Variable- factor being tested in an experiment

Independent Variable- The variable that is being **manipulated** or changed. X-axis

Dependent Variable- The variable that **responds** to the change in the independent variable. Y-axis

Control experiment- Experiment done in exactly the same way as another experiment, but without the variable.

Scientific investigation- Plan for asking questions and testing possible answers.

Scientific Change- when new evidence challenges an accepted idea, scientists must reexamine the old evidence and reevaluate the old idea.

Scientific Law- A statement describing what always happens under certain conditions in nature.

Scientific Theory- Explanation of an aspect of the natural world based on repeated observations.

Bar Graph- Bar graphs are especially useful for comparing values for different things.

Circle graphs (Pie Charts)- Used to show percentages (or fractions) of a whole.

Line graphs- Used for showing changes over time, or time trends in data.

Mean- The answer when you add the values of all the numbers in a set and divide by the # of numbers in the set.

Median- In a list of numbers, it is the middle number. Not the average.

Mode- The number that occurs most often in a set of data.

Additional Notes:

1.1 What is Science?

As you carefully read through the text, answer the following questions as completely as possible!

Introduction

1. _____is the act of viewing or noting a fact or occurrence called?

2. An _____ is an act of drawing a conclusion based on what one already knows.

3. Describe how observations are related to inferences. How are observations and inferences different? Explain.

Scientific Ways of Thinking

4. Modern science is a way of understanding the physical world, based on observable _____, _____, and repeated _____.

5. If scientists develop new ideas about the way the world works, what must they do?

Thinking Like a Scientist

6. What is thinking like a scientist based on?

7. After scientists ask questions, they make detailed _____, develop a _____, design and conduct an _____, and finally draw _____ from the results of their experiment.

8. What is the key to being a great scientist?

9. What does it mean to make an observation? (Define in 2 Sentences)

10. What is a hypothesis? (Define in 1 Sentence)

11. When scientists want to answer a question, they search for evidence using experiments. What is an experiment? (2 Sentences)

12. What is evidence? Explain. (2 Sentences)

13. Good scientists are skeptical. What does this mean? (1 Sentence)

Branches of Science

14. What are the three main branches of science?

_____ _____ _____

15. List four branches of life science and define each branch.

Branch _____ Studies _____

Branch _____ Studies _____

Branch _____ Studies _____

Branch _____ Studies _____

1.2 Scientific Graphing

As you carefully read through the text, answer the following questions as completely as possible!

Using Graphs in Science

1. Graphs are very useful tools in science as they can help _____ a set of data.

2. What are the three commonly used types of graphs? (1 Sentence)

Bar Graphs

3. What are bar graphs especially useful for? Explain. (1 Sentence)

Circle Graphs

4. What are circle graphs used to show? Explain. (1 Sentence)

Line Graphs

5. What are line graphs useful for? Explain. (1 Sentence)

Review

6. Summarize the four points listed. (2 Sentences)

1.3 Scientific Methods

As you carefully read through the text, answer the following questions as completely as possible!

Introduction

1. How do scientists obtain new knowledge? (3 Sentences)

Scientific Method

2. The _____ _____ is a process used to investigate the unknown.
3. Scientists who use this method can _____ another scientist's experiments.
4. List the seven general steps of the scientific method:
    1.
    2.
    3.
    4.
    5.
    6.
    7.

Making Observations

5. Describe several observations described in the text regarding the frogs found in a pond. (2 Sentences)

State the Problem/ Question based on Your Observations

6. List several questions which could be asked about the deformed frogs. (3 Sentences)

Gather Information About the Problem

7. No matter what you observe, you need to find out what is already known about your questions. Why is this so important? (3 Sentences)

8. What might you learn while conducting your research? (3 Sentences)

Form a Hypothesis

9. A _____ is a proposed explanation that tries to explain an observation.

10. What must a good observation allow a scientist to do? (2 Sentences)

11. Every hypothesis needs to be written in a way that it can?
    a. Be tested using evidence
    b. Be proven wrong
    c. Provide measurable results
    d. Provide yes or no answers
    e. All of the above

Design and Experiment to Test the Hypothesis

12. To test the hypothesis, an _____ will be done.

13. The experiment may generate evidence in _____ of the hypothesis, or it may generate evidence _____ the hypothesis false.

14. Once data is collected, it will need to be _____.

Record and Analyze Data

15. If a hypothesis and experiment are well-designed, the experiment will produce results that you can _____, _____, and _____.

State a Conclusion

16. If a hypothesis is supported, scientists will often continue to what? (2 Sentences)

17. If the hypothesis is false, what will the results be used for? (3 Sentences)

18. Explain how scientists may communicate the results of their scientific investigations. (3 Sentences)

Bias

19. What is bias? (3 Sentences)

20. Why is important that we are aware of bias?(3 Sentences)

1.4 Scientific Theories

As you carefully read through the text, answer the following questions as completely as possible!

Introduction

1. Today, most people realize that _____, such as bacteria or _____, are the major causes of infectious disease.

2. What is this concept known as? (2 Sentences)

Scientific Evidence and Theories

3. Describe the three types of scientific evidence. (3 Sentences)

4. What is a scientific law? Explain. (2 Sentences)

5. Explain what is required to develop a scientific theory. (3 Sentences)

6. Scientific theories have a lot of _____ to support the theory, and no evidence _____ the theory.

7. Scientists accept theories as a fundamental _____ of basic science; however, when scientists find new evidence, they can _____ their theories.

8. What is scientific change? Explain. (3 Sentences)

Lab Experiment: How quick are you?

Procedure:

1. Work with your partner.
2. One person holds the ruler (someplace close to the middle).
3. The other person places their hand just below the bottom of the ruler with the thumb and index finger (pointing finger) slightly open.
4. Without warning, the person drops the ruler. The other person grabs the ruler with their thumb and index finger.
5. Record the upper boundary grasp reading on the ruler. Do this in centimeters.
6. When recording the data, completely fill in the row of the data table.
7. Repeat four more times.
8. Switch roles and repeat steps one through seven.
9. After completing the five trials for both you and your partner, collect data from ten other students. Make an effort of to get data from five males & five females.
10. After completion of class data collection, answer the follow up questions.

Reaction Time * **time measured as centimeters**

Name	Male or Female	1st trail (cm)	2nd trail (cm)	3rd trail (cm)	4th trail (cm)	5th trail (cm)
You						
Your partner						

11. Determine the average distance that the meter stick fell for all of the trials. Using that average, calculate the **TIME** it took for you to react and grab the ruler using the equation.

Trial	Distance (CM) of fall	
	Mine	Partner
1		
2		
3		
4		
Average		

Calculation of Reaction Time

$$t = \sqrt{(2d/a)}$$

Where

t= reaction time

d= average distance of fall

a = acceleration due to gravity

$a = 980 cm/S^2$

Follow up Questions

1. What was the fastest reaction time between you and your partner? _____.

   How do you know?

   _____

   _____

2. What was the slowest reaction time between you and your partner? _____.

   How do you know?

   _____

   _____

Classroom

3. What was the fastest male reaction time? _____.
4. What was the fastest female reaction time? _____.
   s
5. Who was the fastest in the class? _____
6. Do you see any patterns in the trials?
   a. What are they?

      _____

      _____

b. Why do you think these patterns exist? -

_____

_____

7. What was the average male reaction time? _____

   a. How do we obtain this?

   _____

   _____

   b. What was the best average? _____

   c. Who had the best average? _____

8. What was the average female reaction time?

   a. How do we obtain this?

   _____

   _____

   b. What was the best average? _____

   c. Who had the best average? _____

9. Where there any other factors that may have affected response time?

   a. What are they?

   _____

   _____

   b. How could we test these factors?

   _____

   _____

7. What is the ***mean*** of your trials? _____
8. What was the ***mean*** of your partner's trials? _____
9. What was the ***median*** of your trials? _____
10. What was the ***median*** of your partner's trials? _____
11. What was the ***mode*** of all the males in your data? _____
12. What was the ***mode*** of all the females in your data? _____

Observations of a Penny

How many observations can you make?

Making detailed observations is an essential part of science. To help fine-tune your observation skills you will be making observations of an object that you are familiar with, but yet may not pay that much attention to – the Penny!! In the space provided, make as many observations of a penny as you possible can! Work as a group. Number each observation as you go. Good Luck!

Scientific Method

How is the Surface Tension of Water Affected by Soap?

Introduction:

Surface tension refers to waters ability to "stick to itself". Surface tension can be measured and observed by dropping water (drop by drop) onto a penny. The number of water drops that can fit on a penny will surprise you.

Initial observation: Observe surface tension by seeing how many drops of water can fit on a penny.

a. Number of drops _____

Question: How does soap affect the water's surface tension?

Hypothesis: What affect do **you** think soap will have on the surface tension? Write your answer **in paragraph form** below.

_____

_____

_____

_____

Experiment:

Test your hypothesis by comparing the number of drops of tap water that can fit on a penny to the number of drops of soapy water that can fit on a penny. Because water drops may vary depending on how well you drop the water, it is better to run many trials and take an average. Record you data on the table below.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
Tap Water						
Soapy Water						

Analyze data and draw conclusions:

Write a paragraph below (using complete sentences) that explains how soap affects the surface tension of water, using your data to help answer the question. Suggest a reason for your answer (Why did it happen). Did the experiment support or reject your hypothesis?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Post Lab Analysis

1. What is surface tension? _____

   _____

2. Why did we conduct many trials? _____

   _____

3. In this experiment what was your control? _____

   _____

4. What was the independent variable? _____

   _____

5. What was the dependent variable? _____

   _____

Independent and Dependent Variables

Identifying the independent and dependent variables in a controlled experiment is a very important skill to have when reading about different experiments. This exercise will help you become more proficient at this skill! First, use your reading packet and/or your notes to write the definition of each the following terms. Then, identify the independent variable and the dependent variable in each investigation.

Definitions:

Controlled Experiment-

Variable-

Independent Variable-

Dependent Variable-

Practice Problems:

1. How does the amount of rainfall affect how quickly the grass grows?

Independent Variable: _____
Dependent Variable: _____

2. How does an increase in the Sea Otter population affect the Pacific Clam population off the coast of California?

Independent Variable: _____
Dependent Variable: _____

3. How does the amount of smoking affect lung cancer rates?

Independent Variable: _____
Dependent Variable: _____

4. How does air pressure affect the boiling point of water?

Independent Variable: _____
Dependent Variable: _____

5. How does the length of time it takes for a wet towel to dry depend on the humidity of the air?

Independent Variable: _____
Dependent Variable: _____

6. How does the rate at which sugar dissolves in water depend on the water's temperature?

Independent Variable: _____
Dependent Variable: _____

7. Write a question below that could be answered using the scientific method. Then, identify the independent and dependent variable.

Independent Variable: _____

Dependent Variable: _____

Identifying Controls and Variables

Smither's 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.

1. What is the control group? _____

2. What is the independent variable? _____

   How do you know? Explain. _____

   _____

3. What is the dependent variable? _____

   How do you know? Explain. _____

   _____

4. What should Smither's conclude? (conclusion)

   _____

   _____

Identifying Controls and Variables (continued)

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.

1. What was the initial observation? _____

2. What is the control group? _____

   How do you know? Explain. _____

   _____

3. What is the independent variable? _____

   How do you know? Explain. _____

   _____

4. What is the dependent variable? _____

   How do you know? Explain. _____

   _____

5. What should Homer conclude? (conclusion)

   _____

   _____

Scientific Method: Bikini Bottom Experiments

The Bikini Bottom gang loves science class and wanted to do a little research.
Read the description for each experiment and use your knowledge of the scientific method to answer the questions.

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.

_____

_____

_____

_____

_____

_____

Super Snails

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

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.

State the Question

What do you want to find out?

_____

_____

Hypothesis

What do you think will happen?

_____

_____

Design an Experiment

Procedure. Write the steps for your experiment in the space below.
Materials. What materials do you need to run the experiment?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Scientific Method: 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.

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? _____

_____

Slimotosis

Sponge Bob notices that his pal Gary is suffering from slimotosis, which occurs when the shell develops a nasty slime and gives off a horrible odor. His friend Patrick tells him that rubbing seaweed on the shell is the perfect cure, while Sandy says that drinking Dr. Kelp will be a better cure. Sponge Bob decides to test this cure by rubbing Gary with seaweed for 1 week and having him drink Dr. Kelp. After a week of treatment, the slime is gone and Gary's shell smells better.

What was the initial observation? _____

What is the independent variable? _____

What is the dependent variable? _____

What should Sponge Bob's conclusion be? _____

Marshmallow Muscles

Larry was told that a certain muscle cream was the newest best thing on the market and claims to double a person's muscle power when used as part of a muscle-building workout. Interested in this product, he buys the special muscle cream and recruits Patrick and SpongeBob to help him with an experiment. Larry develops a special marshmallow weight-lifting program for Patrick and SpongeBob. He meets with them once every day for a period of 2 weeks and keeps track of their results. Before each session Patrick's arms and back are lathered in the muscle cream, while Sponge Bob's arms and back are lathered with the regular lotion.

Time	Patrick	SpongeBob
Initial Amount	18	5
After 1 week	24	9
After 2 weeks	33	17

Which person is in the control group? _____

What is the independent variable? _____

What is the dependent variable? _____

What should Larry's conclusion be? _____

Microwave Miracle

Patrick believes that fish that eat food exposed to microwaves will become smarter and would be able to swim through a maze faster. He decides to perform an experiment by placing fish food in a microwave for 20 seconds. He has the fish swim through a maze and records the time it takes for each one to make it to the end. He feeds the special food to 10 fish and gives regular food to 10 others. After 1 week, he has the fish swim through the maze again and records the times for each.

Special Food Group
(time in minutes/seconds)

Fish	Before	After
1	1:06	1:00
2	1:54	1:20
3	2:04	1:57
4	2:15	2:20
5	1:27	1:20
6	1:45	1:40
7	1:00	1:15
8	1:28	1:26
9	1:09	1:00
10	2:00	1:43

Regular Food Group
(time in minutes/seconds)

Fish	Before	After
1	1:09	1:08
2	1:45	1:30
3	2:00	2:05
4	1:30	1:23
5	1:28	1:24
6	2:09	2:00
7	1:25	1:19
8	1:00	1:15
9	2:04	1:57
10	1:34	1:30

What was Patrick's hypothesis? _____

Which fish are in the control group? _____

What is the independent variable? _____

What is the dependent variable? _____

Look at the results in the charts. What should Patrick's conclusion be?

_____

_____

Introduction to Graphing with Tennis Balls

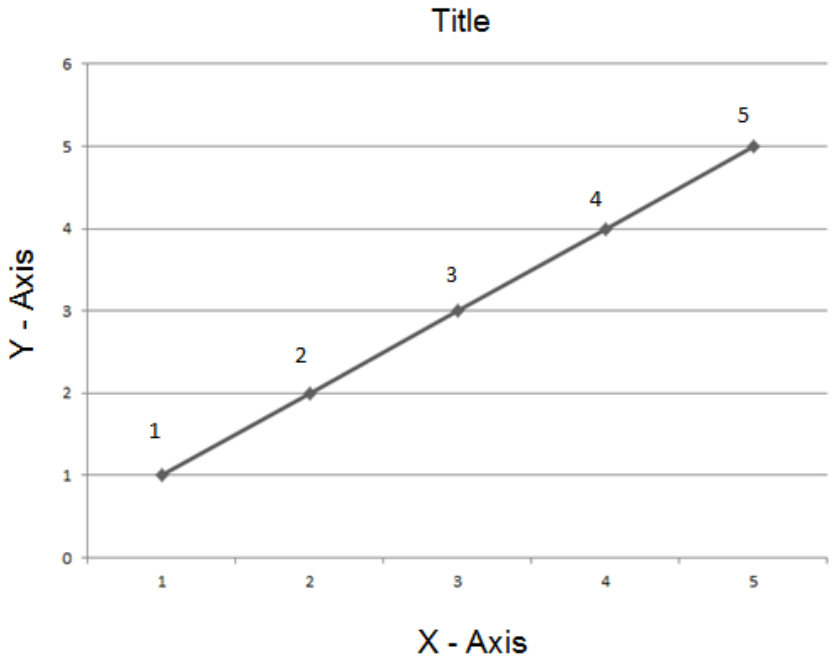
Introduction:

Graphs are very important in the workforce, and in our social media. Scientists, business workers, and athletes all use graphs.

1. Where have you seen graphs outside of the classroom?
2. Why do people use graphs?

Objective:

Graphs are important because they us how data can be analyzed to reach a conclusion. To help us interpret a graph, we need to look for a few important items on a graph:



Let's define the various parts of a line graph.

title	The title of the line graph tells us what the graph is about.
Y-Axis	The vertical label along the side. Dependent Variable (What you measure). Label and unites required.
X-Axis	The horizontal label across the bottom. Independent Variable (What you change). Label and unites required.
scales	The horizontal scale across the bottom and the vertical scale along the side tell us how much or how many.
points	The points or dots on the graph show us the facts. They are done as data points: (x, y)
lines	The lines connecting the points give estimates of the values between the points.

Question:

How does changing the amount of time change how many bounces we get?

Materials:

- Bouncy ball
- Stopwatch

Directions:

1. You will be given a tennis ball. **Do not** throw the tennis ball or use it inappropriately!
2. Your goal is to see how many times you can **gently** bounce the ball on your lab table in a certain amount of time.
   a. A bounce is when the ball touches the table and returns to your hand.
   b. You must close your fingers around the ball when it reaches your hand or else it does not count as a bounce.

One member of the group will time the bouncer using a stopwatch. You will time six different time intervals found in the table below. One member will bounce the ball while being timed.

You may switch who is the timer and who is the bouncer during this lab.

Record the number of bounces your group gets in the table below.

Remembering your experiences with tennis balls, hypothesis how your number of bounces will change as the amount of time increases.

Hypothesis:

I think _____

Because_____

Time (seconds)	Number of Bounces
5	
10	
15	
20	
25	
30	

Questions:

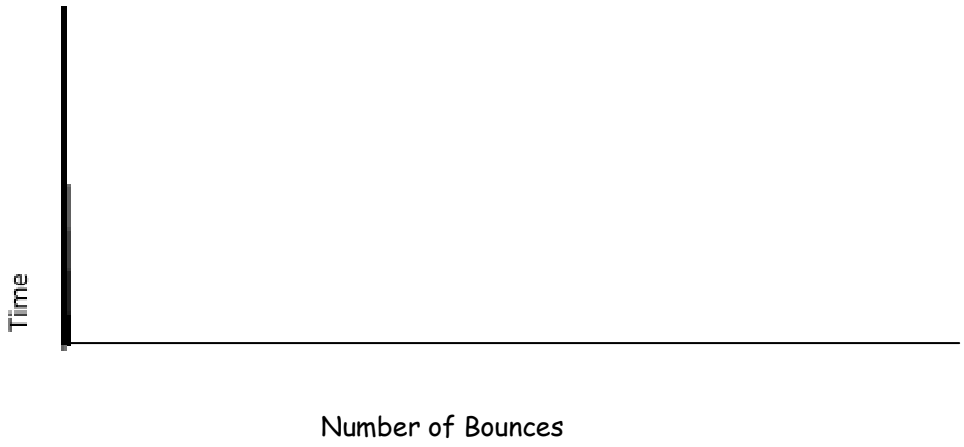
1. What was the question we were trying to answer during this lab? (Hint: Read the question part of this lab again.)

2. Was your hypothesis about bouncing the ball correct? Explain. (This requires more than a "yes" or "no" response!)

3. How did we test our hypothesis?

4.Why do you think some groups had different number of bounces at each time interval than you did?

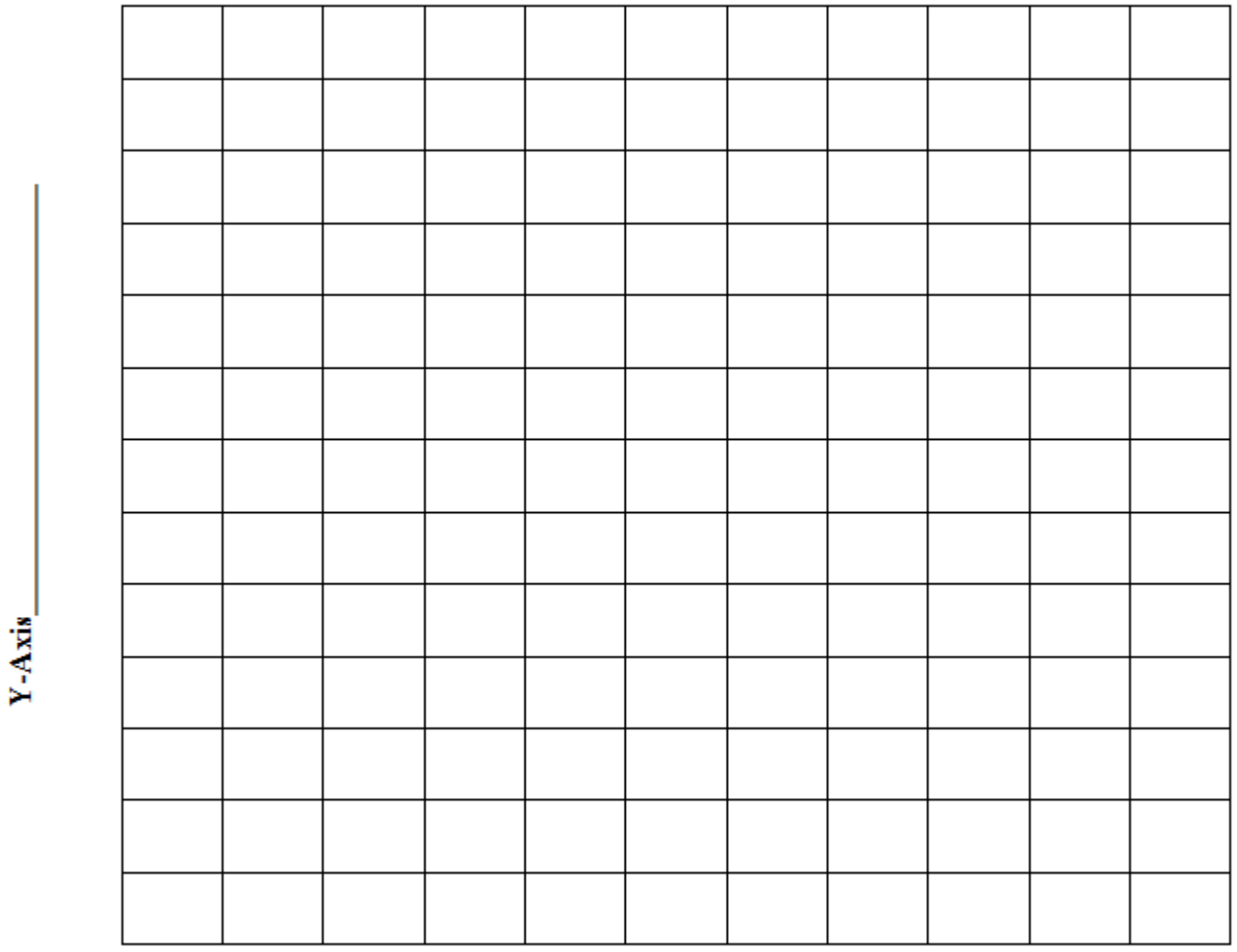
5.Draw a trendline on the graph below for how the number of bounces changed as the amount of time increased.



Now it's time to graph your data!

Use your data from the table you filled in to plot your experiment data on the graph below. Connect all your dots with a line to complete the graph. Be sure to include a **title** above your graph, **labels & unites** on both the Y and X axis, and **scales** on the Y and X axis.

Title:_____



8. What kind of graph did you create? (bar graph, line graph, scatter plot, or pie chart) How do you know?

9. What conclusion can you make based on your graph? (Make a statement about what happened to the number of bounces as time increased.)

Lab Write-Up Resource

Scientific Question:

State the problem you are trying to answer in the form of a question. Be specific in your language (What is the effect of _____ on _____?). It must be testable.

Independent Variable = The part of an experiment that is changed on purpose by the scientist. *Example: Number of hours of sunlight a plant is exposed to*

Dependent Variable = The part of an experiment that may change in response to the independent variable. This is what you measure. *Example: Plant height*

Gather information

Find out about or review everything important related to the problem. Do you or your lab partners have any prior experience with this problem? Gathering prior knowledge is an important step in forming a good hypothesis.

Form a Hypothesis:

Clearly state what you think the answer to your problem is. This is an educated guess. It is ok to be wrong as that is a part of science (some of the best discoveries in science have come from a hypothesis that was originally wrong!), but think about the knowledge you already have before making your hypothesis. The hypothesis should be closely linked to your predictions you made about the lab using an "If…then…" statement.

Design an Experiment

1) Materials: List the materials you used during the lab. They should be bulleted or in list form, not all in one sentence.
2) Procedure: Explain what you did, so that another person could repeat your experiment. You need to be detailed enough so that there is no confusion as to what you did and in what order. It must be replicable by others. Include at least one detailed drawing of the set-up.

Results:

Data is measured without opinions or analysis. Qualitative and quantitative observations are 'just the facts' gathered using your senses. Remember to use data tables and graphs to organize and display your information accurately.

Data Analysis:

What is your data telling you & what does it mean? You must look at the data you collected and explain what it means. Think about the experiment and the data to come up with valid explanations (use specific numbers to validate your statements). Remember to draw upon information that has been presented to you prior to this lab.

Conclusion:

The conclusion should start off stating that the results either supported or rejected your hypothesis. Explain why the data supported or rejected your hypothesis. Write about anything that could have affected your results (sources of error). What ideas does this give you for what you might try to investigate next? How can what you learned be applied to a real-life situation?

Lab Write-up Rubric

Section of Lab	Needs Work (0%-25%)	In Progress (25% - 75%)	Got It! (75% - 100%)
Scientific Question & Variables (5 points)	Question missing or wrong format. Variables not correctly identified.	Variables identified but not correctly categorized as in/dependent. Question is not testable or fully clear.	**Variables** correctly identified as in/dependent. **Question** is testable and written in a question format.
Hypothesis (5 points)	Hypothesis is not stated clearly.	Hypothesis is too vague or hard to prove or disprove with no prediction of outcomes.	**Hypothesis** (If...Then) stated with an explanation of expected outcomes.
Materials (5 points)	Material list incomplete or in sentence format.	Material list is incomplete but in list form.	**Materials** (substances and equipment) for the lab are specific and in a list form.
Procedure (15 points)	Directions are hard to follow (too detailed or not enough). Complete sentences are not used throughout. No helpful diagrams.	Directions are well written, but not organized or missing parts. Data results are mixed in with procedure. Diagrams are incomplete.	**Procedure** directions are specific and well organized. Steps are easy to follow and read. Diagrams are clear & detailed. It is replicable.
Results: Data Table(s) (10 points)	Data is not organized into data tables. Measurements and data incomplete. Units not shown on measurements.	Information complete, but poorly organized. Units, title, or labels missing.	Values during lab are reported in **Data Table** format. Format of tables well planned and easy to read (tables have complete sentence titles). Measurements have proper units and columns line up. Data is complete.
Data Analysis (10 points)	Vague statement of data not containing numbers.	Statements to explain data clear but not containing numbers. Contains numbers but doesn't compare them in relationship to other aspects of the data.	**Data Analysis** has data clearly stated. Sentences are complete and contain numbers to validate. A comparison is made in at least 3 different aspects of your data. Averages are compared.
Conclusion (10 points)	No supporting data, lacking connections to real life and/or sources of error.	Accept or reject hypothesis clearly stated with little supporting data. Sources of error not clear, little to no connection to real life.	**Conclusion** has accept or reject hypothesis clearly stated with supporting information. Sources of error are clear and accurate. Further investigations stated. Connections to real-life are practical.
Overall Effects: Neatness Spelling/Grammar Organization (10 points)	Many spelling and/or grammatical errors. Sections are out of order and lacking headers.	Few spelling or grammatical errors. Lab sections are out of order or not properly labeled with headers.	Neat and easy to read. Lab sections are in proper order and labeled correctly with headers. Complete sentences which are easy to follow and understand.

Name:_____ Hour: _____

Total:_____/70

Independent Investigation

You will be working with a partner to create an experiment using pennies and drops of water. You will need to follow the basic steps in the scientific method. A few ideas … Which will hold more drops of water: cold penny or hot penny; new penny or old penny; and head side or tail side? You may also created test different substances: different brands of soaps, shampoo/conditioners, or other *safe* household liquids. Always plan for safety! Group must have your instructors permission before attempting any part of the experiment. If a group has not addressed possible errors or safety concerns, your instructor will have you rewrite the lab until it meets with their approval.

Basic steps in the scientific method

Step 1: Create a Question

- What do you want to find out?
- Does your question relate to the topic?
- Can you develop an experiment to answer your question?
- Does your question make sense? Is it confusing?

Step 2: Hypothesis

- What do you think will happen?
- BE SPECIFIC!
- Use complete sentences.
- Use If… Then… Statement when writing your hypothesis

Step 3: Procedure

- What steps will you follow to find an answer?
- BE SPECIFIC! Label your steps using 1, 2, 3, etc.
- Would someone else be able to follow your directions?
- How will you collect your data?
- How will you ensure reliable results?
- What safety issues need to be addressed?

Step 4: Experiment & Data

- Be sure to display your data in an organized manner. Use a table or chart to help you show your results. Don't forget to label!
- Include enough data to prove or disprove your hypothesis.

Step 5: Analysis/Conclusion

- What happened during your experiment?
- Did your results support your hypothesis?
- Write a summary of what you learned during your experiment and address your results.
- Explain any unexpected results.
- Are your results reliable?
- Did you use complete sentences?

Independent Investigation

State the Question

What do you want to find out?

_____

_____

Hypothesis

What do you think will happen?

_____

_____

Design an Experiment

Procedure. Write the steps for your experiment in the space below. **Materials.** What materials do you need to run the experiment?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Safety Rules

What safety rules do you need to follow during your experiment?

_____

Results

Create a table, chart, or graph to record your data

Data analysis/Conclusion

Explains how variable affected the results, using data. Suggest a reason for the results. Did the experiment support or reject your hypothesis?

_____

_____

_____

_____

_____

_____

_____

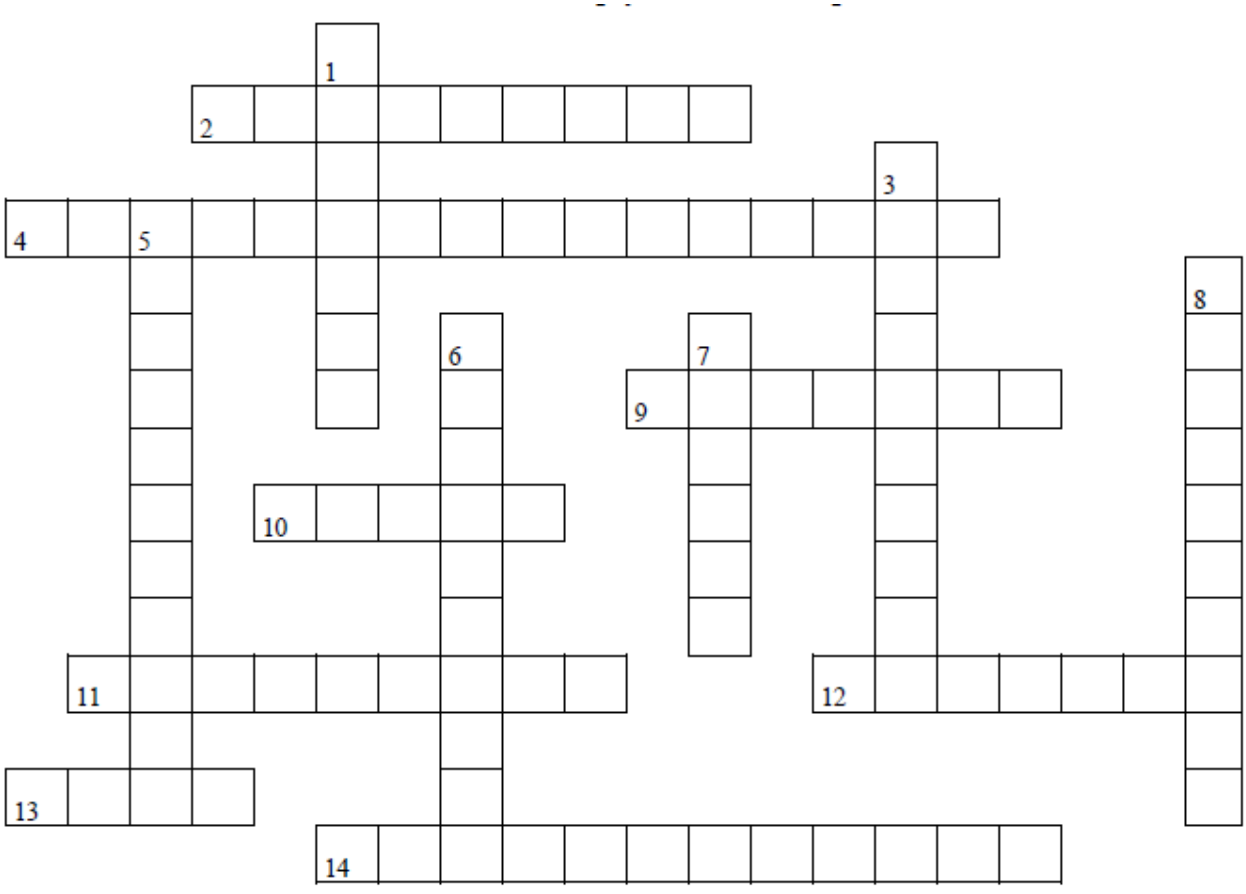
_____

_____

Scientific Method Review

Clues:

1. The ___ is the part of an experiment that is not being tested and is used for comparison.
2. The _____ describes the steps you use during an experiment.
3. After an experiment, scientists write a _____ which summarizes their experiment and results.
4. The ___ ___ is a process used by scientists to find answers to questions or solve a problem.
5. The _____ variable is the part of the experiment that is being tested or the part that is changed by the person doing the experiment.
6. The _____ is an educated guess.
7. Scientists use their data to make charts and _____ to communicate the results of an experiment.
8. After the scientist makes a hypothesis, they perform an ___ to collect data.
9. The first step of the scientific method is to define or identify the ___ .
10. Sometimes scientists make a mistake, or ___ , and need to do an experiment again.
11. The ___ variable is the part of the experiment that is affected by the independent variable.
12. After the experiment, scientists organize and ___ the data.
13. The information collected during an experiment is called ___ .
14. Scientists make ___ to help them make a hypothesis or collect data during an experiment.



Bias & Debunking

Debunking is an attempt to discredit and contradict claims as being false, exaggerated, or pretentious. Bias is prejudice in favor of or against one thing, person, or group compared with another, usually in a way considered to be unfair. Part of science is checking to see if things are truly scientific. You will attempt to debunk and find the bias in the article given to you.

You will be assigned one of the following articles.

- Big Food
- Loch Ness Monster
- Chupacabra
- Colossal Octopus

1. Briefly summarize what your article was about:

2. What do people think happened in this article?

3. Can you give another explanation for what they saw?

4. What evidence would convince you that your story is real?

5. What do you think is really going on? Is the story correct or incorrect? Why?

How Scientists Work Streaming Video: What is the Scientific Method?

Pre-test

1. The first record of the scientific method being used was approximately
a. 600 years ago. b. 3,000 years ago. c. 50 years ago. d. 1,200 years ago.

2. To find out if a person's experiment was accurate and true, you can
a. repeat just the pre-experimental stage. c. repeat all five steps in the scientific method.
b. choose to agree with the hypothesis. d. draw your own conclusion.

3. Collecting data is part of
a. coming to a conclusion. b. doing the experiment. c. gathering material. d. stating the problem.

4. During the experimental stage of the scientific method.
a. a hypothesis is formed. c. most scientists draw their conclusion.
b. measurements are often made. d. a scientific law is written up.

5. Another word for hypothesis is
a. research. b. fact. c. prediction. d. summary.

6. When analyzing what has been observed, such as data collected in an experiment, leads to
a. drawing the conclusion. c. a scientific inquiry.
b. coming up with a question. d. a hypothesis.

7. Before the hypothesis can be stated a
a. theory is proposed. c. galactic law is constructed by a group of professors. upon.
b. conclusion is agreed d. problem needs to be stated in the form of a question.

8. If the experiment shows the original hypothesis to be false, the scientist
a. should doubt the accuracy of the equipment. c. needs to repeat the experiement.
b. will not be able to solve the problem. d. can state a new hypothesis.

9. The hypothesis is
a. formed after the conclusion. c. stated when observations are being recorded.
b. a prediction. d. the result of many theories being tried out.

10. During the experiment a person
a. makes a summary. c. tries to figure out what might go wrong.
b. reads all they can about the subject. d. keeps a record of what is happening.

Post-Test

____1, ____2, ____3, ____4, ____5, ____6, ____7, ____8, ____9, ____10

How Scientists Work Streaming Video: What is the Scientific Method?

Fill in the Flow Chart

Directions: A flow chart illustrates the order of a procedure. Sometimes the scientific method terminology and order of procedures can be confusing. This flow chart will help you remember the steps in the scientific method. Fill in the blank box with the appropriate word or term listed below. Remember this flow chart starts at the top and flows down.

using mathematics	gathering materials	drawing a conclusion
asking a question	forming a hypothesis	observing and recording data
performing measurements	designing and conducting an experiment	
analyzing the results of the experiment		knowing how to use a piece of equipment
identifying a single test variable and controlling other variables		

Any scientific investigation begins with _____

Then comes _____

Followed by the _____ which usually has six steps:

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

And finally _____

How Scientists Work Streaming Video: What is the Scientific Method?

Activity: Two Ears Versus Only One Ear

Materials: Coin, students in class, stool or chair, tennis ball, and wastebasket.

Observation:
When there is a lot of activity around horses, you will often notice their ears move back and forth a great deal. The two ears of cats and dogs do the same thing when they are trying to find from where a sound is coming.

Problem: Compared to only one ear, how do two ears help humans?

Hypothesis: Make an educated guess as to what two ears can do that one ear cannot.

_____

Experiment:

1. When your instructor is ready you should put your head down, and then close your eyes.
2. A quarter will be tossed into the room. When the coin lands, continue to keep your eyes closed, but point to where you think it landed.
3. Wait for your instructor to tell you to raise your head and open your eyes, but continue to point to where you think the coin landed.
4. Also, look around to see where the other students are pointing.

   How close to where you were pointing was the coin? _____ feet/meters

   Did most of the students seem to point close to where this coin landed? Explain.

   _____

   So far, what do you think you have learned about finding where a sound is coming from?

   _____

5. We are going to change this experiment by covering one ear with the palm of your hand. This is being done so only one ear will hear the coin hit the floor.
6. Heads down and eyes closed when your instructor is ready.

7. Point once again to where you think the coin landed.

   How close did you come this time? _____ feet/meters

   How well did the group do this time using only one ear?

   _____

8. The third step in our experiment will need a volunteer selected by your instructor. The student volunteer will sit on a stool that has been placed in front of class. Once seated the student should then close both eyes. The teacher will then snap his or her fingers to one side of the volunteer's head, and the student will then point to where they believe the sound came from. After pointing to the spot, your instructor will snap the fingers again but in a different place. After this is done a few times you should be getting the idea. Just for the fun of it, your instructor should snap his or her fingers exactly above, behind, and in front of the person's head, as well as to one or the other side of the head.

   Does something different happen when the sound comes from a place directly behind the head or directly in front of the person?

   _____

   Why did this happen?

   _____

9. Next, the student will cover one ear and see if he or she can locate the source of the snaps.

   Explain what happened:

   _____

   What can you say about your hypothesis?

   _____

   What did you learn about two ears compared to one ear when it comes to finding where a sound is produced?

   _____

10. In the last part of the experiment, a student volunteer will try to toss a tennis ball into a wastebasket with his/her eyes closed. Your instructor will ask you (that the rest of the class) to make a low-pitched hum while the basket is being moved to some spot in the room. The humming is needed so the volunteer cannot hear where the teaches movements. The humming should stop when the teacher stops. Then the bottom of the basket will make a little noise when it is put down and touches the floor. This is the signal for the person who has his or her eyes closed to attempt to toss the ball into the basket.

11. The volunteer will now cover one ear and repeat the experiment.

    What were the results?

    _____

    _____

Fun facts:

Did you know an outfielder in baseball gets a lot of help by the sound produced when the ball is hit? The player's two ears get clues as to where the ball is going by the sound of the bat hitting the ball. Some owls find their food with their two ears. The same is true for bats.

Exit Questions

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____