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

<table>
<thead>
<tr>
<th>Name</th>
<th>Male or Female</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; trail (cm)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; trail (cm)</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; trail (cm)</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; trail (cm)</th>
<th>5&lt;sup&gt;th&lt;/sup&gt; trail (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>You</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your partner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Distance (CM) of fall</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Mine</strong></td>
<td><strong>Partner</strong></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calculation of Reaction Time**

\[ t = \sqrt{\frac{2d}{a}} \]

Where
\[ t= \text{reaction time} \]
\[ d= \text{average distance of fall} \]
\[ a = \text{acceleration due to gravity} \]
\[ a = 980 \text{cm/s}^2 \]

**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? _____.
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?

8. What was the average female reaction time?
   a. How do we obtain this?

9. Where there any other factors that may have affected response time?
   a. What are they?

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 water's 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 your data on the table below.

<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soapy Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**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?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

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__________________________________________________________________________

__________________________________________________________________________


**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

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.

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 Smithers 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 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 it 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.

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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.

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.

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 help us analyze 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.

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

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>Number of Bounces</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
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 & units on both the Y and X axis, and scales on the Y and X axis.

Title:_____________________________________

X-Axis____________________________________

Y-Axis____________________________________

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.)
**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

<table>
<thead>
<tr>
<th>Section of Lab</th>
<th>Needs Work (0%-25%)</th>
<th>In Progress (25% - 75%)</th>
<th>Got It! (75% - 100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Question &amp; Variables</strong> (5 points)</td>
<td>Question missing or wrong format. Variables not correctly identified.</td>
<td>Variables identified but not correctly categorized as independent. Question is not testable or fully clear.</td>
<td>Variables correctly identified as independent. <em>Question</em> is testable and written in a question format.</td>
</tr>
<tr>
<td><strong>Hypothesis</strong> (5 points)</td>
<td>Hypothesis is not stated clearly.</td>
<td>Hypothesis is too vague or hard to prove or disprove with no prediction of outcomes.</td>
<td>Hypothesis (If...Then) stated with an explanation of expected outcomes.</td>
</tr>
<tr>
<td><strong>Materials</strong> (5 points)</td>
<td>Material list incomplete or in sentence format.</td>
<td>Material list is incomplete but in list form.</td>
<td>Materials (substances and equipment) for the lab are specific and in a list form.</td>
</tr>
<tr>
<td><strong>Procedure</strong> (15 points)</td>
<td>Directions are hard to follow (too detailed or not enough). Complete sentences are not used throughout. No helpful diagrams.</td>
<td>Directions are well written, but not organized or missing parts. Data results are mixed in with procedure. Diagrams are incomplete.</td>
<td>Procedure directions are specific and well organized. Steps are easy to follow and read. Diagrams are clear &amp; detailed. It is replicable.</td>
</tr>
<tr>
<td><strong>Results: Data Table(s)</strong> (10 points)</td>
<td>Data is not organized into data tables. Measurements and data incomplete. Units not shown on measurements.</td>
<td>Information complete, but poorly organized. Units, title, or labels missing.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Data Analysis</strong> (10 points)</td>
<td>Vague statement of data not containing numbers.</td>
<td>Statements to explain data clear but not containing numbers. Contains numbers but doesn’t compare them in relationship to other aspects of the data.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Conclusion</strong> (10 points)</td>
<td>No supporting data, lacking connections to real life and/or sources of error.</td>
<td>Accept or reject hypothesis clearly stated with little supporting data. Sources of error not clear, little to no connection to real life.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Overall Effect:</strong> Neatness Spelling/Grammar Organization (10 points)</td>
<td>Many spelling and/or grammatical errors. Sections are out of order and lacking headers.</td>
<td>Few spelling or grammatical errors. Lab sections are out of order or not properly labeled with headers.</td>
<td>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.</td>
</tr>
</tbody>
</table>

**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?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________
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.    b. choose to agree with the hypothesis.    c. repeat all five steps in the scientific method.    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.    b. measurements are often made.    c. most scientists draw their conclusion.    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.    b. coming up with a question.    c. a scientific inquiry.    d. a hypothesis.

7. Before the hypothesis can be stated a  
   a. theory is proposed.    b. conclusion is agreed    c. galactic law is constructed by a group of professors. upon.    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.    b. will not be able to solve the problem.    c. needs to repeat the experiment.    d. can state a new hypothesis.

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

10. During the experiment a person  
    a. makes a summary.    b. reads all they can about the subject.    c. tries to figure out what might go wrong.    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
- asking a question
- performing measurements
- analyzing the results of the experiment
- designing and conducting an experiment
- observing and recording data
- gathering materials
- drawing a conclusion
- 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. 