Read each of the topics below and determine if they can be investigated with a testable hypothesis. If they are testable, then write your hypothesis on the line provided. If they are not testable, then write “not testable”.

1. Is stealing is wrong?

2. Are those who study the most get the best grades?

3. Do birds seem to react strangely before an earthquake?

4. Are people who recycle generally smarter?

5. Is basketball a better sport than baseball?

6. Is Alex’s bike faster than Andie’s?

7. Is Alex faster at running than Andie?

8. Do SUV’s use more gas than smaller cars?

9. Do Bearded dragons eat dandelions?
Answer the following questions on a separate sheet of paper.

1. You want to figure out whether the shape of a container affects the rate of which water freezes in that container.
   - Write a hypothesis for this problem.
   - What is the manipulated variable?
   - What is the responding variable?
   - What are some of the variable that you would need to control?
   - Do you need an operational definition? If so, what is that definition?

2. You think that if you change the temperature of your refrigerator, than you can have your batteries last longer in storage.
   - Write a hypothesis for this problem.
   - What is the manipulated variable?
   - What is the responding variable?
   - What are some of the variable that you would need to control?
   - Do you need an operational definition? If so, what is that definition?

3. You are confused about which laundry detergent is really best at removing stains. You decide to conduct an experiment to finally decide for all of American which laundry detergent works best.
   - What is the manipulated variable?
   - What is the responding variable?
   - What are some of the variables that you would need to control?
   - Do you need an operational definition? If so, what is that definition?

4. You are confused about which brand of paper towel is really the strongest. You decide to conduct an experiment to finally decide for all of American which paper towel works best.
   - Write a hypothesis for this problem.
   - What is the manipulated variable?
   - What is the responding variable?
   - What are some of the variable that you would need to control?
   - Do you need an operational definition? If so, what is that definition?

5. For two of the above problems, using a minimum of 5 sentences, describe how you would conduct an experiment to test the hypothesis that you have written.
Suppose you fill a fish tank with water. Further suppose you put a can of Pepsi and a can of Diet Pepsi into the fish tank. Examine figure 1 and figure 2 below and then answer the questions which follow.

Figure 1

Figure 2

1. What could have caused one of the cans to sink, and the other float? (Name at least two.)

2. Select one of the two possible explanations above, and develop a testable hypothesis.

3. Describe in detail how you would conduct such an experiment.

4. What would be your manipulated variable and your responding variable?

5. What would be some control variables that you should consider?
Writing Skills

Hypothesis are written in an “If…then…” format. [At more advanced levels a hypothesis would be written as “If…then…because” format. Read the following example.

The printer is not working.

Example Inference: There was a power failure

Example Hypothesis: If the power is restored, then the printer will work properly because the printer needs power for it to operate.

Directions: Now following the example above, write three more inferences and a related hypothesis, which might describe why the printer is not working. For each inference write a hypothesis using both the “If…then” and “If…then…because” formats.

Directions: Now following the example above, write two more inferences and a related hypothesis each, which might describe the following observation:

The tomato plant is dying. For each inference write a hypothesis using both the “If…then” and “If…then…because” formats.
A student sought to discover the best household material for absorbing oil. He used cotton ball, a kitchen sponge, and some paper towels to clean up 5ml of olive oil that he spilled on a brick. After poured the oil on the brick, he first uses cotton balls. Then on the same spot of oil he used the sponge, followed by the paper towels. No matter what he did, an oily spot remained on the brick.

Describe how he could have changed his investigation to better prove which material was best at cleaning up olive oil.

Problem:
Hypothesis:
Materials:
Procedures:
Data:  *(Data table only)*
Analysis:
Conclusion:

What is his manipulated variable?
What is his responding variable?
What variables would he have to keep constant?
Directions: Analyze the diagrams, and then answer the questions.

1. What is different between the group in figure 1 and the group in figure 2?
2. What is the responding variable in the above experiment?
3. Name two variables that would have to be held constant in this experiment and explain why.
4. Write a hypothesis for the above experiment.
5. Which figure represents the control in the above experiment? Why?
6. Extra Credit: In graphing this problem what would be on the “X” axis?

**Bicycle Tires:**

After many observations, you notice that your bicycle tires (and/or basketball) always look flatter on colder days or during the winter, than they do on warmer days or during the summer. You decide to use the scientific method.

What is the problem or question confronting you?

Background information: what happens to the bounce of a basketball when you leave it outside in the winter?
What Hypothesis would you develop?
How would you perform such an experiment to test your hypothesis?
(Hint: you would probably use a smaller object.)

How would you record your data?
How would you analyze your data?
What would you include in your conclusion?
Should you repeat your experiment after it works correctly the first time? Explain.

**What is Pasteurization?**

*Louis Pasteur was a famous scientist. As you know when you leave milk out it spoils. When Pasteur was alive, people thought that certain cows were more likely (than others) to cause milk spoilage because they produced an inferior type of milk. However Pasteur thought it might have to do with bacteria. He set up an experiment where he used two glasses of milk. In one of the glasses he added boiled milk. He discovered that the boiled milk did not spoil as fast as the un-boiled milk. He told his colleagues; and when his colleagues tried the experiment, they got the same results.*

1. What was the problem for Pasteur?
2. What was his opinion on the problem?
3. What do you think was his hypothesis?
4. What was the manipulated variable?
5. What was the variable he measured?
6. What variable do you think he had to keep constant?
7. How did he verify his facts?

Which group was the control: the boiled milk, or the unboiled milk. Explain.
Step 4: Operational Definitions:

Operational definitions clear up the vagueness and/or the ambiguity of certain terms. Write two possible operational definitions for the underlines variables in the space provided.

1. Select the tomato that **grows the best**.
2. On a **cold day**, determine what happens to a can of soda left outside.
3. Rearrange the **Refrigerators at Best Buy with the largest ones** in the front.
4. People who sleep at least 8 hours per day are probably **better drivers**.
5. Students who sleep at least 8 hours per day are probably **better students**.
6. After touching the bearded dragons, make sure you **wash your hand thoroughly**.

**Going Further**

*What do you think the downside is of not having good operational definitions?*
Variables are factors that could change in an experiment. In well-designed experiments, only one factor is purposely changed so that we can measure the response it causes in another factor. In a well-designed experiment all the other factors that we are not testing must be held constant.

As an example, suppose you had the following hypothesis: “If I dip steel wool in different temperatures of water, then the steel wool will rust at different rates.”

Independent variable = temperature
Dependant variable = rate of rusting
Constant variable = amount of steel wool used, type of steel wool, amount of water

For the problems below: Using the background information you have, develop a testable hypothesis for each one of the Problems. Then identify the independent and the dependent variable.

1. Problem: What is the relationship between SPF strength and sunburn?
   Hypothesis: If a person uses a higher numbered SPF, then they will become less sunburned.
   IV___________________ DV___________________________

2. Problem: What is the relationship between frequency of brushing teeth and cavities?
   Hypothesis: If a person brushes his teeth more, then they will have less cavities.
   IV___________________ DV___________________________

3. Problem: What is the effect of instant messaging on students’ grades.
   Hypothesis: If student spend more time using IM, then their GPA will be less.
   IV___________________ DV___________________________

4. Problem: How does the angle of light affect the temperature of the surface? *
   Hypothesis:_________________________________________
   IV_____________________ DV________________________

5. Problem: How does an increase in sea otters affect the population of the abalone?
6. Problem: How does the amount of smoking affect emphysema rates?

7. Problem: How does air pressure affect the boiling point of water?

8. Problem: How does humidity affect the amount of time it takes clothes to dry?

9. Problem: How does water temperature affect the amount of salt that can be dissolved? *

10. Problem: What is the effect of snowboard length on snowboard speed?

11. Problem: What is the effect of plant food on the number of flowers produced?

12. Problem: What is the effect of an object’s height on its amount of energy? *

13. Problem: What is the effect of surface area on evaporation?

Finally in three or four sentences describe how you would conduct each experiment to test your hypothesis.
Directions: Examine the data below. Then graph your data using a double line graph. After you have completed the graph, answer the questions that follow.

Deer and Wolf Population in Wilderness County:

<table>
<thead>
<tr>
<th>Year</th>
<th>Wolf Population</th>
<th>Deer Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>800</td>
<td>20000</td>
</tr>
<tr>
<td>1930</td>
<td>500</td>
<td>30000</td>
</tr>
<tr>
<td>1940</td>
<td>400</td>
<td>50000</td>
</tr>
<tr>
<td>1950</td>
<td>300</td>
<td>75000</td>
</tr>
<tr>
<td>1960</td>
<td>200</td>
<td>30000</td>
</tr>
<tr>
<td>1970</td>
<td>200</td>
<td>20000</td>
</tr>
</tbody>
</table>

Answer in complete sentences:

1. What was the general trend of the wolf population?
2. List at least two possible reasons to explain this.
3. What happened, at first, to the deer population as the wolf population changed?
5. What would you normally expect to happen to the deer population when the wolf population declines? Did this happen? Explain in 4-5 sentences.
Step 7: Drawing Conclusions

Jack and Jill are studying heat. They are posed with a problem. They wonder whether the color container will affect how much heat that color will retain. Jack said, “If I put hot water in a dark can and a light can, then they will cool down at the same rate.” Jill said, “If I put hot water in a dark can and a light can, then the dark can will cool down faster.” They designed and cooperatively conducted an experiment using light colored and dark colored soup cans.

Their data table is below:

<table>
<thead>
<tr>
<th>Time (Minutes)</th>
<th>Light Can Temp °C</th>
<th>Dark Can Temp °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>90</td>
<td>70</td>
</tr>
<tr>
<td>10</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>20</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>40</td>
<td>30</td>
<td>22</td>
</tr>
<tr>
<td>50</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>60</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>70</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Directions: Answer in complete sentences where applicable.

1. Graph this data in a double line graph.
2. Compare the two line on your graph: How was the cooling the same?
3. Compare the two line on your graph: How was the cooling different?

Remember that a conclusion is written in paragraph format. A conclusion states whether your hypothesis was correct or incorrect and why. A conclusion should also refer back to your data and your analysis in support of your written statements.

4. Write Jill’s conclusion in 4-5 sentences.
5. Write Jack’s conclusion in 4-5 sentences

Hint:

Both Jack and Jill had a start temperature of 100 degrees; and both cans reached 20 degrees after 60 minutes – the exact same time. Isn’t this like a race between the tortoise and the hare. Which one runs faster? (Answer: the hare) But, what happens when they both cross the finish line at the same time? Was the hare still faster?
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.

(1) What did SpongeBob do wrong in this experiment? Explain.

(2) 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. Analyze the data in the chart and determine whether or not the Super Snail Snacks create smarter snails!

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

<table>
<thead>
<tr>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snail</td>
</tr>
<tr>
<td>Gary</td>
</tr>
<tr>
<td>Larry</td>
</tr>
<tr>
<td>Barry</td>
</tr>
<tr>
<td>Terry</td>
</tr>
</tbody>
</table>
**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.
Write a definition for each:
Control -
Variable -
Independent Variable -
Dependent Variable -

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

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

1. Which people are in the control group?
2. What is the independent variable?
3. What is the dependent variable?
4. What should Mr. Krabs’ conclusion be?
5. Why do you think 10 people in group B reported fresher breath?

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

6. What was the problem SpongeBob wanted to investigate?
7. What is the independent variable?
8. What is the dependent variable?
9. What should Sponge Bob’s conclusion be?
Squidward’s Symphony
Squidward loves playing his clarinet and believes it attracts more jellyfish than any other instrument he has played. In order to test his hypothesis, Squidward played a song on his clarinet for a total of 5 minutes and counted the number of jellyfish he saw in his front yard. He played the song a total of 3 times on his clarinet and repeated the experiment using a flute and a guitar. He also recorded the number of jellyfish he observed when he was not playing an instrument. The results are shown in the chart.

<table>
<thead>
<tr>
<th>Trial</th>
<th>No Music</th>
<th>Clarinet</th>
<th>Flute</th>
<th>Guitar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>12</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

10. What is the independent variable?
11. What is the dependent variable?
12. What should Squidward’s conclusion be?
13. Are the results reliable? Why or why not?

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

<table>
<thead>
<tr>
<th>Bubble</th>
<th>Super Bubble</th>
<th>Regular Soap</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
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</tr>
<tr>
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<td>16</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>15</td>
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<tr>
<td>9</td>
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<td>15</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

14. What did the Super Bubble ads claim?
15. What is the independent variable?
16. What is the dependent variable?
17. Look at the results in the chart.
   a. Calculate the average diameter for each bubble solution.
      Super Bubble = _______ cm  Regular Soap = _______ cm
   b. What should their conclusion be?
18. Are the results reliable? Why or why not?
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.
**SCIENTIFIC METHOD**

<table>
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</tr>
</thead>
<tbody>
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</tr>
<tr>
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</tr>
<tr>
<td>N O H R E A W M P O P B M S U E U E</td>
</tr>
<tr>
<td>A Q H T T H X S I M L N L E I N O P</td>
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<tr>
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<tr>
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<tr>
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<td>H S X N S E L U R Y T E F A S S O P</td>
</tr>
<tr>
<td>W J Z S I X S T N E M I R E P X E C</td>
</tr>
</tbody>
</table>

**How many words can you make out of the letters in “Scientific Method”?**

**T. Trimpe 2002  http://sciencespot.net/**