Take Aim with the Scientific Method

Purpose: Ask a question about your squirt guns. Which gun is the most accurate? Which distance will give at least 50% accuracy? What shooting angle is the most accurate? What target is the easiest/hardest to knock down?

Once you have decided on a question, you will write a hypothesis and design an experiment that will test your question.

By the End of this Learning Activity you will:
1) Read the “scenario” below. Formulate a simple hypothesis.
2) Follow the directions in the procedure.
3) Make sure you DESIGN your experiment so that you obtain fair results.
4) Conduct the experiment.
5) Record your observations: Record data in a data table. Make a graph.
6) Write a complete lab report for this experiment using the standard lab report format. You must complete your lab report on a SEPARATE SHEET OF GRAPH PAPER (you must also copy the procedure on to your lab report!). You may use this worksheet as a guide to take notes and record data.
7) Analyze your results: Write your conclusions.

Question (choose one from above or come up with one of your own):

Hypothesis: What do you think will happen and why? For example, “If I increase the distance from the water pistol to the ball my shooting accuracy will …” State why you think this will happen. INCLUDE BOTH THE INDEPENDENT AND DEPENDENT VARIABLES!!!
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Once you have created your question and written your hypothesis, make a list about the variables (things that can change from trial to trial) involved in your experiment. Some examples include: distance, angle, height, gun, etc.

_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________

Think about which of these variables need to be controlled (stay the same for each trial) in your experiment. What variable needs to be tested (to be different)? What will be your possible results? Use the chart on the below to put the VARIABLES in their proper categories.

<table>
<thead>
<tr>
<th>Same (controlled)</th>
<th>Different (independent)</th>
<th>Result (dependent)</th>
<th>Other (can't control)</th>
</tr>
</thead>
<tbody>
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Procedure: These are instructions as to how the experiment will be conducted. Below are some examples.

1) Materials: 2 squirt guns, clay, 3 golf tees, 2 ping pong balls, one tape measure or ruler, one pencil, one data sheet.
2) The procedure should be clear and precise. Don’t leave out any important details!!
3) Some examples of what the procedure should explain: How to set up the target, Distances and heights, How to measure distances and heights, How to hold gun, How to measure and record results, How many shots.

Procedure:

Write out your procedure. For example, how much water do you use, how many trials, who squirts the gun and how, etc.

Materials: first list ALL of the materials you will need for your experiment. Next, list the directions you need to follow in order to conduct your experiment. Number each step. Remember, a diagram is a very effective tool in explaining how to do something. Use labels, measurements, and descriptions with all diagrams!!

1. 
   
   
2. 
   
   
3. etc.
   
   


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Observations:

1) Score the shot as a hit if the target is knocked over. Record the successful hits from each distance.

2) Make a data table in your lab book like the example below. Record your results in the table.

<table>
<thead>
<tr>
<th>Distance (ft.)</th>
<th>Number of Hits (target knocked down)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Etc.</td>
<td>Etc.</td>
</tr>
</tbody>
</table>

3) Draw diagrams of what you saw. Be sure to use labels!!!

4) Make a bar graph or a line graph to show your data.

5) Example of a line graph for the affect of distance on accuracy: Plot your data with distance on the X axis and the number of hits on the Y axis. Now draw a line that best fits your data points. Now draw a horizontal line from five hits on the Y axis. The point where your "best-fit line" and the horizontal line intersect is your estimated distance for hitting the target 50% of the time.
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Conclusions:

1) Was this a fair test? Discuss variables that could influence results. Some examples include the following: Was wind a factor? Did shooters all use the same gun? Did shooters practice? Make a list of all the variables that can influence the results. Include the variables from your list above and add any you discovered while conducting the experiment.

   1. Would you expect the same results if a high school science class in California repeated your experiment? Why?
   2. Would you expect the same results if a fourth grade class in Maine repeated your experiment? Why?

2) Formulate “null hypothesis” (no effect) and “alternative hypotheses” about one of the variables identified by the group. For example:

   (1) Null hypothesis – a shorter distance did not give more accurate shots than a longer distance.
   (2) Alternative hypothesis – a longer distance gave more accurate shots.

3) How could you improve this experiment? What could you do to make sure that all elements of the experiment would be controlled (ex. invent technology to shoot the pistol at the same pressure each time)?

4) Give a scientific reason for your results. Why did you get the results you got? Why did the larger pistol shoot more accurately? Why did distance from the target affect your accuracy?

Answer the Following Questions: Use your chart from page 2

1. What is the independent/experimental variable? ___________
2. Name a controlled variable? _____________________
3. Are there any more controlled variables? If so, what are they?
   _____________________________________________
   _____________________________________________
   _____________________________________________

4. What is the dependent variable? ____________________________