Building a Parachute

Content standards:

6th grade Experiment and investigation

Learning objectives: Learning Objectives:

Science process skills:

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:
    a. Develop a hypothesis.
    b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
    c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
    d. Communicate the steps and results from an investigation in written reports and oral presentations.
    e. Recognize whether evidence is consistent with a proposed explanation.

Formal and Informal Assessments:

- Students will be able to graph their data as position vs. time
- Students will be able to collect data of position and time for the parachute
- Students will be able to develop a hypothesis and come to a well defined conclusion.
- Students will be able to perform tests to prove their hypothesis.
-Students will share their observations, variables that could be changed and explain how that will improve the performance of the prototype and why.

Instructional Procedures:

Scientists answer questions about the world they live in by formulating hypotheses and designing experiments to test them. Formulating a hypothesis and designing an experiment to test it are the first steps in all **scientific inquiry**.

This lesson will require students to formulate and test **hypotheses**, to **identify variables** that can affect their results and to analyze the results of their experiments

The main goal is to give the student the opportunity to experience “doing” science while investigating how to build a parachute .The investigation is about using basic science to think about the design and performance of the parachute. The parachute is the object of the investigation and students will explore to see what influences its behavior and how it performs.

Students will build a prototype parachute and in groups will think about how to improve it (in the second lesson).
The teacher will ask students to brainstorm what the following terms mean: independent variable, dependent variable, and controlled variables. Then, write these simple definitions on the board:

- ✓ **Independent variable**: the variable that is purposefully changed in an experiment
- ✓ **Controlled variables**: the variables that are kept the same during an experiment
- ✓ **Dependent variable**: the variable that is changed depending on the value of the independent variable

Also, ask students if they:

- Know what a graph is?
- Can tell you the names of the different types of graphs?
- Know why information is often presented in graphs instead of just in a list or table?

Project: 1st day

- Students will be broken up into groups of 3-5.
- Teacher will go over what the children are going to be building (prototype parachute)
- Teachers will introduce the lesson by explaining to them that we are going to be competing in a parachute contest. There is a big company named Pete's Parachutes that is looking for the best parachute. Pete says the best parachute is the one that can stay in the air the longest and land the closest to his bull's eye. Now class, we need to help design a parachute for Pete that will win us this contest. From here, the teacher will go onto talking about what the design will be and look like. The teacher will also have the student's draw what a parachute looks like to them.
- Students will create their prototype parachute with dimensions of the canopy (50cmx100cm), one string attached to each corner at 100 cm, and one washer tied to the four strings.
- The students will then drop their parachutes from a controlled height and area and try to get the parachute to stay in the air the longest and hit a target directly below the launch point.
- The students will run 3 trials and measure how close their parachute comes to the target and how long the parachute is in flight.
- The students will record the data in the table provided by the teacher.

Trial #	Hang time (seconds)	Distance from bulls eye (cm)
1		
2		
3		

- If time is allotted, students will compare their data with other classmates and graph.
-Students and teachers will discuss the variable which can be changed to improve the flight time and accuracy of the parachute.

- What were some of the reasons why trial one gave different hang time than the other two trials?
- Did the way we dropped the parachute alter the time the parachute stayed in the air or the distance the parachute was from the bull's eye?
- Other questions discussing the variables and etc.
-Teacher and students will choose a variable to change for next week's parachute.
- If we changed the way we dropped the parachute (holding it differently or changing the height, or throwing it up in the air) would it fly differently?
- Can we change anything else about the parachute (canopy, weight, strings)?
- What are the things we are changing called? (variables)

Project: 2nd day
We will begin today's lesson with a little review of variables (independent, dependent), hypothesis, graphing, and why all this is important when conducting an experiment.

The first step in an experiment is to ask a **question** about whatever you want to find out. For a question to be answered scientifically, it must be clear and testable, and the phenomenon that you question must be measurable and controllable. What is the question we are trying to answer with our experiment?

The next step in an experiment is to come up with a **hypothesis**, a tentative explanation for a scientific phenomenon. For instance, you might hypothesize:
The paper bag (material) canopy makes the parachute float longest in the air.
Make sure your hypothesis can be proven wrong. If it cannot be proven wrong, it is useless to conduct an experiment to test it.
Along with a hypothesis comes a prediction. A **prediction** is what you think will happen in the experiment. It takes the form of an if/then statement: IF the hypothesis is true, THEN these are the results I expect.
Example: IF I change the material of the canopy to paper bag material, THEN the parachute will stay in the air longest.

There are **three kinds of variables** that you must account for in an experiment. The **independent** variable is what you change in the experiment. It is important that you have only one independent variable in your experiment. For example, you cannot change both the material of the canopy and the weight of the load. You would not be able to draw reliable conclusions from the experiment if you altered more than one variable.
The **dependent** variable is what you measure in the experiment. Any other conditions in the experiment are called **controlled** variables. You must keep these conditions constant for all tries in the experiment. What are some controlled variables in our experiment? If you change these variables, they become independent variables, and remember that you cannot have more than one independent variable in a scientific experiment.

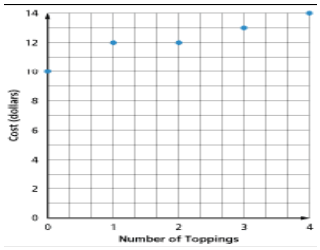
The teacher will also ask questions about graphing, will encourage students to participate in the discussion and use their responses to generate a class list on the blackboard or flip chart.

A few practice examples for review: (we will only use #1 b/c of time constrains**)**

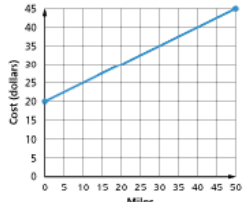
1. A pizza place charges $10 for a medium pizza. They charge $2 for the first 2 toppings and $1 for each additional topping over 2.
The number of toppings is the independent variable, and the total cost is the dependent variable.
Make a table showing the charge of a medium pizza for 0 to 4 toppings.

Number of Toppings	0	1	2	3	4
Total Cost ($)	10	12	12	13	14

The ordered pairs can be determined from the table. The number of toppings is the independent variable, and the total cost is the dependent variable. So, the ordered pairs are (0, 10), (1, 12), (2, 12), (3, 13), and (4, 14).
Draw a graph that shows the relationship between the number of toppings and the total cost.



2. Laura finds a rental car company charges $20 plus $0.50 per mile that you use a car. The charge of the rental car is a function of the number of miles you drive. Suppose Lara will not drive more than 50 miles.
a. Identify a reasonable domain and range for this situation.
The domain contains the miles driven. Since Lara will not drive more than 50 miles, a reasonable domain would be 0 to 50 miles. The range contains the total cost from $20 to $20 + $0.50 ·50 or $45. Thus, a reasonable range is $20 to $45.
b. Draw a graph that shows the relationship between the number of miles driven and the amount charged.
Graph the ordered pairs (0, 20) and (50, 45). Since she will not drive more than 50 miles, connect the two points with a line to include those two points.



3. Identify the independent and dependent variables.
a. The amount that a spring stretches increases with the amount of weight placed on it. Weight is the independent variable. The amount that the spring stretches is the dependent variable as it is affected by the weight.
b. The circumference of a circle decreases as the radius of the circle decreases.
The radius is the independent variable. The circumference is the dependent variable as it is affected by the radius.

Students will decide (with teacher guidance) which variable to change (paper bag or plastic bag) and will build the new model.

Students will then go to the cafeteria and will drop their new parachute from the same height they dropped their prototype. Each student will have the same roles as the first time, so that they have a "fair test."

After they have all the data, the group will go back to the classroom to put the data on a graph and analyze their findings. After the graphs are finished, they should be displayed with the data sheets. Review the scientific process. Review what was tested and what was changed in our parachute experiment.

They will choose the better parachute between the prototype and the new model and will share it with the other groups at the end of the class.
The last fifteen minutes the students will be formally tested on the concepts learned. (See attached)

Differentiated instruction/ Accommodation strategies:

- We will have to accommodate for EL children and incorporate some SDAIE elements.
- Some guided teaching may be needed when we come to discuss the different variables.
-Use slower speech, big pictures to give instructions, vocabulary words, give easily distracted students specific chores. Advanced students can group with others not as advanced to help.

Resources and Materials:

- 50cm x 25cm tarp or some type of material for the canopy
- String(4 lengths of 100 inches)
- One washer(per parachute)
- Timers or stopwatches
- Calculators
- Paper and pencils, scissors, measuring sticks
- Data recording sheets (see attached)
- Instructions for parachute building (attached)

Physics 107 Laboratory Workbook- January 2008
Campbell, Neil A. "Lab Topic 1: Scientific Investigation." *Lab Manual for Campbell, Fifth Edition. Ed*. Dan Wivagg. Menlo Park, California: Benjamin/Cummings, 2000, pp. 1-27.
Aero.com<http://www.aero.com/publications/parachutes/Makeprch.htm>

ASSESSMENT

Circle the correct answer.

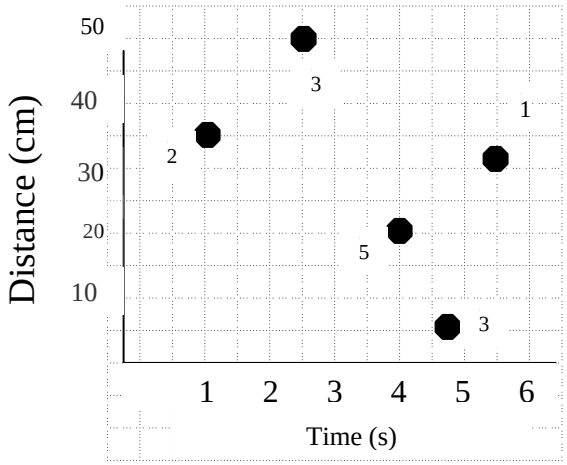
1. Which of the following questions is testable in a scientific investigation?

A. Are dogs better pets then cats?

B. Are dogs happy when they are walked?

C. Are cats more active at night than during the day?

D. Are cars easier to take care of than dogs?



2. Use the cart above to fill in the blanks:

Trail #	Time (s)	Distance (cm)
1	5.5 s	30 cm
2	1 s	
3		5 cm
4		
5		

3. Which trail number landed the closest to the target? _____

4. Which trail has the short amount of time?_____

5. Fill in the following sentences using the vocabulary independent and dependent.

_____ are variables that that we are recoding.

_____ are the variables we chose to change.