Name _____ Date _____ Period _____

Lab: Balloon Rockets and Newton's Laws
CONCEPTUAL PHYSICS: UNIT 1

Background: A rocket's movement depends on ***Newton's Third Law of Motion – For every action there is an equal and opposite reaction***. When a rocket blows out gas at high speed in one direction (action force), the rocket is pushed in the opposite direction (reaction force). In other words, when there is a force on one thing in one direction, another force is acting on something else in another direction. The gas pushes against the rocket and the rocket pushes back just as hard against the gas.

Objective: To have a balloon travel over a measured distance in the shortest possible time. The balloon will be attached to a soda straw. The soda straw will have a length of string running through it. The balloon will then travel along a length of fishing line or thread after being filled with air, and the air inside then being allowed to escape. Somehow, you must come up with a way for your balloon to travel from start to finish in the quickest way possible using only the pressure of air inside it to propel it forward. You may also modify the balloon using the materials listed.

Problem: What design would produce the fastest and longest traveling balloon rocket? Write your hypothesis on what would make the best design below before you begin experimenting.

Hypothesis :

Materials:
- balloon
- string/fishing line
- stopwatch
- scissors, tape
- Clothes pins
- Straw
- Sheets of paper
- Paper clips
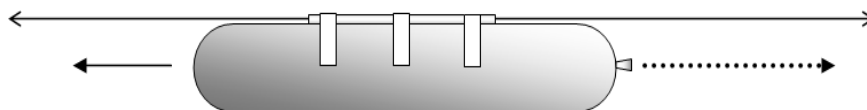
Procedure:

1. Using the materials available, design and construct a balloon rocket.

2. Blow up the balloon and clamp it shut with the clothespin again.

3. Thread the string through the drinking straw. Tape the long side of the balloon along the length of the straw.

4. Have two people hold the ends of the string. Make sure the string is stretched tight.

5. Slide the balloon-straw system down the string until the clamped end reaches the end of the string held by a person.

6. Release the clothespin. Record your observations. Complete at least 4 trials and record.

7. Blow up the balloon and repeat steps 5 and 6 but this time only fill the balloon half full of air. Repeat 4 times and record your data in the data table

8. Calculate average distance traveled and average speeds for each test in the table below.

9. Answer the conclusion questions after you have completed the data table

DATA TABLE

Balloon filled with air			
Trial	Distance traveled (m)	Time (s)	Average speed
1			
2			
3			
4			
AVE.			

Balloon half-filled with air			
Trial	Distance traveled (m)	Time (s)	Average speed
1			
2			
3			
4			
Ave.			

Conclusion Questions:

1. What is the action force in this investigation?

2. What is the reaction force in this investigation?

3. Draw a diagram of your balloon rocket and label forces acting on it.

4. What other forces were acting on your balloon rocket?

5. What happened when the amount of force (amount of air in the balloon) was changed?

6.How did your results compare to other students designs?

7. How might you modify your design to make it travel further and faster?

9. What do you think would happen if your balloon had twice the mass when you launched it? Answer the question using Newton's First and Second Laws.

10. Tape some pennies onto your balloon to increase its mass and see if your hypothesis in question #9 was correct. How did the distance and average speed compare? Explain.

11. What if you had set your string vertically instead of horizontally when you conducted your experiment. Would it have traveled the same distance with the same speed? Draw a diagram and show vectors describing all forces at play.

12. Describe the motion of your balloon rockets in terms of potential and kinetic energy when the balloon was half filled and fully filled with air.

13. Using the data you collected, could you determine the initial potential energies in the balloon rockets? What other value would you need to make this calculation?

14. Was all of the initial potential energy in the balloon rockets converted to kinetic energy? Explain

15. Which of your balloon rockets provided the most power? Explain using equation $P = \dfrac{W}{t}$