Lab Group Members_____

Subject _____

Balloon Racers

LUNG CAPACITY LAB

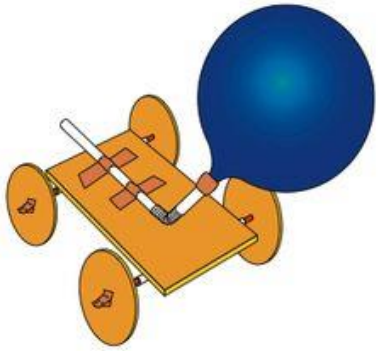
When blowing up a balloon, most usually take 2-3 deep breaths to get the balloon to maximum size. This is using vital lung capacity! In this activity, you will design, build, try, and test a balloon car design of your choice. The air that streams out of the balloon pushes it in the opposite direction of the airflow. This is called propulsion (and Newton's 3rd Law of Motion). Design the car for smooth travel in a straight line. Then, you will manipulate the volume of air in the balloon and measure the distance the car travels. Measure and record traveling distance. Graph results. You will then race your model against your classmates!

Observe:

Tidal volume – the amount of air your lungs hold during normal breathing.
Vital capacity – the amount of air exhaled in one breath; the maximum amount of air forcibly exhaled after breathing in as much as possible.
Newton's 3rd Law of Motion – for every action, there is an equal yet opposite reaction.

Objectives:

- Measure Lung Capacity
- Create a balloon powered race car for maximum distance
- Incorporate Newton's Laws of Motion
- Graph volume versus distance



Materials Provided:

- Design Brainstorming Template
- Measuring Tape
- Balloons + Straws
- Lab Report + Rubric
- Graphing Template
- Hot glue guns

Below are just a few suggestions for building materials. You can use ideas of your own! HINT: Do not use CDs or DVDs; they rarely work well.

- Toilet paper roll
- Small cardboard cartons
- Popsicle sticks or craft sticks
- Cardstock, foam board, cardboard
- Plastic bottles
- Straws
- Skewers
- Duct tape, hot glue, masking tape
- Plastic bottle caps, checkers, Lego wheels

RULES:

- The car can have only ONE balloon.
- The car must have a minimum of 3 wheels.
- It cannot leave the ground!

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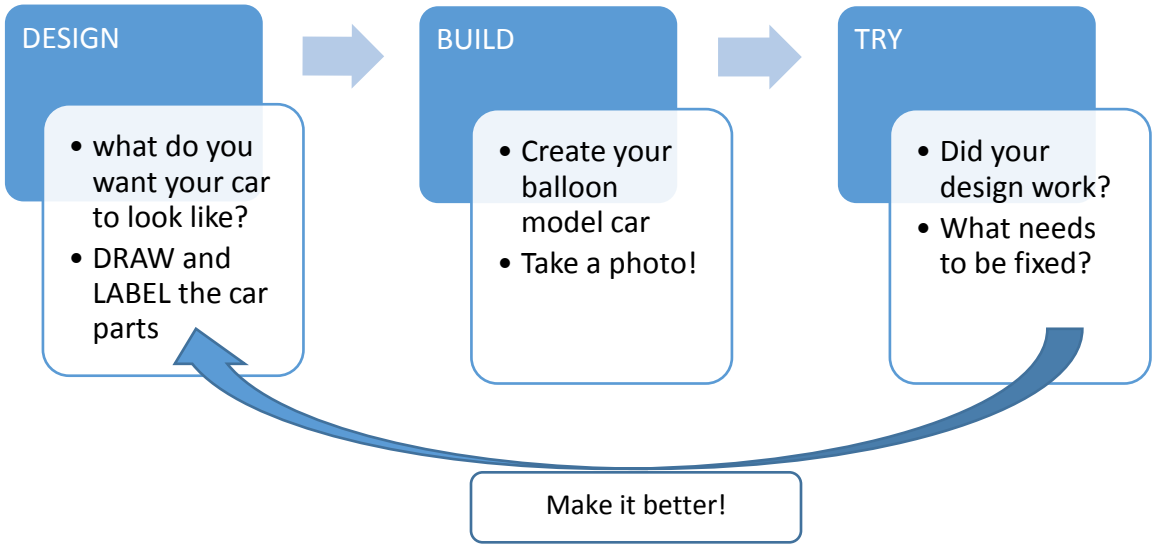
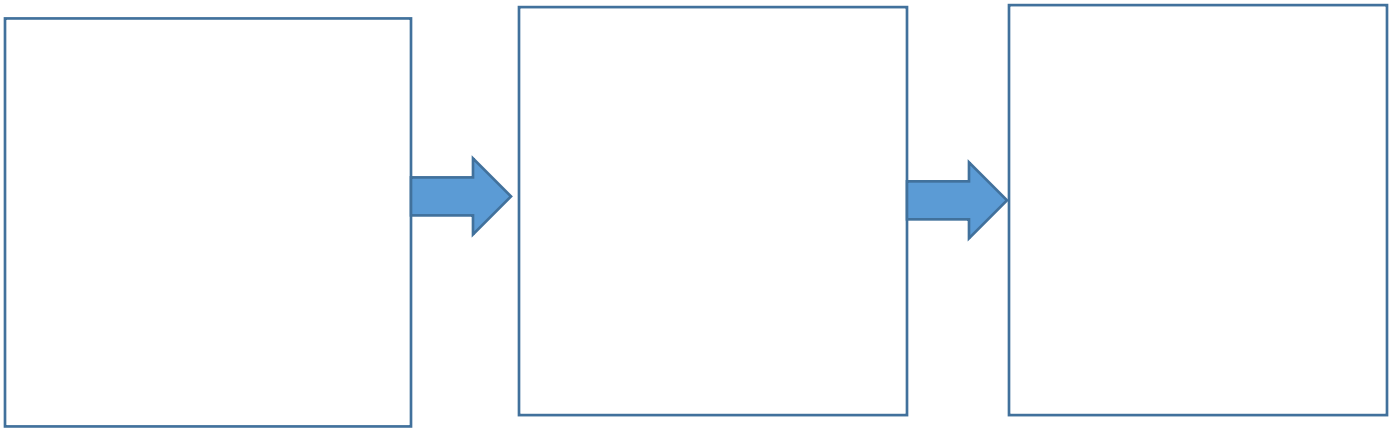
METHOD:

Brainstorming Ideas- Design, Build, & Try:

Using the design process, draw, build, and tryout out your model car. You must identify (label) the materials used in the sketch(es).



Design 1: Prototype Drawing | Car Model Photo | Any Changes?



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1. **HYPOTHESIS: Circle one.**
   If the *balloon volume increases*, then the distance will (**increase, decrease, or remain the same**).

2. **Procedure (Measure and Record Observations):**
   a. Place the measuring tape on the floor to measure at least up to 500 centimeters.
   b. Blow up the balloon with one deep breath (vital capacity), then pinch the straw closed.
   c. Put the car on the ground at the start of the measuring tape, release the straw, and measure the car's distance traveled! Hopefully, it runs straight. Otherwise, you have some adjustments to make.
   d. Using the Complex Data below, measure and record distance the car travels in **centimeters.**
   e. Repeat the steps for balloon volumes of 2, 3, and up to 4 breaths.
   f. The volume of the balloon is equal to the Lung Volume. A correlating graph is on the last page. However, for this lab you will graph Balloon Volume versus Distance.

Title _____

Volume of Balloon (cm)	Distance the car travels (cm)					
	T1	T2	T3	T4	T5	Average

1. **Graph the Data:** On graph paper, graph your results. **Title -** The Effect of (IV) on (DV)
2. **Reflection Questions: Answer all questions below.**

   a. When you blow up the balloon, the volume relates to your lung capacity. Is this **Tidal Volume or Vital Capacity**?
   b. Did friction or drag slow down your car? What changes could you make to your car to make it go faster? _____Did any other design issue prevent your car from traveling straight or far?_____
   c. How many "breaths" did it take to blow up the balloon?_____
   d. Which balloon volume made the car go the farthest? _____
   e. Define **Asthma**:
   f. Define **Bronchitis**:
   g. How would this experiment have been different for someone with asthma or bronchitis?

BONUS: Using the Lung Capacity graph on the rubric, your 26 cm balloon volume equals _____ (cm3) lung capacity.

Lab Group Members_____

Subject _____

BALLON RACER PROJECT: RUBRIC

_____/ 2.5 points Hypothesis

_____/ 25 Design + Construction Photos

_____/ 10 Completed Data Table _____/ 10 Completed Graph _____ / 5 Past tense Conclusion

_____/ 7.5 Daily Participation

_____/ 5 Car moved in a straight line

_____/ 5 Followed the Rules OR _____ Car Disqualified

_____/ 5 Bonus: Car made from scratch (did not use manufactured car or car wheels)

_____ Not turned in/ Incomplete

Comments:

Student Signature: Date:

Extended learning: Calculate your True Vital Capacity!

From "Ask the Van" University of Illinois Department of Physics

The average 14 year old teenager is about 160 cm tall.

V is vital lung capacity in liters of air

h is height in centimeters

a is age in years

So h=160 and a=14. This gives us a vital lung capacity of about 3.6 liters. **Calculate your own Vital Capacity:**

V = (0.041*h) **-** (0.018*a) **-** 2.69

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