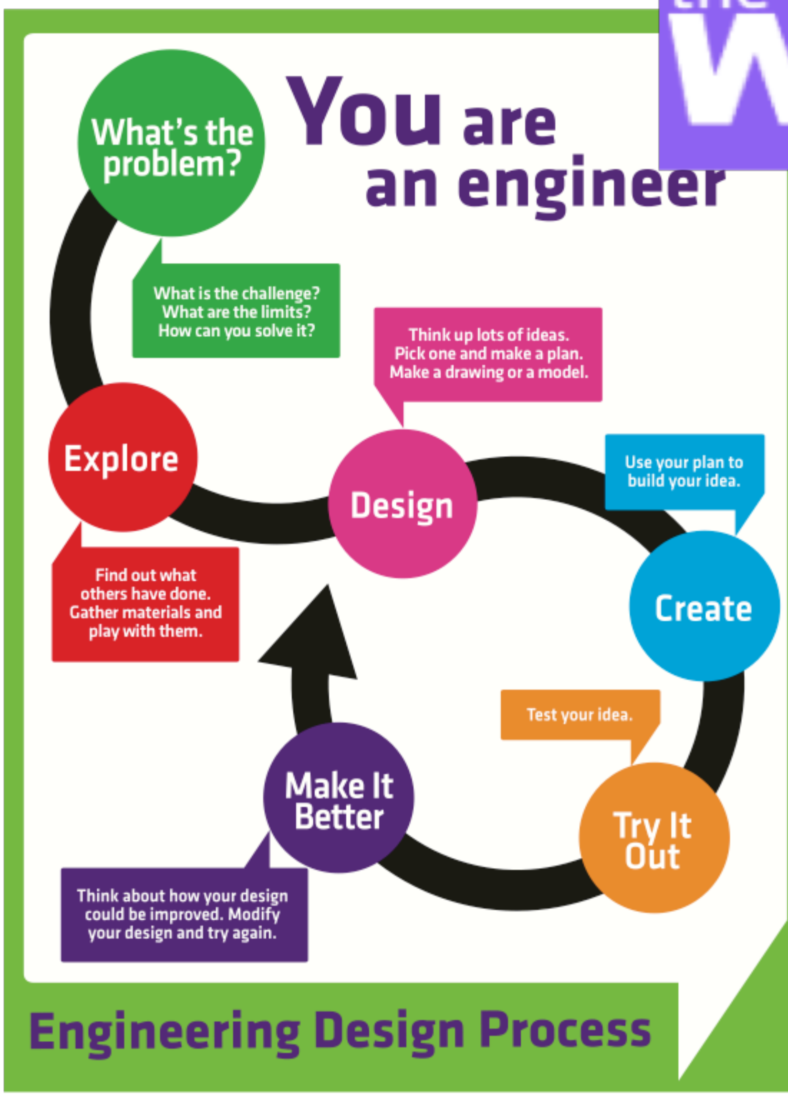
Let's Rock-et!

the Works



Name: ___________________________________

Date: ________________ Grade: ____ Section: ___

Let's Rock-et Project

DESIGN CHALLENGE

Design and build a bottle rocket that will fly straight, reach the highest altitude possible, and return safely to Earth.

Criteria

Your rocket must...

- be made from a 2- liter plastic soda bottle
- have at least three fins attached to its body
- fit on the launcher
- be capable of multiple launches
- have a recovery (parachute) systems

Constraints

Your rocket must stay within these limitations:

- fins cannot extend below the neck of the bottle (where it begins to narrow).
- the rocket cannot have any parts that could cause injury

Approved Materia

- 2 liter plastic bottle
- tape
- cardboard
- ping-pong balls
- tennis balls
- string
- duct tape
- masking tape
- plastic bags
- straws

NOTE: Keep track of and safeguard all materials. **Points will be lost if replacement parts are needed.**

Key Points

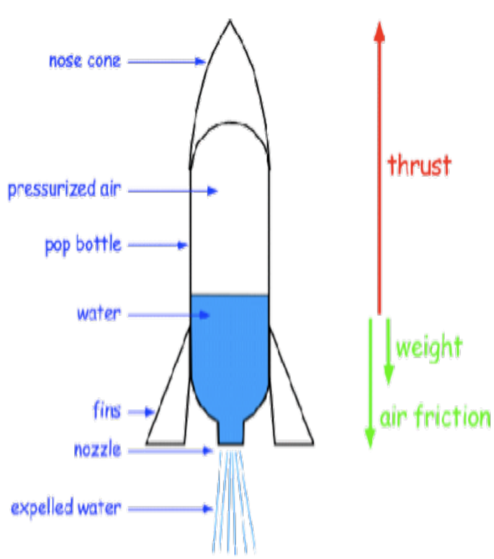
- The bottle cannot be cut, punctured, or damaged in any way or the rocket will not hold the air pressure. Can you blow up a balloon that has a hole in it?

Key Terms

- **Drag:** the force that slows down or prevents an object from moving.
- **Lift:** the force that lifts an object from the ground
- **Thrust: t**he force that propels or pushes an object forward.

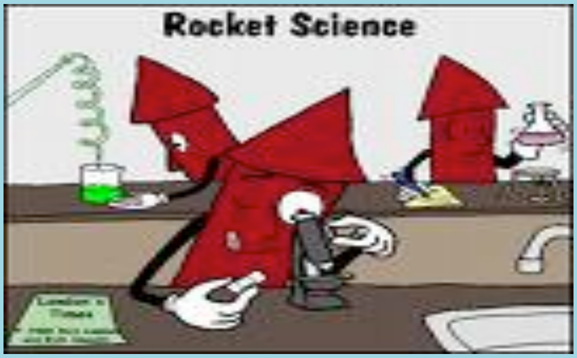
Class Competition

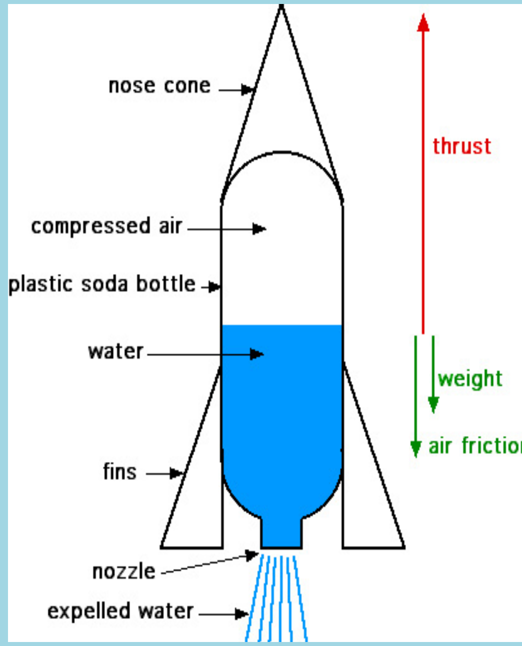
- Rockets will be judged on how high and straight it flies. Two spotters will measure altitude.
- Water may be added to the rocket prior to launch. The amount is to be determined by he students.
- Each team is responsible for getting its own data. A member of the student team that built the rocket must launch the rocket.
- Rockets will fill with a maximum of 90 psi of air.



It really is "Rocket Science"

Rockets use Newton's 3rd Law of Motion: *"for every action there is an equal and opposite reaction"* to blast off. Follow the steps and suggestions below and you should have an easy time building your rocket.

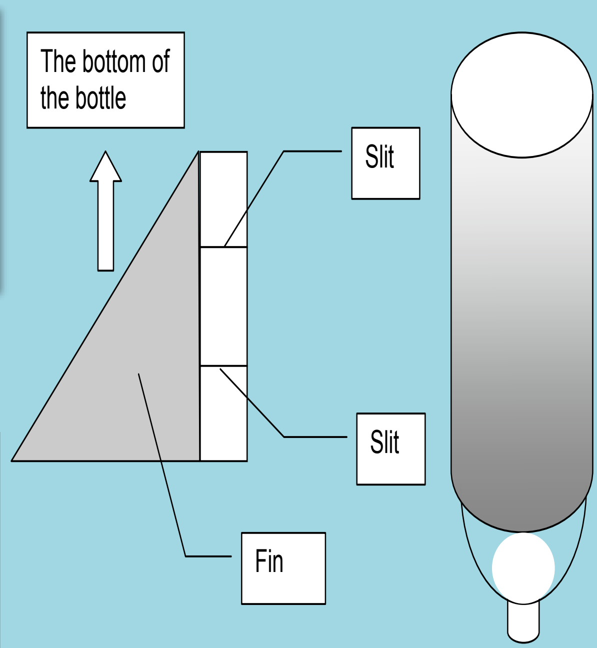




STEP 1:

Draw a picture of your rocket fin on a piece of cardboard. Fins on a rocket, like feathers on an arrow, help keep the rocket going straight and keep the front end facing forward. **The bigger your fins, the more likely your rocket will go straight.** However, the bigger the fins, the slower your rocket will go.

When drawing the fin, leave one or two inches of cardboard that you can attach to the side of the rocket. If you cut two small slits into the extra part, it helps stabilize the fin when you put it on the rocket. The shape to the right is an example >>>>>>>>>>>>>>>>>>>>>>>>>>>



STEP 2:
Now cut out the fin. Use this first fin as a template for the other tail fins.

Decide if you would like 2, 3 or 4 fins and make that many fins.

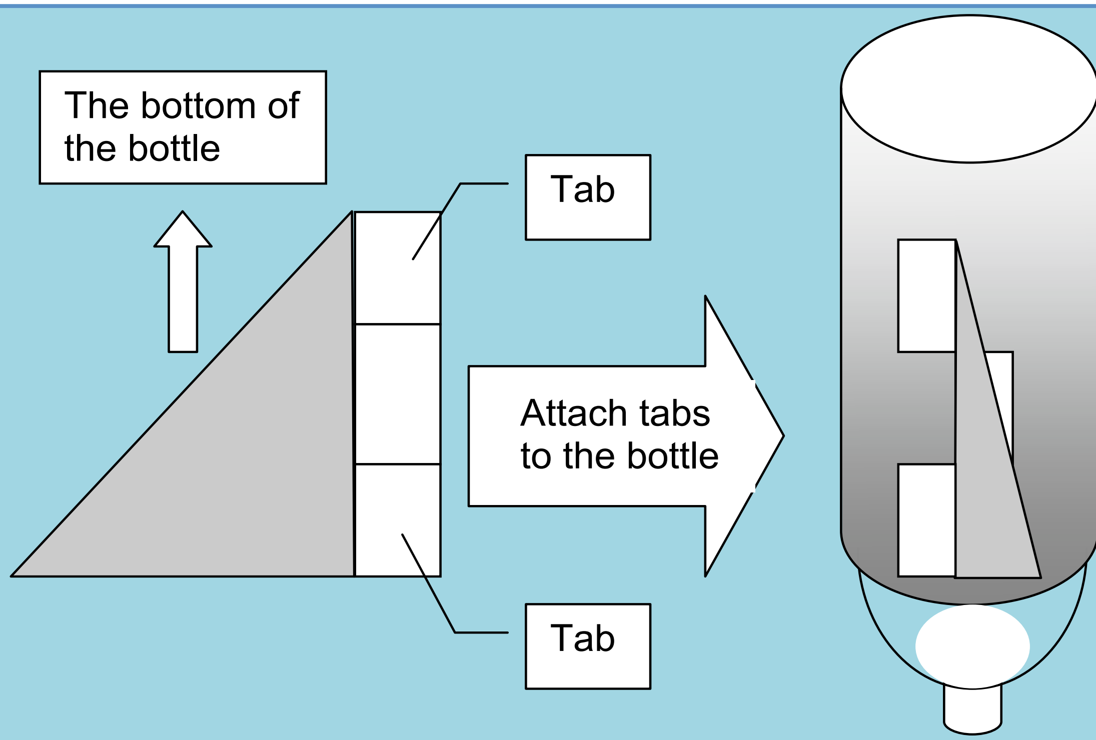
- Fins should be firm and secure. If they flop around they are useless.
- The best fins are made of rigid cardboard.
- The size of the fin does matter!

The best rockets fly well with long and narrow fins.

STEP 3:
Now attach the fins to the side of the rocket. Remember, the bottom of the bottle will become the top of the rocket so make sure the point end points toward the bottom of the bottle and flat end is toward the top of the bottle (see figure below.) The fins should be closer to the bottom of the rocket than the top.

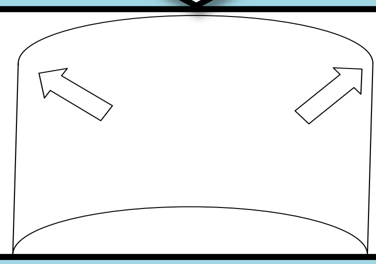
Figure out where you would like to put your fin. Spread the fin sections out so that they are flush against the side of the bottle as in the figure below. Tape or glue the tabs to the side of the bottle. Repeat this step for all your fins spacing them out evenly around the bottle.

The fins need to be about **<u>3 cm above</u>** the rocket's nozzle (the part of the bottle where the cap screws on).



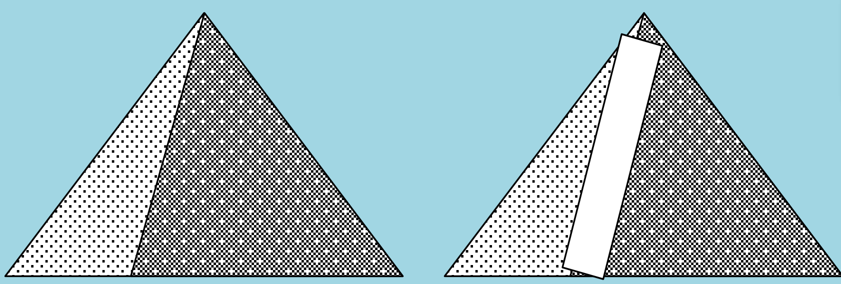
✔ Rocket mass **<u>must not exceed 350 grams</u>** (without water).

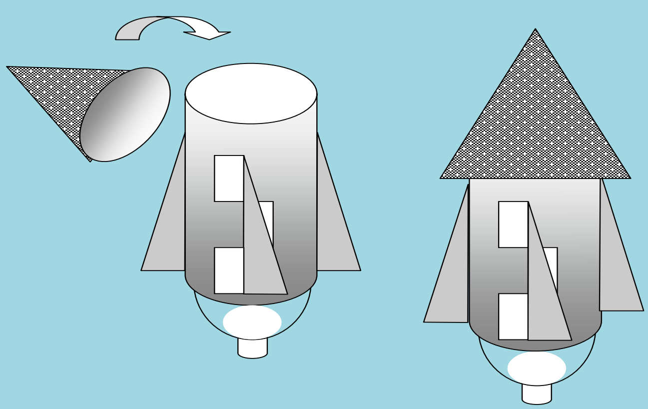
STEP 4:
Now take the card stock/thin cardboard and hold it sideways as shown in the picture below:



STEP 4 (Continued)
Now take the top two corners (the corners pointed to in the picture) and bring them together. Overlap them a little bit but be careful because if you overlap too much, the cone may not fit on the top of the rocket. You should now have a cone aerodynamics and allow it to move smoothly through the air).

(Nose cones are used to help the rocket's to help the rocket's aerodynamics and allow it to move smoothly through the air). Take the scissors and cut around the base of the cone so that it is even.

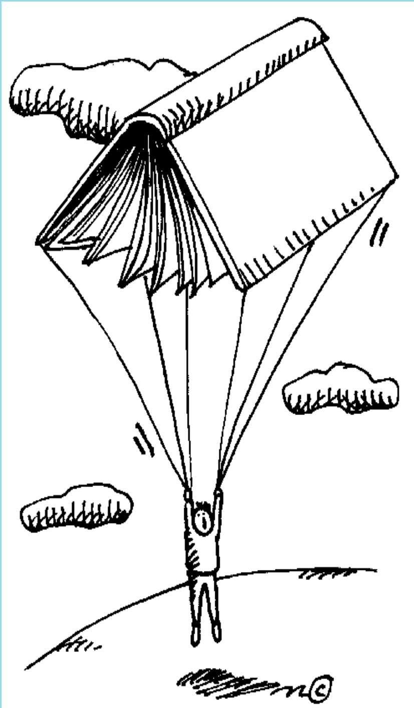




STEP 5:
Attach the inside of the cone to the top of the bottle using glue or tape.

✔ **IMPORTANT!** If your rocket's "pressure bottle" has even a microscopic pinhole in it, it won't go one centimeter off the launch pad.

PARACHUTE SYSTEMS



It may not be completely obvious to you yet, but as the old saying goes, what goes up... must come down. It's time to think about saving all your hard work by creating a recovery system for your rocket.

The size and shape of your parachute can be as varied as your rocket. A good rule of thumb is to make your chute 15 to 13 cm across depending on a 1 or 2 liter bottle. Your chute could be larger but some rocket styles have narrow nosecones and the chute could get stuck.

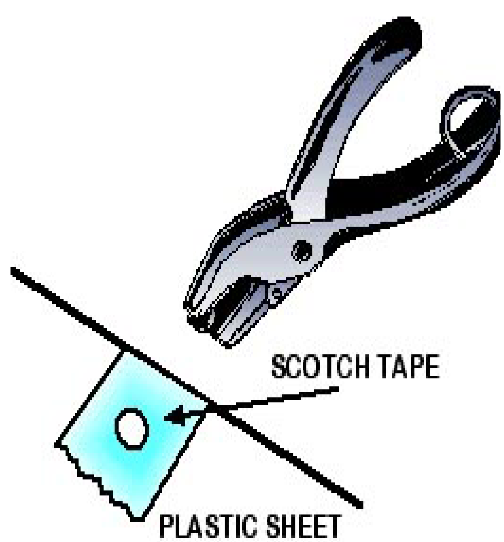
Suggested Materials:

-Plastic garbage/grocery bags
-Tape
-Ping-pong balls
- Kite string
-Tennis/whiffle ball
-Paper/plastic cups

The Square Chute

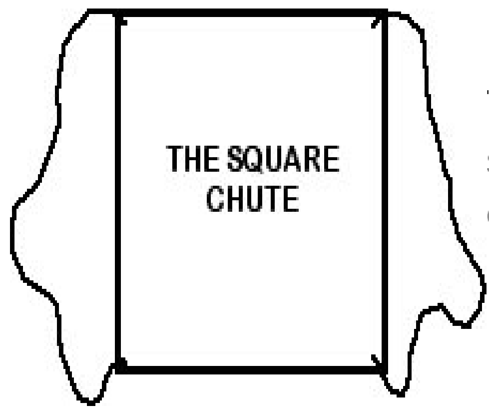
The simplest chute to make is the "Square Chute". Prepare the edges, where you will connect the strings, with tape grommets. First apply a piece of tape to both sides of the plastic. Then, with a hole punch, punch a clean hole through the center of the tape and plastic tab. Repeat this procedure for each location where you are placing a string.

Continued >>



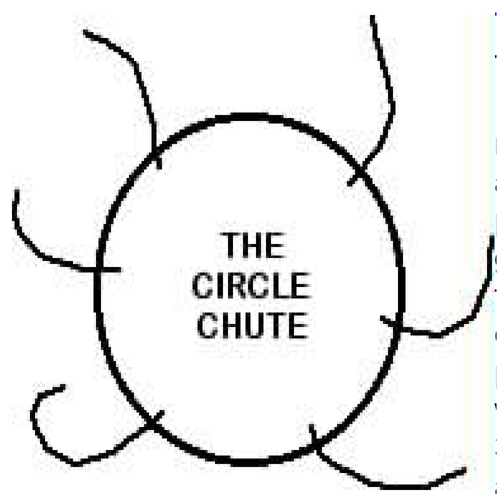
-Continued-

To complete the "Square Chute", measure two 60 cm lengths of string and tie each end to one of the grommet holes. Bring the centers of the string loops together and tie them off.



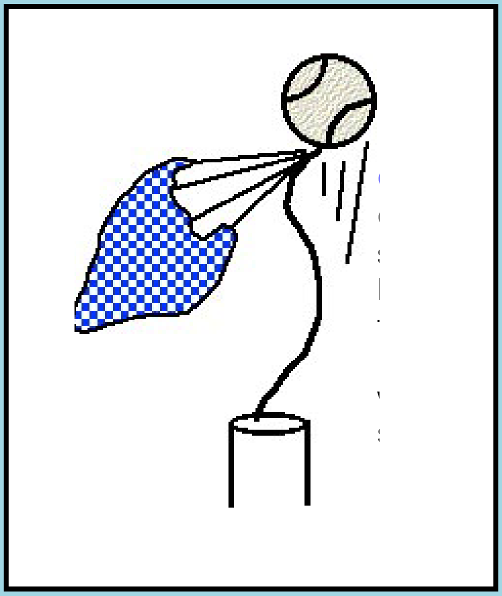
The Circle Chute

Trace the circle on the plastic with a marker and cut. If you don't have anything large enough to trace, fold the plastic in half, then in half again, then fold on the diagonal. This will give you a triangular wedge. With a sharp pair of scissors, cut along the section that has the open edges. You don't have to worry about cutting on the curve, just cut strait across the bottom. Finish the edges with tape grommets as mentioned above, Tie the string leads to each grommet and then gather them all together in a secure knot.



The Nose Cone Chute

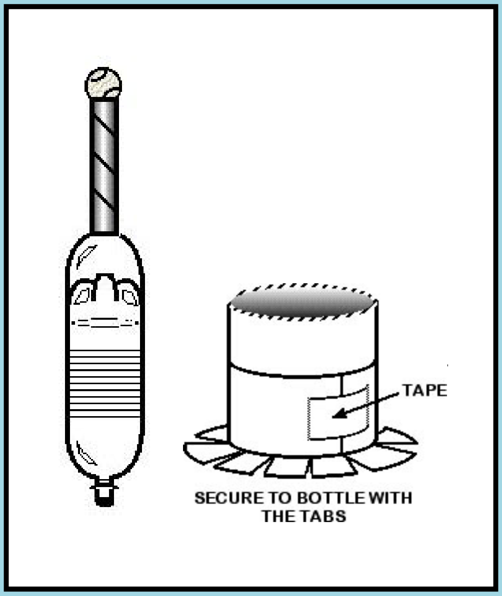
This parachute uses the force of the lifting nose cone to pull the chute out of the sleeve or needle assembly. Attach a safety line to the nose cone or tennis ball. Attach a parachute close to the cone/ball assembly. The chute needs to be folded small enough to fit inside the needle yet not too tight. It's important to have enough line to allow the parachute to unravel. Packing is also important as the line can easily get tangled and malfunction in flight.



The Space Needle

This one can be made from a **spare bottle, empty paper towel roll, and a tennis ball or ping-pong ball**. This type of nose cone adds a great deal of inertial mass to the rocket and makes it really stable. Simply, attach the towel roll to the top of the nose cone and then fix the tennis ball to the top of the roll. Take your time building this set up because you want the entire assembly to be straight as an arrow.

Cut tabs in an index card and glue it to the tube to hold it upright. Then tape the tabs onto the nose cone top.



IDENTIFY THE PROBLEM

In your own words... state what you've been asked to do.

I have been asked to ____ that will

____

Look at the rubric for this project on the last page and then answer the next two questions.

1. Which goal do you think will be the most challenging? ____________________________________

2. What's ONE strategy you can try to overcome it? ____

____

DEVELOP POSSIBLE SOLUTIONS

In the boxes below, draw six (6) **different versions** of what your design might look like. It's very important to label the drawings to help me understand your thinking.

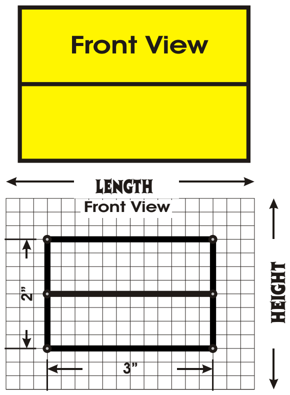
Prototype #1	Prototype #2

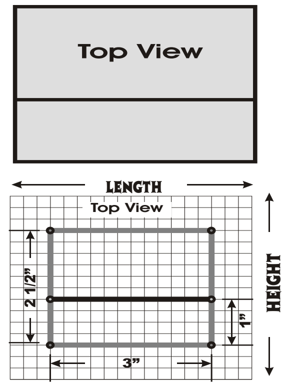
Prototype #3	Prototype #4

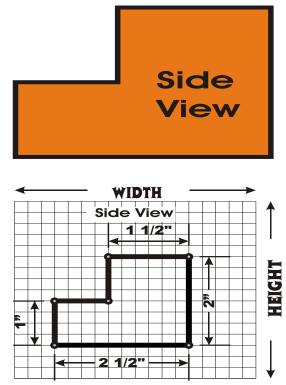
Prototype #5	Prototype #6

CHOOSE A SOLUTION

You need to create clear, specific and labeled drawings (using rulers and other drawing instruments) from three different views (front, top and side). Draw the designs in **centimeters** and **label the dimensions**. **You will not be able to begin construction until this drawing is completed. Teacher's initial are required for approval.** Follow the examples below.







Production Drawings

Front View

Top View

Materials Needed

Tools Needed

Side View

CHOOSE A SOLUTION

Identify which prototype you've chosen to make and explain why. *If you really can't describe it to me and tell me why this prototype is insanely great, you shouldn't be building it.*

A paragraph has a beginning a middle and an end.
*The **beginning,** or the topic sentence, states what the paragraph is about.*

*The **middle** develops the idea in detail by giving specific support & details for it (usually 3 - 5).*

*The **end** (conclusion) restates the main idea in the topic sentence.*

ENGINEERING YOUR PROTOTYPE

All transportation vehicles have sub-systems or parts that work together to make them go. The scooter on the right has a motor for **PROPULSION,** a handle bar for **GUIDANCE**, a hand brake for **CONTROL** and a wheel for **SUSPENSION**.

A) Identify each of the same sub-systems parts in your prototype

PROPULSION: ______________________________________

GUIDANCE: ____

CONTROL: ____

SUSPENSION: ______________________________________

DRAG the force that slows down or prevents an object from moving.

B) Which of the vehicles below will likely produce the **least** drag? _____

A.

B.

C.

D.

C) How are you going to reduce drag in the design and building of your prototype? (Complete sent.)

____

____

____

____

____

____

____

____

____

____

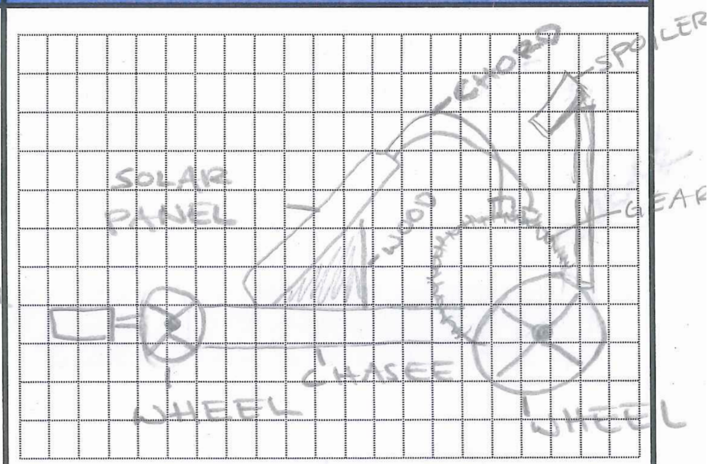
____

____

____

____

EXAMPLE

On the lines below, describe what you did. Mention any difficulties you had or any design changes you made.	Make a labeled sketch that shows what you did.
LOG #5: Date: 5/3/12 Today, I finished attaching the motor. I had a hard time w/ the gears because the the gear with the gray motor is so big so I changed it to a little smaller instead. I also used a velcro instead of gluing the motor on the car. Today my car is fe-	
❑ **YES** I described the drawing in a clear and understandable way ❑ **YES** I used key terms and information to accurately describe my progress and drawing. I have enough information. ❑ **YES** My description is neatly written and legible.	❑ **YES** My drawing is large enough to show all the details. ❑ **YES** My line quality is sharp and precise (no smudges) ❑ **YES** My labels are outside the drawing and accurate ❑ **YES** My drawing uses shading for highlights

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #1 Date: ___________________ ____________________ ____________________ ____________________ ____________________ ____________________ ____________________ ____________________ ____________________ ____________________ ____________________ ____________________	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #2 Date: ____________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #3 Date: ____________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #4 Date: ___________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions..	Make a labeled sketch that shows what you did.
LOG #5 Date: ___________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

ROCKET FLIGHT DATA							
Trial	Altitude (m)	Pressure (psi.)	Amount of water (ml)	Flew straight w/o tumbling or wobbling	Rocket tumbled or wobbled; did not fly straight	Parachute deployed for a "soft" landing	Rocket or parachute did not function correctly
1							
2							
3							
4							
5							

Things that worked or went well

1. ______________________________
2. ______________________________
3. ______________________________

Things that did not work or go well

1. ______________________________
2. ______________________________
3. ______________________________

Things that I redesigned (changed)

1. ______________________________
2. ______________________________
3. ______________________________

What the changes did

1. ______________________________
2. ______________________________
3. ______________________________

Things I'd do differently next time

1. ______________________________
2. ______________________________
3. ______________________________

What these might do

1. ______________________________
2. ______________________________
3. ______________________________

Bottle Rocket Project

GOAL #1: I CAN use and follow the engineering design process in my design brief to solve problems about transportation technology.				
This is how I'll do it...				
***a.** I will make a collection of concept drawings that shows different ways to solve a transportation problem.*				
0	1	2	3	4
***b.** I will make three-view drawings of my "best idea" with measurements & labels that others can follow.*				
0	1	2	3	4
***c.** I will have an explanation for my "best idea" with specific reasons and supporting details.*				
0	1	2	3	4
***d.** I will create a written response to an open response question about transportation technology.*				
0	1	2	3	4
***e.** I will keep track of my progress and design changes by completing engineering logs during the project.*				
Engineering Log #1				
0	1	2	3	4
Engineering Log #2				
0	1	2	3	4
Engineering Log #3				
0	1	2	3	4
Engineering Log #4				
0	1	2	3	4
Engineering Log #5				
0	1	2	3	4
***f.** I will collect and display data about my prototype and use it to evaluate how well it worked.*				
0	1	2	3	4
Final Score				

GOAL#2: I CAN choose, use and keep track of tools and materials and have good reasons for using them.				
This is how I'll do it...				
***a.** I will wear safety goggles and follow all safety procedures in the workshop.*				
0	1	2	3	4
***b.** I'll keep track of my materials and not need any replacement parts.*				
0	1	2	3	4
***c.** I will clean up my work space and put tools and materials back where they belong.*				
0	1	2	3	4
Final Score				

GOAL#3: I CAN use tools and materials to build a prototype that works.				
This is how I'll do it...				
***a.** I will follow my building guide and make a bottle rocket that* will fly straight, reach the highest altitude possible, and return safely to Earth.				
0	1	2	3	4
***b.** I will build a prototype that looks like a finished product without any loose parts, damaged or rough surfaces, dents, gouges or globs of glue.*				
0	1	2	3	4
***c.** I will build, test and demonstrate a prototype that is sturdy, holds together and doesn't need repairs between multiple uses.*				
0	1	2	3	4
Final Score				

Comments: