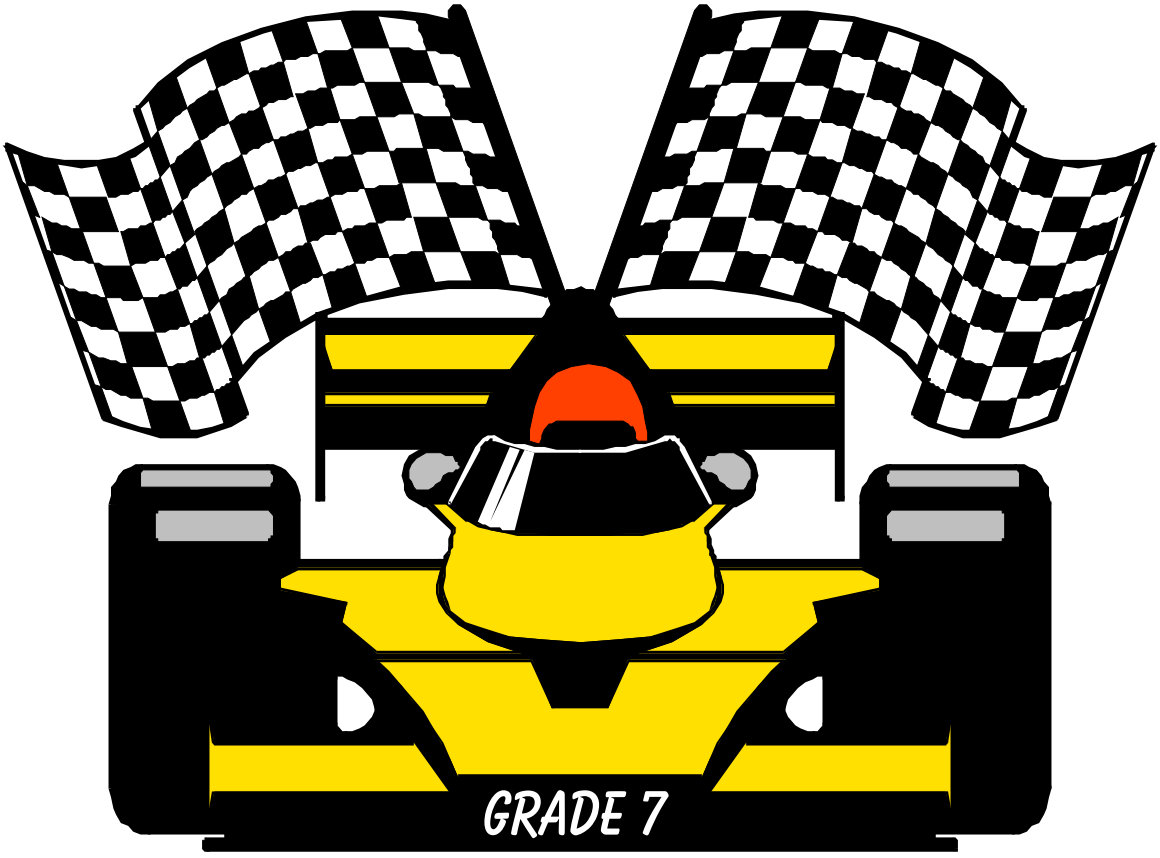
Engineering Technology

SHOW, SHINE $ DRAG



BIGELOW

MIDDLE SCHOOL
Newton, MA

TECHNOLOGY EDUCATION

09-19-06

INTRODUCTION

In this unit you will be challenged to design, build, and race your own CO2 powered dragster. The car you will build is a fully functional, miniature, rocket-powered dragster. And boy-oh-boy do they go fast! When race car drivers and automobile designers begin to design new cars they have to start somewhere. They start small by designing and making scale-models, then as they progress and make alterations, they move on to the full size car. The dragsters we will build are small replicas of the full-sized NHRA drag racers that you might have seen on TV. Can you think of a reason why engineers build small-scale models before they build one the actual size?

You will have the opportunity to design your car for SHOW, SPEED, AERODYNAMICS, or all three! As you design and build your dragster, do not cut corners. It will have a better chance of going fast and looking good, if you design it to the fullest of your potential.

The Design Process

To make the design process fun and easy, you should design and build your dragster in four easy steps. We call this the "Design Process". First, you will come up with many different ideas for your dragster. Next, you will select one design and refine it until it is just right. After you have worked out all the bugs it's time to build the dragster. The final stage is when you and the other students in your class test the cars for Show, Speed, and Aerodynamics. All cars will be graded for originality, creativity, design, and craftsmanship.

THE DESIGN PROCESS

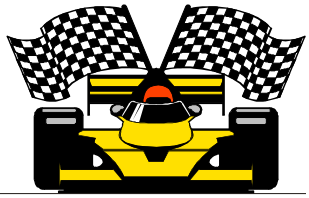
1. **Thumbnails** are small drawings that help you to see how your dragster might look. They may be of the whole car or parts of the car. They are not detailed drawings, just quick sketches to give you ideas.

2. **Rough Sketches** are more detailed than thumbnails. They usually show the car from many views (front, top, and side). They should be larger drawings of what you want your final design to look like.

3. **Final Drawings** show all the details you will need to build your dragster. They should be drawn to exact size or to scale. You will draw these on grid paper to use as a pattern later on. These drawings will serve as your "working drawings".

4. **Construct** your dragster with the best craftsmanship you can. Take pride in your work!

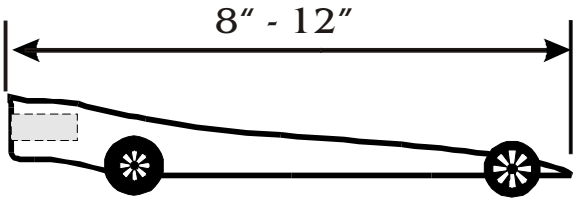
DESIGN LIMITATIONS



Pay close attention to the restrictions listed below. Your car will not quallify, if it does not meet these requirements.

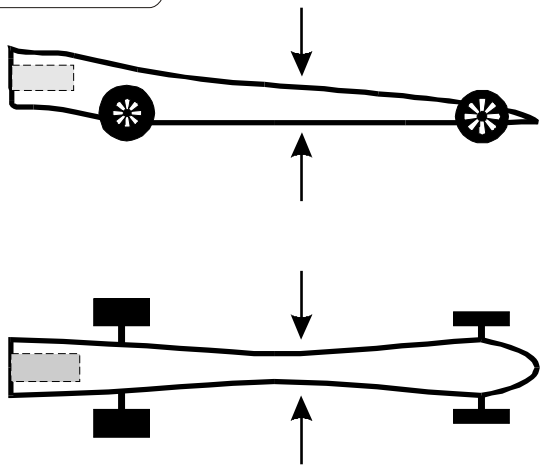
LENGTH & WEIGHT

The minimum length of the car is 8"
The maximum length of the car is 12"
(Show cars - 6" minimum length)



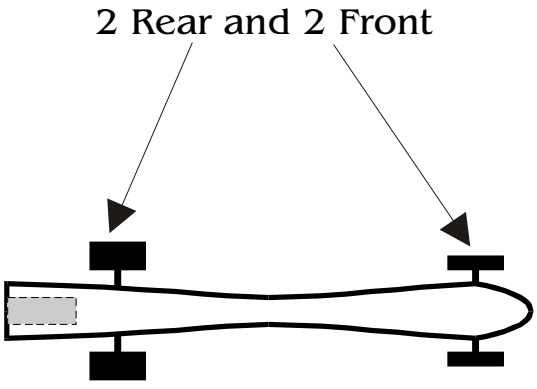
The minimum weight of your assembled car including wheels, axles, and screw eyes cannot exceed 65 grams.

WIDTH



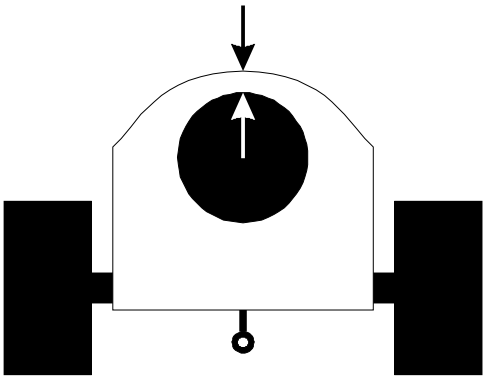
The minimum thickness is 1/2".
The only exceptions are; the front may be tapered and if you have 2 sides.

WHEELS



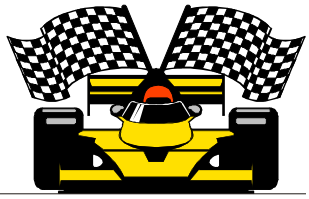
All cars must have 4 wheels.
(2 front and 2 rear)

THICKNESS



The minimum wood thickness around the CO2 hole is 1/8".
Any thinner would be dangerous!

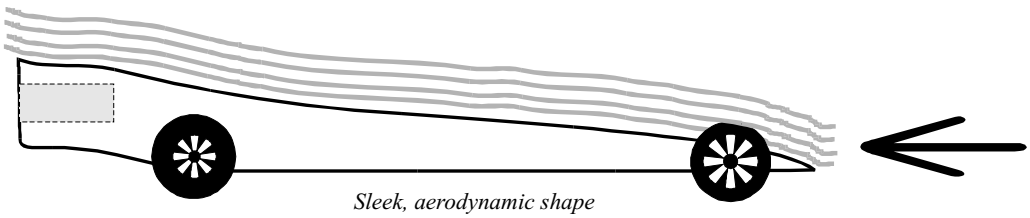
SPEED OR SHOW???



SPEED

If you choose to design your dragster for speed, you must keep a few simple design principles in mind. The first is AERODYNAMICS. Aerodynamics is the study of air flow over and around objects. In order to make your dragster have very little wind resistance, you must design your dragster so the air can travel over and around it with ease. Round edges allow the air to travel over them much easier than square edges. Looking at the drawings below, which of the two do you think would be faster? Which would be more efficient?

DESIGN A



Sleek, aerodynamic shape

DESIGN B

Square and bulky, not very aerodynamic

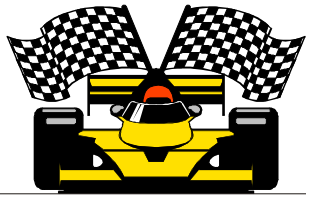
The second design principle is WEIGHT. The lighter you design your car, the faster your car should go. Remember there are some design limitations when it comes to the thickness of the wood. (To assure you are staying within the design limitations, refer to the "Design Limitations" sheet). Try to think of ways of making your car light and aerodynamic at the same time. Don't give up, the better you design - the better your car will turn out!

SHOW

If you choose to design your dragster for SHOW, there are three qualities in which the car will be judged; aesthetics, craftsmanship, and originality. **Aesthetics** is the overall appearance of the car. (Is it visually appealing?) **Craftsmanship** is the quality of work done to the car. (cutting, filing, sanding, paint and finish) **Originality** is how creative you got in designing your car. (If the car looks just like the car used in demonstrations, than you probably did not get very creative!) REMEMBER, the show competition is being judged by adults in the building. Try to design a car that has never been done before. Get crazy with your design, that's part of the fun of it!!!

Name:_____ Class:_____

THUMBNAIL DRAWINGS



Use the space below for your thumbnail drawings. You are required to come up with at least ***10 different*** car designs. Each design should be different and must include a side view and top view for each. If you need more space use the back side of this sheet. ***(Each drawing is worth 10 points)***

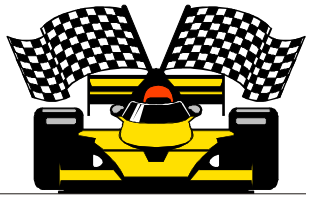
THUMBNAIL DRAWINGS

SIDE VIEWS	TOP VIEWS

GOOD			IMPROVE		
☐	HIGH QUALITY WORK	☐ FOLLOWED DIRECTIONS	☐	SOME POOR IDEAS	☐ WORK IS INCOMPLETE
☐	CREATIVE OR ORIGINAL	☐ WELL THOUGHT OUT	☐	MANY SIMILAR IDEAS	☐ TURNED IN LATE
☐	10 GOOD IDEAS	☐ NEAT WORK	☐	DIDN'T FOLLOW DIRECTIONS	☐ MORE EFFORT NEEDED

Name:_____ **Class:**_____

THUMBNAIL DRAWINGS



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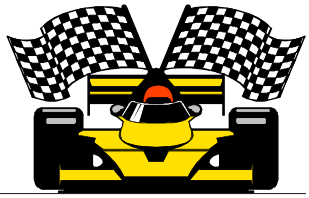
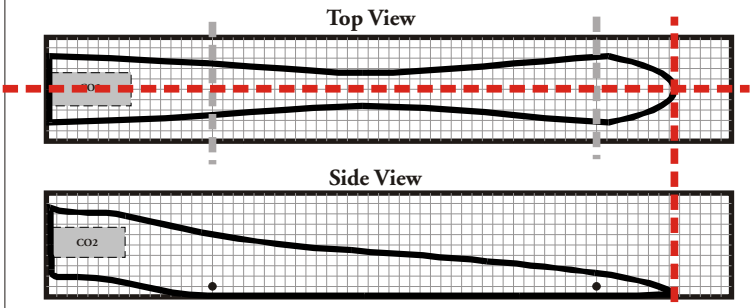
SIDE VIEWS	TOP VIEWS

DRAWING CHECK SHEET



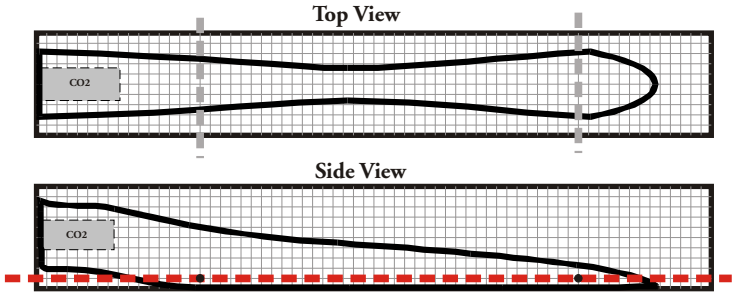
Use the following check sheet to assure you have stayed within the guidelines of the final drawing. ☑ Check off each guideline as you do them.

☐ **Side and Top views should be the same length**

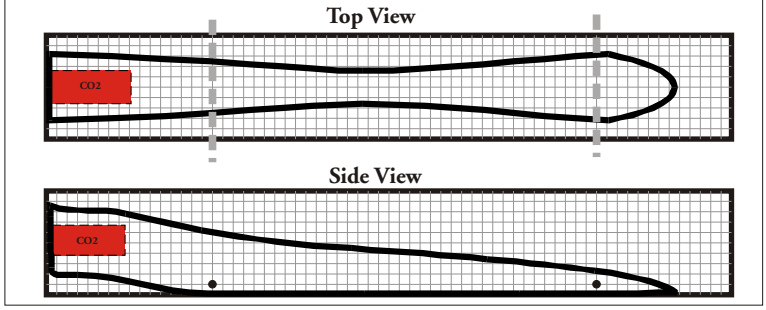


☐ **Top View must be symetrical**

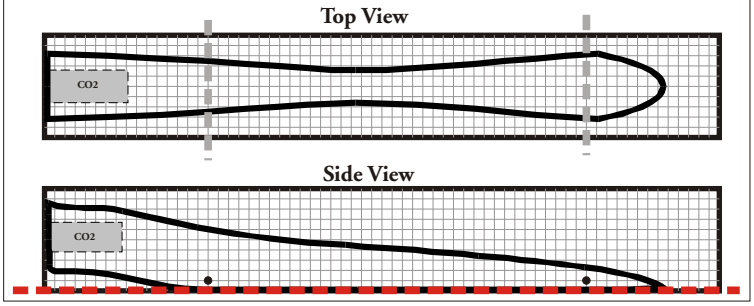
☐ **Wheel axle holes should be 1/4" up from the bottom**



☐ **Each view must include the CO2 hole**

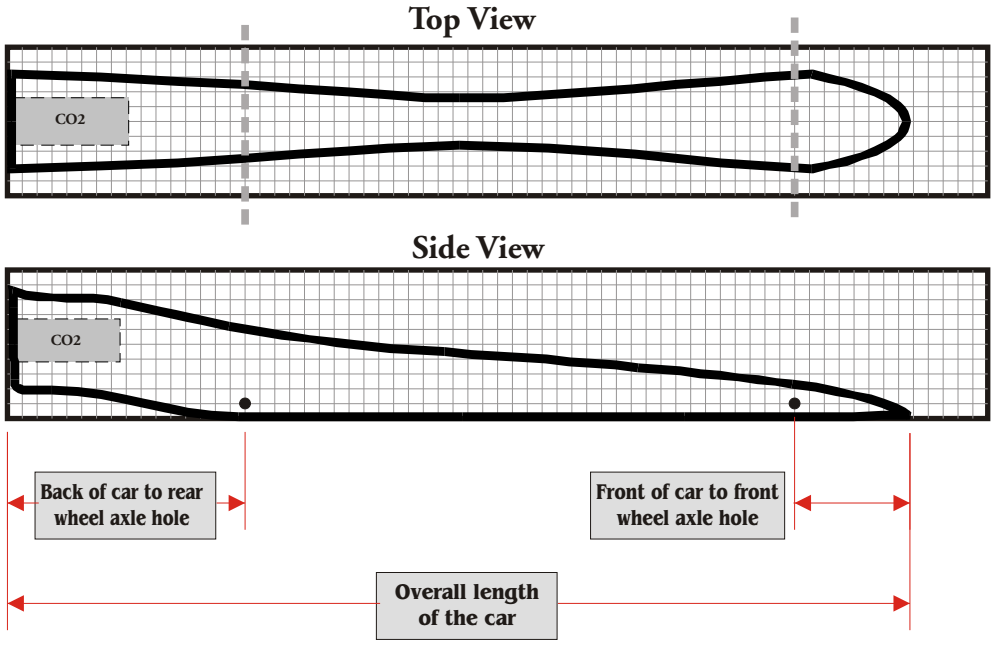


☐ **Side View must touch the bottom of the block**



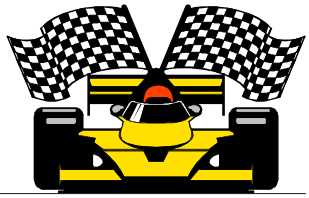
☐ **Dimensions that are needed**

- ☐ Overall length of the car
- ☐ Distance from the back of the car to the rear wheel axle
- ☐ Distance from the front of the car to the rfront wheel axle



Name:_____ Class:_____

ROUGH SKETCHES FOR SPEED



Use the boxes below to Draw three of your best thumbnail sketches with a little more detail. Rough sketches are drawn to scale but are usually smaller than the actual object. You do not need to include dimensions at this stage. These boxes are to scale, so you can get a feel for how the car will look. Include all steps on the **"Drawing Check Sheet"** except for the "**dimensions**". (Remember, rough sketches show details in both top and side views)

Top View

CO2

1 2 3 4 5 6 7 8 9 10 11 12

Side View

CO2

Put wheel axles along this line

Top View

CO2

1 2 3 4 5 6 7 8 9 10 11 12

Side View

CO2

Put wheel axles along this line

Top View

CO2

1 2 3 4 5 6 7 8 9 10 11 12

Side View

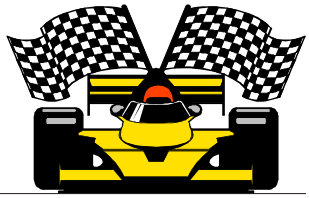
CO2

Put wheel axles along this line

GOOD			IMPROVE		
	☐ HIGH QUALITY WORK	☐ FOLLOWED DIRECTIONS		☐ SOME POOR IDEAS	☐ WORK IS INCOMPLETE
	☐ CREATIVE OR ORIGINAL	☐ WELL THOUGHT OUT		☐ MANY SIMILAR IDEAS	☐ TURNED IN LATE
	☐ 3 GOOD IDEAS	☐ NEAT WORK		☐ DIDN'T FOLLOW DIRECTIONS	☐ MORE EFFORT NEEDED

Name:_____ Class:_____

ROUGH SKETCHES FOR SHOW



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Top View

CO2

1 2 3 4 5 6 7 8 9

Side View

CO2

Put wheel axles along this line

Top View

CO2

1 2 3 4 5 6 7 8 9

Side View

CO2

Put wheel axles along this line

Top View

CO2

1 2 3 4 5 6 7 8 9

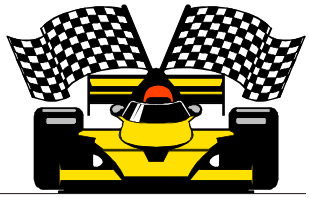
Side View

CO2

Put wheel axles along this line

GOOD			IMPROVE		
☐	HIGH QUALITY WORK	☐ FOLLOWED DIRECTIONS	☐	SOME POOR IDEAS	☐ WORK IS INCOMPLETE
☐	CREATIVE OR ORIGINAL	☐ WELL THOUGHT OUT	☐	MANY SIMILAR IDEAS	☐ TURNED IN LATE
☐	3 GOOD IDEAS	☐ NEAT WORK	☐	DIDN'T FOLLOW DIRECTIONS	☐ MORE EFFORT NEEDED

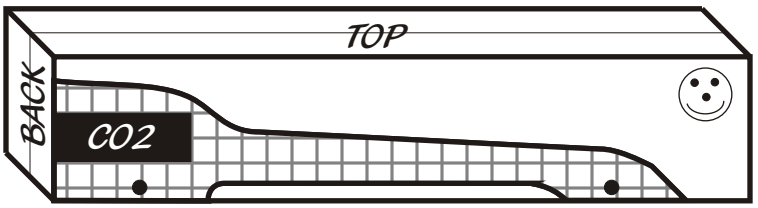
PATTERN LAYOUT



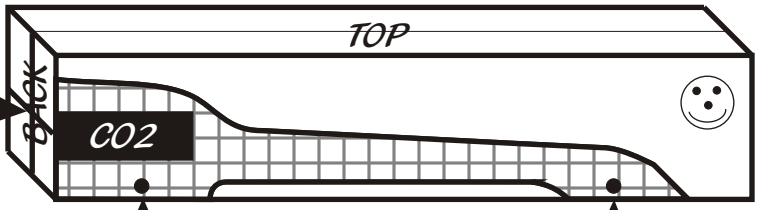
Follow these steps to transfer your final design onto your block of wood. Pay close attention to how the block of wood is oriented.

1. Using a pencil, mark the bottom and the back of your wood. Put a smiley face in the upper right corner of your side view.

2. Cut out your side view drawing and tape it to the right side of your block of wood. Make sure the Co2 hole is to the BACK of the wood and the wheels are to the BOTTOM of the wood. Align the pattern perfectly!

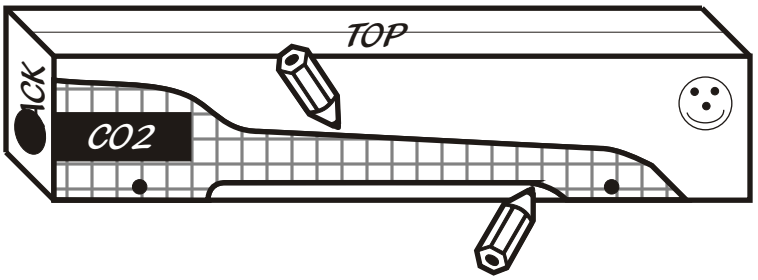


3. Using a Try Square, extend the center line of the CO2 cartridge hole all the way across the back of the wood. Also darken in the vertical glue line to form a large "+" sign. Then drill a 3/4" hole using the bit and brace.

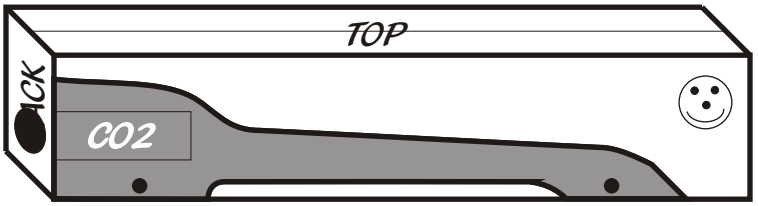


4. Using a 9/64" drill bit, drill the front and rear axle holes all the way through your pattern paper and the wood.

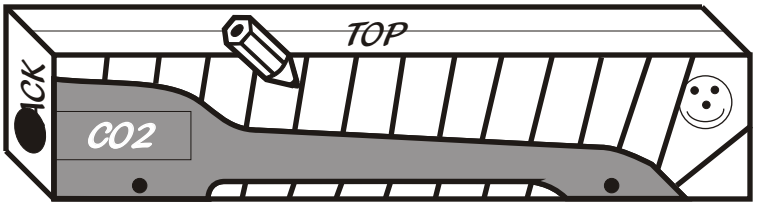
5. Using a pencil, trace the entire right view pattern onto your block of wood. Take your time and draw neatly, these will be the object lines that you will cut!!!



6. Your block of wood should look similar to the example to the right.

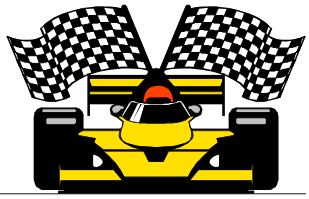


7. Using a pencil, draw a series of "relief" cut lines along every edge of your side view. Space the lines roughly 1/2" apart as you go. We will cut the lines first, before we cut out the car shape.



Name:_____ Class:_____

SPEED CALCULATIONS



The races we have just conducted were timed in FEET PER SECOND. Now we can take our times and convert them into MILES PER HOUR. This will allow us to see how fast our dragsters would be going in real life. Follow these simple steps, to convert feet per second into miles per hour.

1. Write down your time in seconds. TIME IN SECONDS_____

2. Divide the length of the track (65 feet) by your race time. This will give you how many feet per second your car traveled. FEET PER SECOND_____

time) 65

3. Multiply that number (feet per second) times 60. This will give you feet per minute. FEET PER MINUTE_____

4. Multiply that number (feet per minute) times 60. This will give you feet per hour. FEET PER HOUR_____

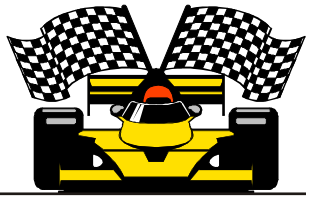
5. Divide that number (feet per hour) by the number of feet in a mile (5,280). This will give you miles per hour (M.P.H.). MILES PER HOUR_____

6. Weigh your car on the scale and record the weight in GRAMS. WEIGHT IN GRAMS_____

7. Test your car for aerodynamics in the Wind Tunnel and record the resistance in GRAMS. AERODYNAMICS_____

Name:_____ Class:_____

AERODYNAMICS WORKSHEET



1. What is the basic principle behind AERODYNAMICS?_____.
   _____.
   _____.

2. A wind tunnel measures _____ and _____.

3. Give three reasons why aerodynamics is an important technology.
   a. _____
   b. _____
   C. _____

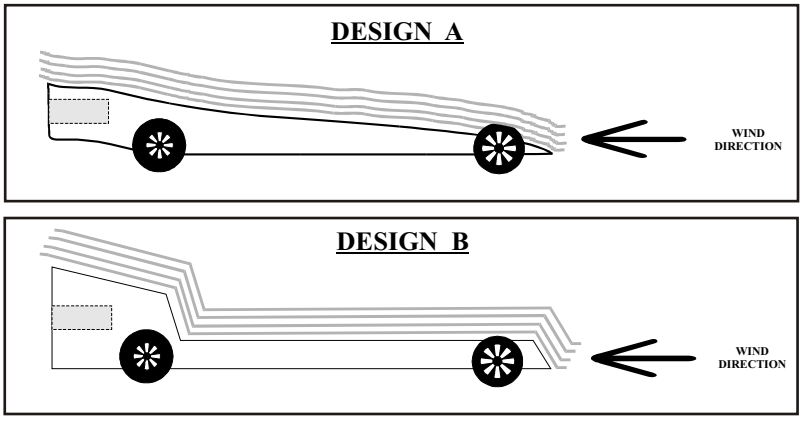
4. Explain how aerodynamics effects fuel economy for automobiles?_____.
   _____.
   _____.

5. _____ is the force applied up or down on an object.

6. _____ is the air resistance force of a moving object.

7. Which of the following designs would be the least aerodynamic.

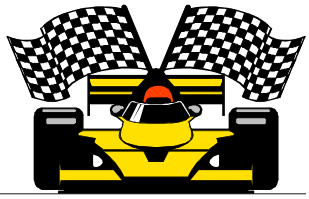
   Design A Design B



RACE EFFICIENCY

1. What was the **DRAG** of your car?. Drag in grams ____
2. What was the **WEIGHT** of your car?. Weight in grams ____
3. Multiply both numbers together. This will give you the EFFICIENCY of your dragster in grams. Race Efficiency ____

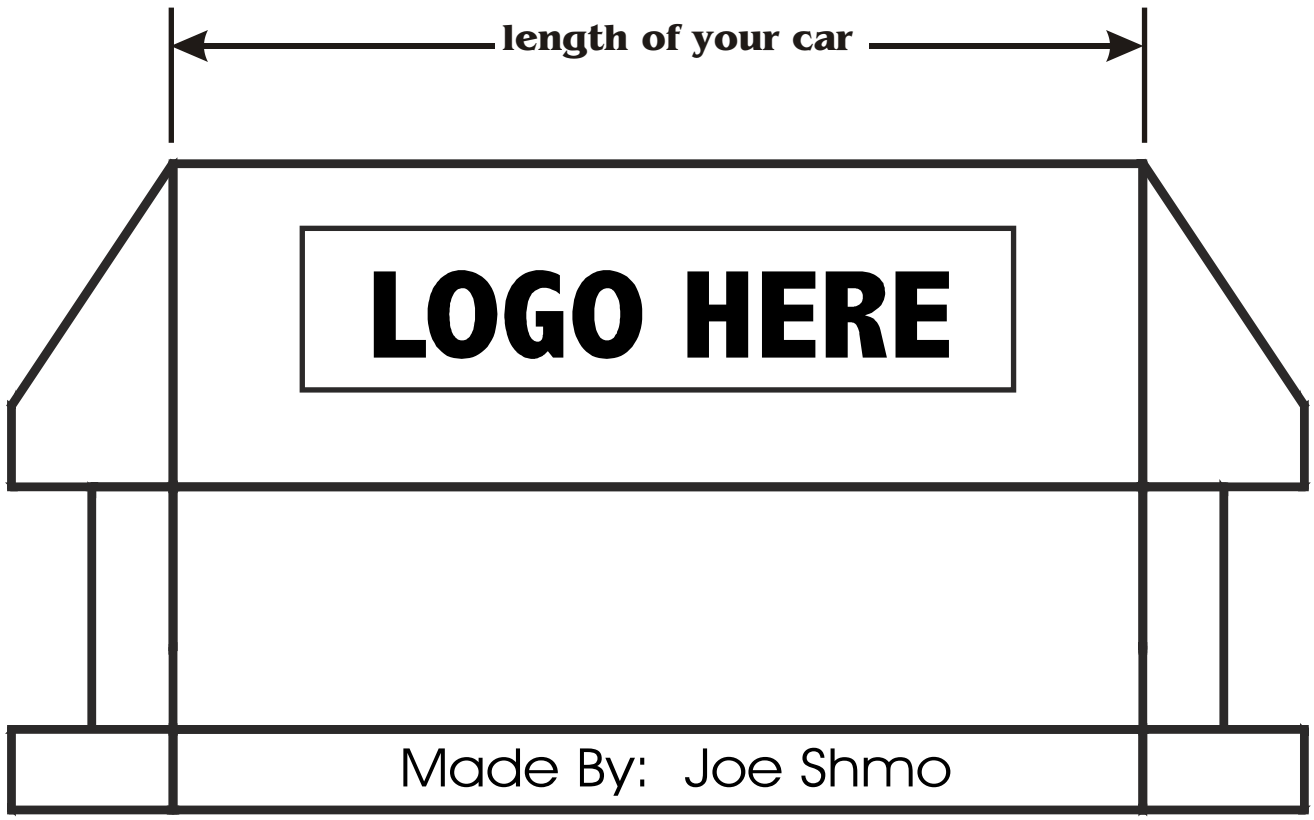
SPONSORSHIP & DISPLAY



After your car has been successfully constructed you must solicit a sponsor for your race car. The sponsor must be willing to donate $5.00 to have their name and /or logo appear on your display. The sponsor can be a local business, organization, group, etc. or perhaps a parent would be willing to sponsor you. The display may be constructed out of octag, or another suitable material, to display and protect your dragster. The sponsor's name MUST appear on that display and be no smaller than 6" in length. If possible, get stickers or similar promotional items from your sponsor to use in your display. You are encouraged to use the computer to generate the company name and/or logo.

making the display

If you choose to make the display out of octag you must first draw the shape of your display before it gets folded. (See example below) If you choose to make your own design please keep a few things in mind. 1. The display has to be large enough to hold your dragster after it has been assembled. 2. The display must have a suitable area to put your sponsor's name and/or logo. 3. The display must not exceed13" in length or 12" in height.



11" x 17" OCTAG

OBJECTIVES & MATERIALS

Upon completing this activity the student will:

- Learn about the history of land transportation
- Understand how the evolution of Technology has influenced the design and implementation of land transportation vehicles
- Learn how design characteristics of automobiles have changed to improve performance and efficiency
- Learn which design characteristics effect speed
- Learn which design characteristics effect aestetics
- Understand the principle of aerodynamics and how it effects the performance of an automobile
- Learn the Design Process
- Design and construct a CO2 powered vehicle
- demonstrate the safe operation of various tools
- Demonstrate communication skills through technical drawings
- Test their vehicles for speed and aerodynamics
- Obtain a sponsor for their vehicle
- Construct a display for their vehicle that shows the race results, sponsor logo, and the name o the student

MATERIALS:

- 1 ream of 8 ½“ x 14" white bond paper
- Scissors
- Masking tape
- Pencils
- Sand paper (100 & 220 grits preferably)
- 1-1/2" X 2" X 12" Pine, Balsa, or Bass wood (1 per student)
- Wood glue
- Bit and brace equipped with ¾" bit for CO2 hole
- Drill press for drilling wheel axle holes
- 9/64" drill bit inserted into the drill press
- Power band saw or jig saw
- Various files (combination, rat tail, triangular, etc.)
- Wood planes (small block planes work well)
- Chisels
- Try squares and rulers
- Scratch awls
- Wheels (front and rear)*
- Axles*
- Screw eyes*
- Co2 cartridges*
- Starting and finishing gate*
- Fishing Line*

CONNECTION TO FRAMEWORKS

Upon completion of this TLA students will have learned and / or demonstrated the following Frameworks Standards:

1 Materials, Tools, and Machines

1.1 Given a design task, identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (e.g., weight, strength, hardness, and flexibility).
1.2 Identify and explain appropriate measuring tools, hand tools, and power tools used to hold, lift, carry, fasten, and separate, and explain their safe and proper use.
1.3 Identify and explain the safe and proper use of measuring tools, hand tools, and machines (e.g., band saw, drill press, sanders, hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) needed to construct a prototype of an engineering design.

2 Engineering Design

2.1 Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
2.2 Demonstrate methods of representing solutions to a design problem, e.g., sketches, orthographic projections, multi-view drawings.
2.3 Describe and explain the purpose of a given prototype.
2.4 Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.
2.5 Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.
2.6 Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.

3 Communication Technologies

3.2 Identify and explain the appropriate tools, machines, and electronic devices (e.g., drawing tools, computer-aided design, and cameras) used to produce and/or reproduce design solutions (e.g., engineering drawings, prototypes, and reports).

6 Transportation Technologies

6.1 Identify and compare examples of transportation systems and devices that operate on each of the following: land, air, water, and space. 6.2 Given a transportation problem, explain a possible solution using the universal systems model.
6.2 Identify and describe three subsystems of a transportation vehicle or device, i.e., structural, propulsion, guidance, suspension, control, and support.
6.3 Identify and explain lift, drag, friction, thrust, and gravity in a vehicle or device, e.g., cars, boats, airplanes, rockets.