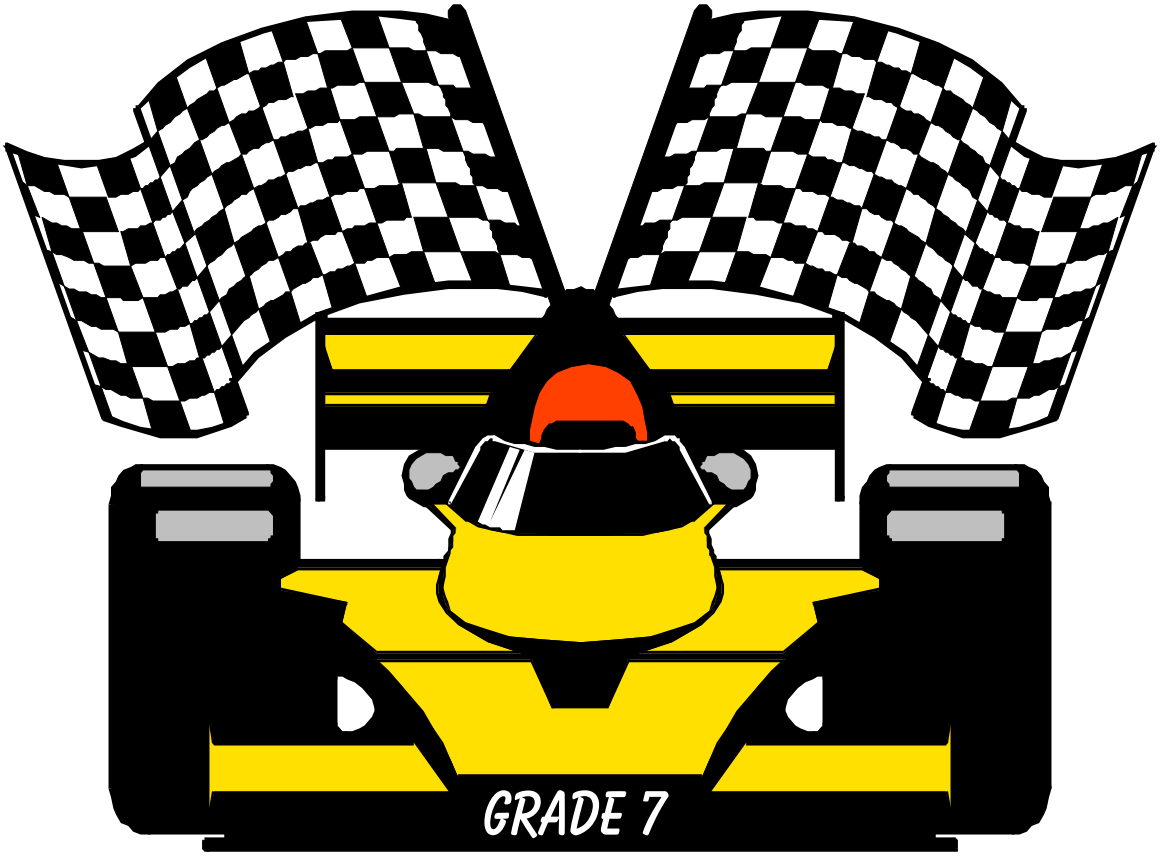
Engineering Technology

SHOW, SHINE $ DRAG



BIGELOW

MIDDLE SCHOOL
Newton, MA

ENGINEERING TECHNOLOGY

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. You will be amazed at how fast they go! 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

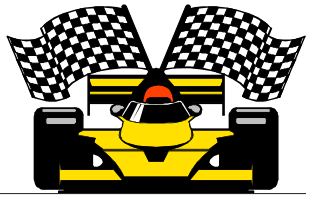
1. Thumbnails are small drawings that help you to see how your dragster might look. They may be of the whole car or parts of the car. They are not detailed drawings, just quick sketches to give you ideas.

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!

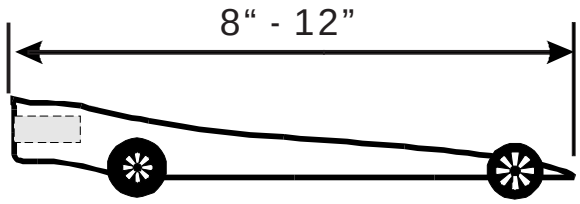
DESIGN LIMITATIONS



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

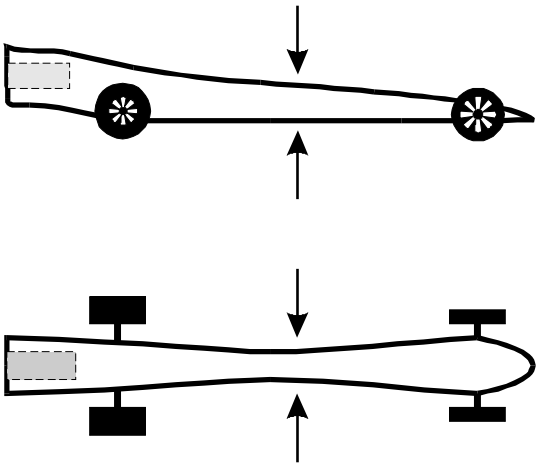
LENGTH & WEIGHT

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



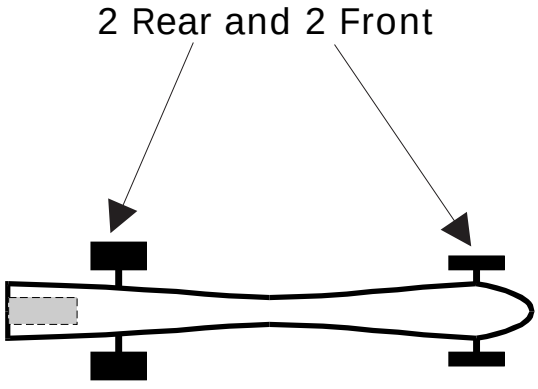
The minimum weight of your assembled car, including wheels, axles, and screw eyes, cannot exceed 65 grams.

WIDTH



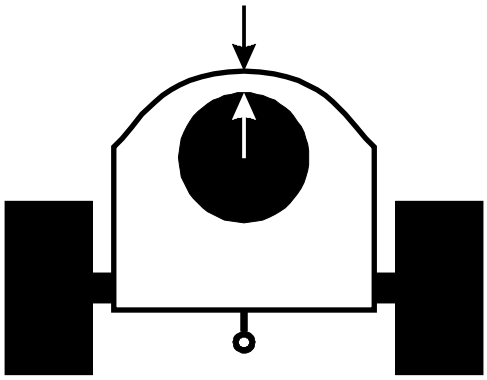
The minimum thickness is 1/2".
The only exceptions are; the front may be tapered and if you have 2 sides.

WHEELS



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

THICKNESS



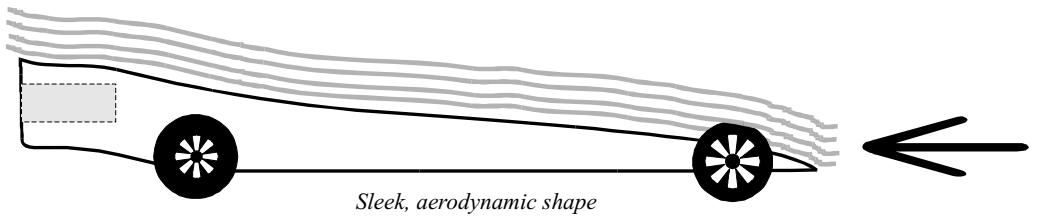
The minimum wood thickness around the CO2 hole is 1/8".
Any thinner would be dangerous!

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

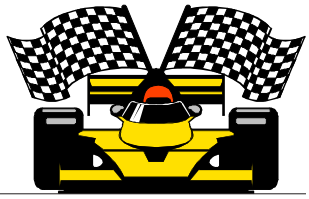
The second design principle is WEIGHT. The lighter you design your car, the faster your car should go. Remember there are some design limitations when it comes to the thickness of the wood. (To assure you are staying within the design limitations, refer to the "Design Limitations" sheet). Try to think 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



Thumbnails are small drawings that help you to see how your CO2 car might look. They are not detailed drawings, just quick sketches to give you ideas. Use the space below for your thumbnail drawings. You are required to come up with at least ***5 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 20 points)

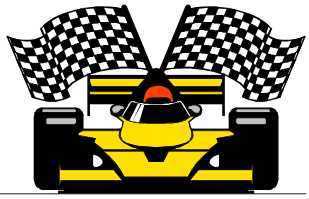
THUMBNAIL DRAWINGS

SIDE VIEWS	TOP VIEWS
1	1
2	2
3	3
4	4
5	5

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:_____

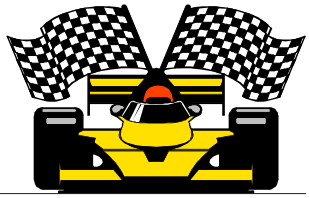
THUMBNAIL DRAWINGS (CONTINUED)



Use the spaces below for your thumbnail drawings. You are required to come up with at least ***5 different*** car designs, but if you can think of more, your idea will most likely be more creative. Each design should be different and must include a side view and top view. ***(Each drawing is worth 20 points)***

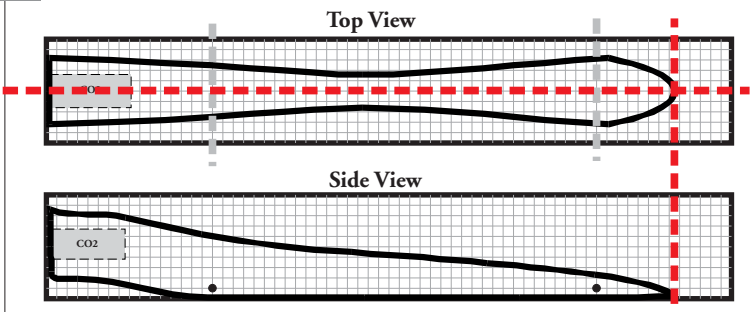
SIDE VIEWS	TOP VIEWS
6	6
7	7
8	8
9	9
10	10
11	11

DRAWING CHECK SHEET



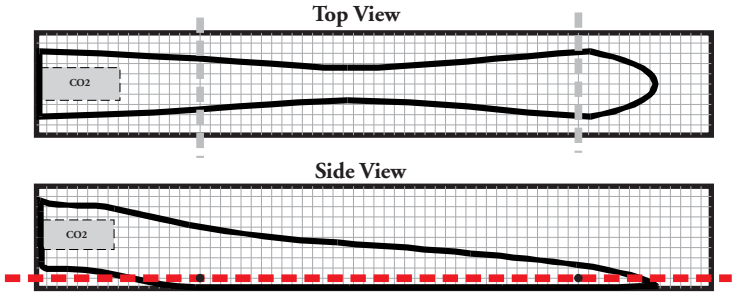
Use the following check sheet to assure you have stayed within the guidelines of the final drawing. ☑ Check off each guideline as you do them.

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

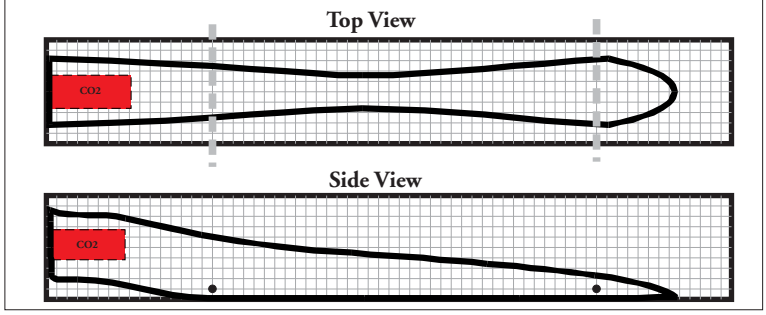


☐ **Top View must be symetrical**

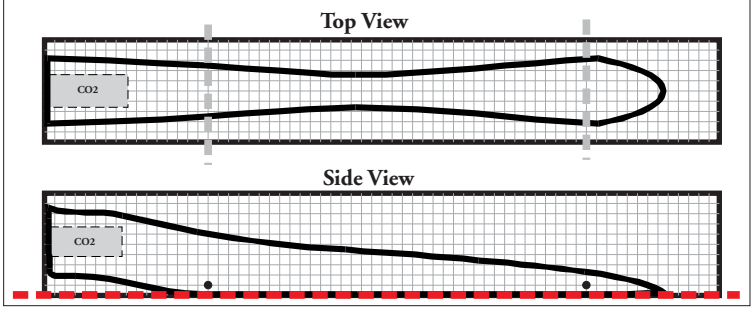
☐ **Wheel axle holes should be 1/4" up from the bottom**



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



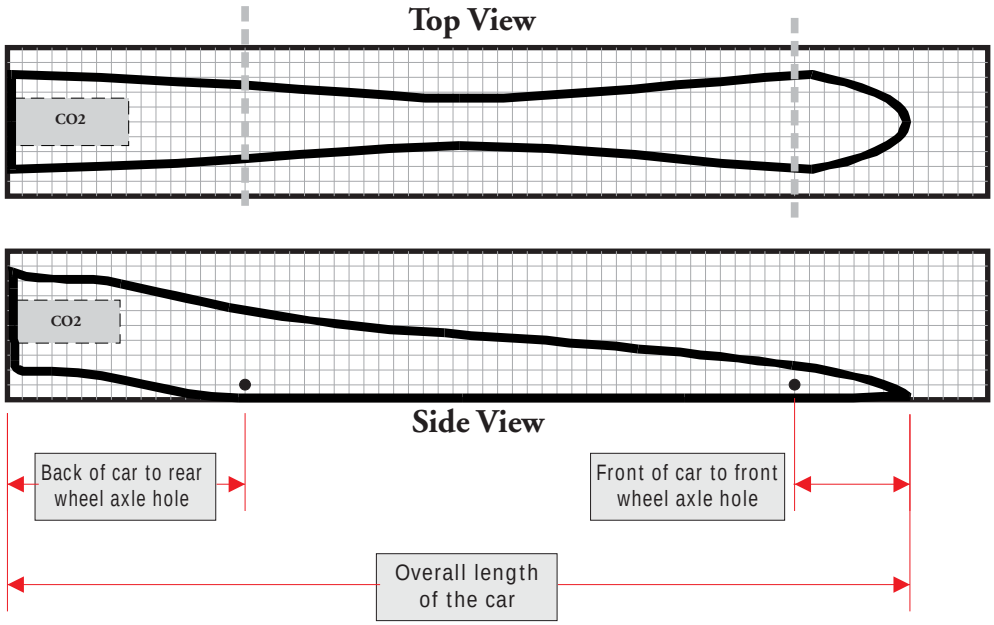
☐ **Side View must touch the bottom of the block**



This step is for the Final Design ONLY!

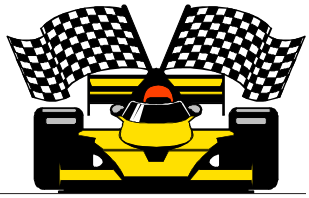
☐ **Dimensions that are needed for the final design**

- ☐ 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 Rough Sketches of Speed Cars. Rough sketches should be drawn to the exact size you intend to make your final car design. You do not need to include dimensions at this stage. The grid is the same scale we have been using, (each block = 1/4") so you can see how the car will actually look. Include all steps on the **"Drawing Check Sheet"** except for the "**dimensions"**.

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

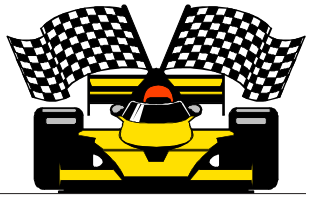
CO2

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



Use the boxes below to Draw Rough Sketches of Show Cars. Rough sketches should be drawn to the exact size you intend to make your final car design. You do not need to include dimensions at this stage. The grid is the same scale we have been using, (each block = 1/4") so you can see how the car will actually look. Include all steps on the **"Drawing Check Sheet"** except for the "**dimensions**".

☐ **View**

1 2 3 4 5 6 7 8 9

☐ **View**

☐ **View**

1 2 3 4 5 6 7 8 9

☐ **View**

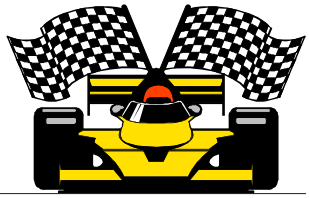
☐ **View**

1 2 3 4 5 6 7 8 9

☐ **View**

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

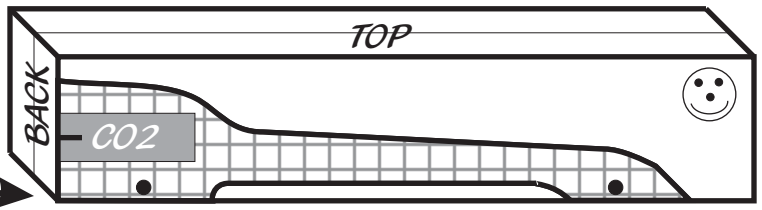
PATTERN LAYOUT



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

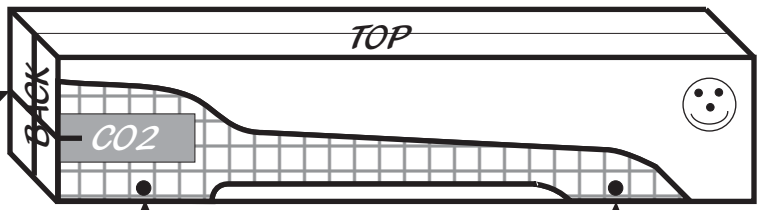
1. Using a pencil, mark the bottom and the back of your wood. Put a smiley face in the upper right corner of your side view. (REMEMBER: The back and bottom are smooth)

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!

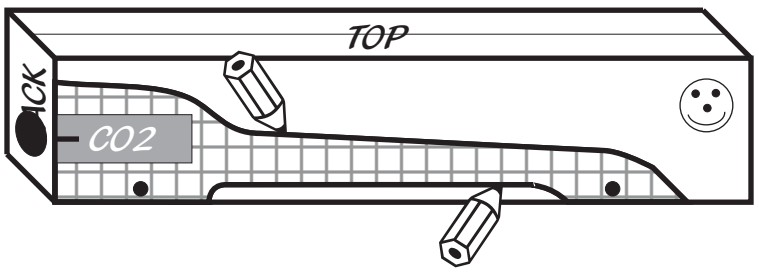


3. Using a Try Square, extend the center line of the CO2 cartridge hole all the way across the back of the wood. Also darken in the vertical glue line to form a large "+" sign. Then drill a 3/4" hole using the bit and brace.

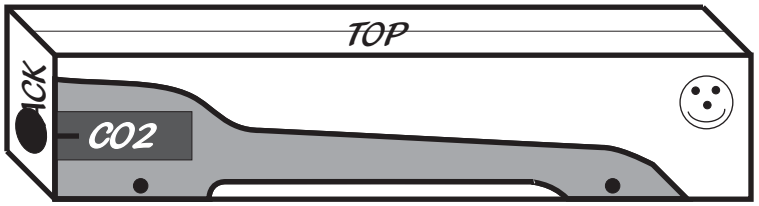
4. Using a 9/64" drill bit, drill the front and rear axle holes all the way through your pattern paper and the wood.



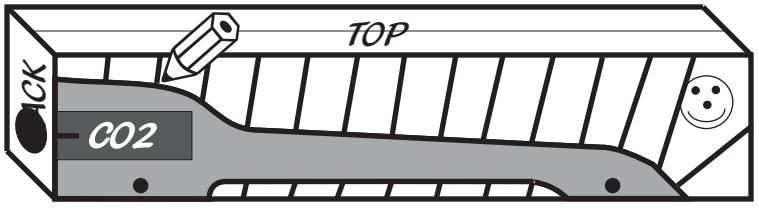
5. Using a pencil, trace the entire right view pattern onto your block of wood. Take your time and draw neatly, these will be the object lines that you will cut!!!



6. Now remove your paper pattern and put it safely in your Tech Binder. Your block of wood should look similar to the example to the right.

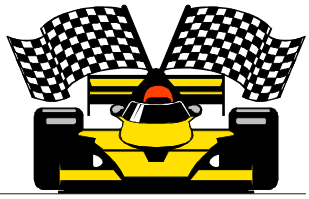


7. Using a pencil, draw a series of "relief" cut lines along every edge of your side view. Space the lines roughly 1/2" apart as you go. We will cut the lines first, before we cut out the car shape.



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 traveling in real life. Follow these simple steps, to convert feet per second into miles per hour.

1. Write down your race 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

) 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_____

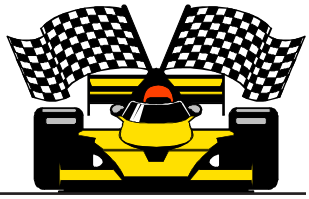
5. Divide that number (feet per hour) by the number of feet in a mile (5,280). This will give you miles per hour (M.P.H.). MILES PER HOUR_____

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



DIRECTIONS: Fill in the worksheet below. If you do not know the answers to the questions, use the Engineering Technology web site to research the answers. Use the ***TechnoTerms*** link. Or feel free to use any other resource.

1. What is 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.

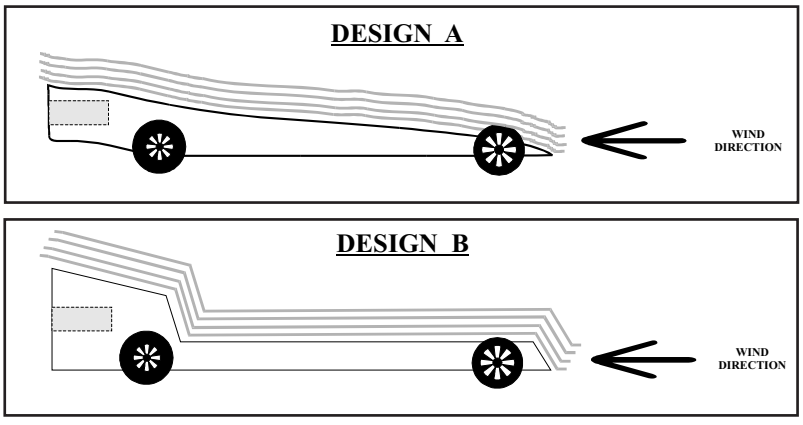
6. _____ is the air resistance force of a moving object.

7. Explain how aerodynamics effects the speed of CO2 racecars?
   _____
   _____

8. Which of the following designs would be the least aerodynamic?

   (circle one)

   Design A Design B



RACE EFFICIENCY

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

Drag in grams _____

X

Weight in grams _____

Race Efficiency _____