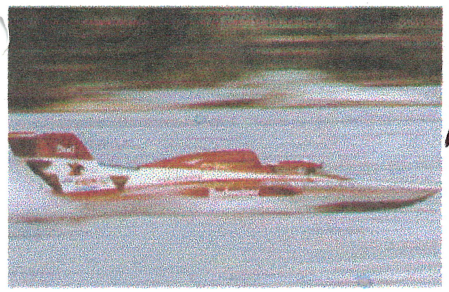


DRAG BOATS

MINI - THUNDERFEST!

THE PURPOSE...

The purpose of this activity is to learn the Design Process to design and build a unique, creative, high quality, light, aerodynamic and fast drag boat powered by an electric motor. You will also construct your own propellor, finely tuned to your particular boat for maximum performance. You will race the boat in Single-Elimination competition against the other boats in your class, with one boat being declared the Champion!

Unlimiteds Detroit

THE PREPARATION...

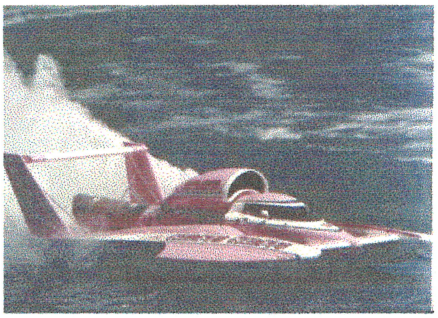
To complete this activity you will need the following:

- ❑ Internet access
- ❑ Printer access
- ❑ Paper
- ❑ Pencil
- ❑ Eraser
- ❑ Ruler
- ❑ Scissors
- ❑ Styrofoam hull blank
- ❑ 1 - 1/8" metal rod propellor shaft
- ❑ 1" - section of vacuum hose
- ❑ 1/4" x ½" strip ABS plastic
- ❑ Electric motor
- ❑ Two 10" stranded wires
- ❑ Two small washers
- ❑ Demonstrated safe use of the Band Saw
- ❑ Demonstrated safe use of the Scroll Saw
- ❑ Demonstrated safe use of the Glue Gun
- ❑ Wood rasp
- ❑ Files
- ❑ Sandpaper

THE PROCEDURE...

Begin by reading the following information and answering the

questions that follow.



WATER

Our lives revolve around and depend on the water, no matter where we live. Throughout history it has been common to see civilizations arise along the shorelines and prosper. The water is our most important life source. Humans can survive for weeks without food or shelter, but we can survive merely days without water. Civilizations along the water also benefited from the use of boats. Boats were made for a variety of uses such as transportation, exploration, fishing, and trade. A boat could have been anything as primitive as a raft made of a few trees lashed together, or a tree hollowed out to make a canoe. Boats have always been an important part of human life especially to those living near the water. The overwhelming variety of boats in use today shows how dependent we have become on them for many reasons!

A visit to a local marina or port will clarify the wide variety of boats available for use just in your local area. Consider the variety of boats available today around the world. Consider the variety of careers people have involving boats. A few of the categories boats can fit into are fishing, scuba diving, pleasure craft, transportation, barges, research vessels, sailing vessels, canoes, kayaks, ice breakers, and tug boats. Each of these categories can be broken down even further and I'm sure you can come up with several others as well.

When considering a boat design, we need to think of some of the basic physics that go along with it. When you were a child playing in the bathtub and you set your new toy boat in the water, why didn't it sink? How can vessels made out of steel and carrying several thousand tons of cargo float from one port to another?

BUOYANCY

All boats have the same basic concepts with which we should

become familiar. The boat is a physical object subject to all the laws of physics. She has weight - gravity pulls her downward. She floats - buoyancy holds her up in the water against gravity. Buoyancy is really just a manifestation of gravity. How does buoyancy act against gravity in such a way to make boats float?

Imagine a small tub of water wherein the surface is flat and level. All of the water has been pulled down by gravity. Now, if we put a block of wood into the tub, we are pushing some of that water aside and working against gravity. Gravity will try to pull the displaced water back into the space now occupied by the block of wood. That means that water is pushing back upward against the block of wood that has pushed it aside. The strength of this upward push will equal the weight of the water that was pushed aside.

Consider another illustration: Imagine you have filled the bathtub to the very brim, and can arrange a way to catch any overflowing water from the tub. You climb into the bathtub and completely submerge yourself. What is going to happen to the water in the bathtub? It will overflow into the catch basins. Imagine you then have the ability to weigh all of the water that overflowed from the tub. You will find that the weight of the water displaced by your body will be equal to your body weight.

DISPLACEMENT

This is true on any size scale! When a boat is placed in the water it displaces water. The water surface rises, and gravity tries to pull it back resulting in an upward force, buoyancy, on the boat. The amount of water a boat pushes aside while it is sitting in the water is called **displacement**. There are two hull types that we should become familiar with when considering various boats and their uses as well.

Consider that different types of boat hulls react differently when put in motion. A displacement hull is a type of hull that displaces the same amount of water no matter how fast it is travelling

through the water. This type of hull is most common with large vessels. A planing hull is a type of hull that displaces less water once it is put in motion. A boat with a planing hull will take a certain amount of forward speed to get it in motion and to get the hull out of the water and up on a plane. The hull skims the surface of the water when it is "on plane." Once the boat is "on plane" the speed can be adjusted accordingly as long as it doesn't slow down to the breaking point, where the hull will drop back down into the water. When a boat is "on plane" it displaces less water than when it is moving slow or standing still in the water. Usually smaller vessels, such as ski boats or sport-fishing boats will be designed with a planing hull allowing for the ability to travel at faster speeds.

QUESTIONS

1. In your own words, define buoyancy

2. In your own words, define displacement

3. What type of hull would you expect to see on a tanker?

4. What is the advantage of this hull (from #3)?

5. What type of hull would you expect to see on a jet boat?

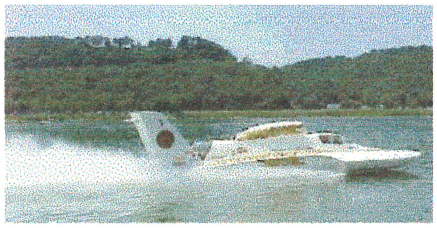
6. What is the advantage of this hull (from #5)?

7. In your own words, define "on-plane"

THE CHALLENGE...

Work your way through the following assignments in the design and production of your boat. Always make sure your assignments are handed in.

☞ The more effort you put into each assignment, the better your product will be!



THE DESIGN PROCESS

There are six stages to the Design Process that we will be using for our boat hull: Research, Brainstorming, Sketching, Drafting, Prototyping, and Testing.

> Paper is cheap! It is always better (and cost-effective) to mess up many sheets of paper than it is to mess up even one piece of wood!

Since you are going to come up with a fantastic unique hull design, you have to do more than grab a piece of foam and start hacking it up. All top designers research their market for ideas to help them design. They use brainstorming to try out ideas on paper before any material is used. Good designs are sketched out in detail, and critically evaluated. The best design is then selected, and drafted in perfect detail and quality. This final design is then used as the "blueprint" for production.

The first three stages are the most critical - quality time **must** be spent here to ensure quality results!

The first thing you need to do is some research - you need to find out what your needs are, and what needs to be done.

Let's presume that you want your boat to:

- perform well
- look good
- float!

For these goals, it will need smooth, flowing lines. What lines would a good boat hull design have? What would it look like? Do you know what shape is going to be the best? Is your idea going to be stable?

It can take a lot of time to design, test and re-design each idea you come up with. There is a faster way of getting started - research! Find out what others have done, then expand on them!

"Learn from the mistakes of others -
You don't have enough time to make them on your own!"

RESEARCH

STEP ONE

The first step in this project is to get some ideas of what different types of boat hull designs exist. You will need to hand in three web site references pertaining to boat hull designs, as well as three pictorial examples of boat hulls. You will receive bonus marks if you find web sites that are not referenced by any other student.

Use your Internet search skills to research some effective boat hull designs. There are a myriad of web sites out there - YOU have to learn how to:

- ❑ Search for information
- ❑ Get a quick overview of the site
- ❑ Sort out useful from useless

Some handy hints for searching:

- ❑ Use a meta-search engine such as "Google" or "Meta-Crawler" since it uses a multitude of search engines to accomplish the task

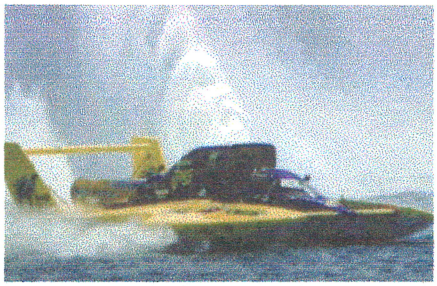
- ❑ Use quotes (" ") to search for groups or phrases. For example,

  Search for: "boat hull"

- ❑ Use + and - signs to refine your search. For example,

  Search for: +"boat hull" +drag -pigs -fish

Your completed assignment shall be handed in word-processed, with your full name, date and block in the top right corner.



BRAINSTORMING
STEP TWO

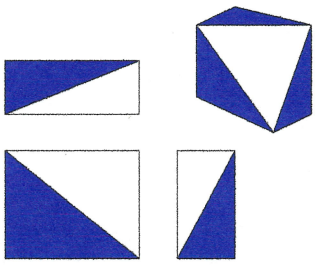
- ❑ On a blank sheet of paper, sketch at least 10 different designs that could potentially meet the requirements of your design
- ❑ Be as creative as you can, explore all options and possibilities. Each idea does not necessarily need to be perfect, but again, detail is super important, as the ideas you explore here will affect the quality of your design stage.
- ❑ Each drawing should be clear, detailed and very high quality. If you design garbage, you will make garbage, so put some effort into this stage!
- ❑ Presentation is super important here - If you want to convince an investor to fund your project, you need to make the project look like a sure-fire thing, guaranteed to make money!
- ❑ Take your designs to your instructor for input!

DO NOT rely on some witty paragraph to explain your drawings. This is not a **Salvador Dali** exhibit - if you have to explain it, redraw it!

SKETCHING

STEP THREE

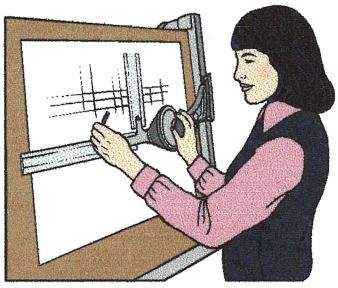
Sketching is where you explore some of your brainstorm drawings in finer detail and in even higher quality. In these drawings, you will be drawing in Orthographic Format.



"Orthographic drawing is a way of depicting 3-dimensional objects in a 2-dimensional plane, such as on drawing paper. Typically only the top, front and right side views of the object are shown. The drawing on the left shows the top, front and right side view of a cube that has one corner removed (shown in the top right corner).

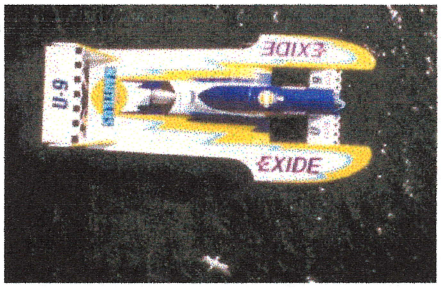
Now is a good time to work through any design flaws you might see as you work with this design. If you find that more brainstorming needs to be done with this design then do so - this is NOT wasted time - it is IMPORTANT!

- ❑ Select the best three ideas you came up with in Step Two.
- ❑ Draw an Orthographic drawing for each design.
- ❑ The top view is always directly above the front view. The side view is directly beside the front view. Ensure that the **depth** of the object is shown the same on the top and side views (rookie mistake).



- ❑ In these pictures, show absolutely all the detail you can. If there are important details that you can not see, draw another view depicting those details. You should be able to give these designs to someone from a different class, and they should be able to build the product for you! If they can't, it is **your drawing** that is at fault!

Detail! Detail!! Detail!!!



DRAFTING

STEP FOUR

This drawing is shown in exact detail and is drawn to exact scale. In these pictures, show absolutely all the detail you can. If there are important details that you can not see, draw another view depicting those details. You should be able to give these designs to someone from a different class, and they should be able to build the product for you! If they can't, it is your drawing that is at fault! This drawing is essentially your "Blueprint."

Detail! Detail!! Detail!!!

Get a **Drag Boat Template** from your instructor in order to complete this drawing. This final drawing will act as your blueprint and template used in production. Ensure that this drawing is as high quality and as high accuracy as you can possibly make it - the success of your project depends on it!

Make sure your dragster conforms to all the required parameters!

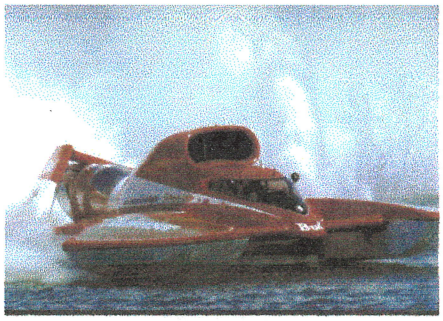
Show your finished drawing to your instructor. If and only if it is perfect, will you receive your materials to complete the next step!

The "Blueprint" process:

In the Bad-Old-Days, hand-drafted plans were placed on top of paper treated with a photosensitive solution; the paper sandwich was then rolled out onto platforms outside the window to be exposed to the sun.

After the exposure, the paper was processed; it turned blue except where the lines of the original drawing had covered it, where it stayed white.

Today, the blueprint process is only recently obsolete, yet the term "blueprint" remains firmly embedded in our daily vocabulary!



PROTOTYPING

STEP FIVE

This stage is where all your intense planning and effort come to fruition. This is where your design will sink or swim.

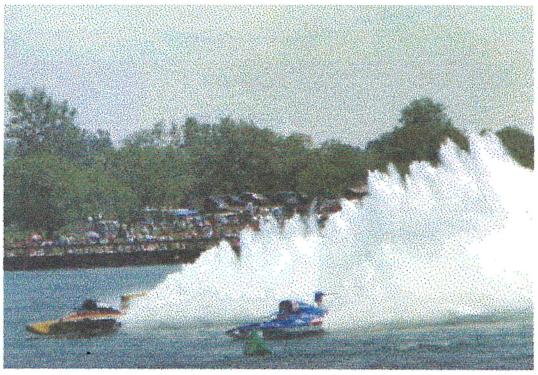
Whether you use carefully made patterns, or you carefully measure and mark the material directly, be particularly careful in this stage of layout. *Measure three times, cut once.* Sometimes materials can be so expensive or difficult to obtain, that even a simple mistake can become a very costly one!

- ❑ Acquire the Styrofoam Drag Boat Blank from your instructor
- ❑ Using the Drag Boat Template, trace your design onto the sides of the foam block
- ❑ Use a hacksaw or file to cut and shape your foam block to the desired shape. Be smooth and gentle if you want a smooth shape
- ❑ Use sandpaper to smooth the hull to design. You must be super-gentle or the foam will be ripped up by the sandpaper
- ❑ Carve out the centre of the hull for the motor to sit
- ❑ You will need to drill a hole for the prop shaft to pass through. The shaft will be supported by a plastic drinking straw as a bearing - make sure the straw fits!
  - ❑ The hole must be at an angle, so that the water line does not begin to fill the boat - check the buoyancy!
  - ❑ The propeller must be *below* the surface of the water (you'd be surprised how many mess this up)

- ❑ Use tin snips, a file, sandpaper and the strip bender to carve and shape your propeller out of a strip of ABS plastic. Think of the types of propellers you have seen as you design your own
  - ❑ Make sure the propeller is designed to turn the right way! You'll look pretty funny going backwards!
- ❑ Set the motor in the hull, and cut the prop shaft to length, such that it extends at least 25mm beyond the hull
- ❑ Use some vacuum hose to connect the motor to the prop shaft. This flexible coupling allows for some misalignment between the motor and the prop shaft
- ❑ When everything looks good, use a minimum of hot glue to attach the motor to the hull and the prop to the prop shaft.
- ❑ Solder 300mm of wire to each motor terminal. Be sure to identify + and - on the motor
- ❑ Cut a small washer so that it can be slipped onto the power lines of the track
- ❑ Solder the free ends of the wire attached to the motor onto the small washer
- ❑ Apply any finishing touches to the boat, as once they are finished, it's...

COMPETITION

STEP SIX



Traditional drag racing is single elimination competition. Each competitor is paired up with one other; the winner moves to the next round, the loser goes home. Regardless of how many rounds in which you *could* compete, your success matters in THIS round, right now!

Your instructor will randomly select competitors for the first round. When called, you will place your drag boat onto the guidelines (being mindful of polarity - you don't want the boat to go backwards; you will lose the round!), and when both boats are ready, the switch will be thrown and the race begins!

There is only ONE chance, and only ONE winner!

If you win, you go on to the next round!!