

# **Inflatable Structures**

## *Physical Science and Technology*

### **Project Introduction:**

In this project we will explore the basic skills needed to design and build a simple, air-inflated structure. These skills will be used for most of the subsequent projects in this class. Your overall goal will be to build a small (roughly 0.75 cubic meter) building out of soft plastic; the building will be inflated by a fan. Parts of this project are individual - you will need to complete steps 1 – 5 on your own. After you have completed step 5, you may choose a partner who has also completed step 5, pick one structure, and build it together.

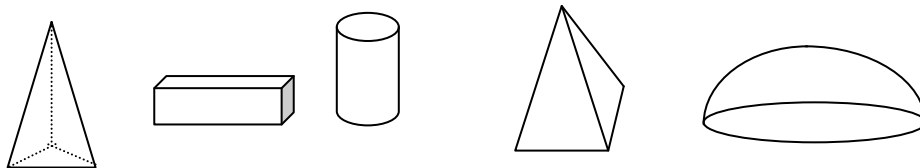
The project will be broken down into the following sections:

1. Platonic solids and thumbnail sketches (8 points)
2. Quick paper model of a structure
3. Refined paper model of a structure (10 points)
4. Orthographic drawings of the front, side, and top of the structure (including dimensions) (10 points)
5. A scale layout drawing (1 cm = 10 cm) (10 points)
6. Constructing your structure (25 points)

All necessary materials will be provided for you. Please remember that every day you will need a 3-ring binder with paper, a pencil, and a calculator.

### **Step 1: Platonic solids and thumbnail sketches**

Platonic solids are the basis for all three-dimensional shapes. Rectangular solids, pyramids, cones, spheres, and cylinders are all examples of platonic solids. Platonic solids can be modified through addition or removal of other shapes; they can also be stretched to form new shapes. Here are some examples of platonic solids – these shapes are (in order) a 3-sided pyramid, a rectangular solid, a cylinder, a 4-sided pyramid, and a dome:



Your inflatable structure needs to be made from at least three different platonic solids (for example, a cone, a rectangular solid, and a pyramid). These solids can be arranged in any way, as long as they are all interconnected.

Start by making eight thumbnail sketches of potential structures you could build (take about 20 minutes to do this). A thumbnail sketch is a very quick (1-2 minutes) drawing that has enough detail to be used as the basis for a more refined drawing later on. Thumbnail sketches are generally small (you should be able to fit 4 on one side

of a regular sheet of paper and all eight on both sides of a regular sheet of paper) and often include notes or diagrams to help you remember your ideas.

### **Step 2: Quick paper model**

Pick your favorite thumbnail sketch and make a quick paper three dimensional model. Your quick paper model should be no larger than a shoe box, or roughly 20cm by 20cm by 40cm.

Use any type of paper, a ruler and/or circle templates to make neat and clean structures, and tape to hold the sides of your model together.

Remember, your quick paper model should have at least three different Platonic solids as part of the structure.

Once you have completed your quick paper model, you will use it to help you create your refined paper model.

### **Step 3: Refined paper model**

Once you have your quick paper model finished, you need to create a refined paper model of the same thumbnail sketch. You can modify your entire quick paper model to make the refined paper model, modify just a part of your quick paper model, or make a new model using your quick one as a guide.

Your refined paper model should be the same size as your quick paper model.

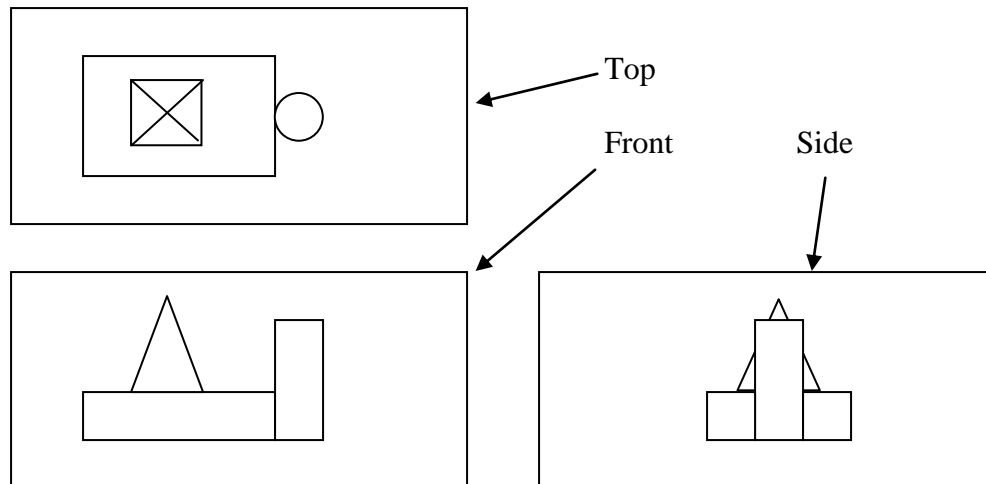
In addition to using at least three different Platonic solids and making a neat and clean structure, your refined paper model can not have ANY overlap of any material. The goal is to create your refined model using as little material as possible. Your refined paper model should also be neat and clean, with careful cuts and taping.

When you are finished with your refined paper model, make sure your name is on all the individual parts of your model and show it to a teacher.

Once a teacher approves your refined paper model, you will unfold and remove any tape so that your model can be laid out flat to see the various two dimensional shapes that you used to create your model. Trace these shapes into your notebook so you can remember exactly how to cut out the shapes necessary for your structure. After you have traced the shapes, reassembled your refined model and turn it in.

### **Step 4: Orthographic drawings**

An orthographic drawing is one that shows your structure drawn from the top, the front, and the side. Each view should be roughly the same scale (in other words, objects should be similar in size in each view). The drawings should be arranged like this:



Notice that all of the objects in each view are lined up properly.

Like in your rough sketch of the completed building, be sure to include dimensions so you have an idea of how large your building will be. Use a ruler and circle templates so your drawing is neat and clean.

### Step 5: Scale layout drawing (1 cm = 10 cm)

Your scale layout drawing will show exactly how you plan to cut and fold the shapes from your sheet of plastic. It is called a scale drawing because it will have the correct proportions, but everything will be smaller – your scale drawing will be 10 times smaller than your real sheet of plastic, so every centimeter on your drawing will represent 10 centimeters in “real life”.

Start by making a sketch of your layout, so you have something to work with when you calculate scale and make your final layout drawing. Since your full sheet of plastic will be 100 cm by 300 cm, your scale layout drawing will need to be 10 cm by 30 cm – use a piece of legal-sized paper so everything fits on one sheet. On your sketch layout, make sure all the dimensions are labeled (use centimeters) – and make sure that the dimensions you choose will actually fit on the plastic!

To make your final layout drawing, you’ll need to divide all the dimensions by ten. This will convert your dimensions from “real life” to scale measurements (10 times smaller). You can write the scale measurements above or to the side of the full-size measurements on your sketch layout. Then, use a ruler, protractor, and/or compass to make your final layout drawing using the scale measurements you calculated.

### Step 6: Make your structure

Now that you have a scale layout drawing, you’re ready to transfer those measurements to the actual sheet of plastic you’ll use to construct your structure. Keep in mind that all your scale measurements will be multiplied by ten in order to figure out the actual measurement on the plastic.

Once you have carefully measured the lines on the plastic, you can cut out your shapes and tape them together to form the final structure. To add the fan, cut a hole along the side of your structure and tape the fan in securely (you want your structure to be as air-tight as possible).