

# **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 and the building will be inflated by a fan. Parts of this project are individual - you will need to complete steps 1 through 4 on your own. After you have completed step 4, you may choose a partner who has also completed step 4, pick one of your structures, and build it together.

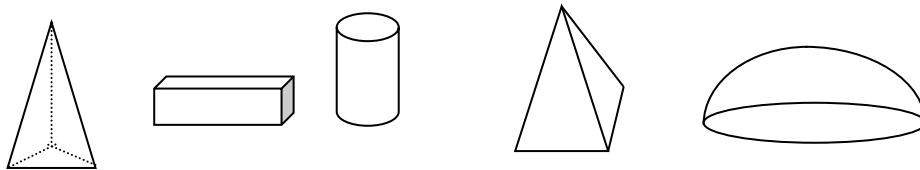
The project will be broken down into the following sections:

1. Platonic solids and thumbnail sketches (5 points)
2. Refined drawing using A+CAD (10 points)
3. Paper model of a structure (10 points)
4. A scale layout drawing using A+CAD (10 points)
5. Constructing and testing 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 (5 points)**

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 shapes made from two different platonic solids (for example, two cones, and a rectangular solid). These solids can be arranged in any way, as long as they are all connected to each other.

Start by making four 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 all 4 on one side of a regular sheet of paper) and often include notes or diagrams to help you remember your ideas.

### **Step 2: Detailed drawing (10 points)**

Pick your favorite thumbnail sketch and make a larger, more detailed drawing. Your drawing should take up one full sheet of paper so you have lots of room for notes and/or diagrams. You can use rulers and circle templates or A+CAD to make your drawing. Add as much detailed information as you can think of to your drawing, including dimensions, particular shapes, and notes about attachment locations.

Your detailed drawing should show where you want each platonic solid. It should also show attachment points that are in the correct location. In other words, if you want to have a cylinder attached to the middle of a rectangular solid, draw it in the correct location.

For your final structure, you will have one sheet of plastic that is 100 cm x 300 cm to use, so keep this in mind while you are making your drawing.

### **Step 3: Paper model (10 points)**

Your quick paper model should be made from a single piece of paper that is 10cm x 30 cm in size. By using only this amount of paper, it will be easier for you to create an A+CAD drawing – all you will have to do is dismantle your paper model from Step #2 and use a ruler to measure various dimensions.

Use a ruler and/or circle templates to make neat and clean structures, and tape to hold the sides of your model together. **Make sure there is no overlapping paper.** You want to use as much of your paper (and eventually your plastic) as possible. Include air passages between your shapes so air can flow freely throughout the finished structure.

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

Once you have completed your paper model, you will use it to help you create your layout drawing.

### **Step 4: Scale layout drawing (10 points)**

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 and dimensions.

Start by unfolding your paper model so that you have something to look at when you make your final layout drawing. Use A+CAD to create your layout. Since your full sheet of plastic will be 100 cm by 300 cm, you will need to start by using the A+CAD template that has a rectangle that is 300 cm wide by 100 cm tall. All of the shapes you plan to cut out for your inflatable structure need to be able to fit into this box!

To the best of your ability, make sure that the shapes you make in A+CAD are the same size relative to each other as the unfolded shapes from your paper model. This will ensure that everything fits together when you make your final structure from plastic. After you have made your shapes in A+CAD, add dimensions to each of the lines in your drawing so that you know how long to make each part of each shape when you are working with your plastic.

**Step 5: Make your structure (25 points)**

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 parts will need to fit on the single sheet of plastic provided, so you should put features in the same spot on the plastic as they are on your layout drawing.

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).

Once you have your structure completely assembled with the fan, find a teacher to turn on your fan and find out if your structure actually inflates or not. If your structure does not inflate, you will have to make corrections to the structure until it will inflate.