Name _____

Design of a Radio Telescope Dish

You and your group are going to design a new radio telescope dish. Now it is very rare for someone to start a project like this completely from the beginning. Instead, you are going to use an existing telescope as the model for your dish.

Step 1: Selecting a Radio Telescope

Spend some time looking at all the radio telescopes from around the world. First, focus on the shape of the dish but then look into their recent discoveries. Finally, select a telescope based on its appearance and discoveries.

Telescope _____

Location _____

Two recent discoveries (you will need this for your presentation) _____

Reason for selection _____

_____

_____

Step 2: Creating a scale model

Now you need to create a scale model of the dish.

Diameter of the real dish _____

Width of sheet of paper _____

You know the diameter of the dish and the width of your paper. You need to create a scale that allows you to use as much of the paper as possible. An example may be helpful at this point. Let's say the dish is 10 meters across and our paper is 1 meter wide. So, if we laid the papers across the dish widthwise we could lay 10 sheets of paper down. So our paper is 1/10 the width of the dish. Therefore, we need a unit that is 1/10 of the width of the paper so we can use this to represent 1 meter in real life. Luckily, finding this unit is easy with metric units because a decimeter is 1/10 of a meter, meaning 10 decimeters equals a meter. So the scale for my drawing would be 1 decimeter = 1 meter. I would then draw the dish so that the diameter is 1 meter.

Scale _____

Step 3: Identifying the focus location

You now have a scale drawing of the dish. You need to locate the place on the dish where the focus should be placed. This is the exact center of the dish. Measure the halfway point of the dish from at least three locations. If you don't get the same answer each time, measure again. If you continue to get different answers ask your teacher for help.

Step 4: Identifying the curvature of the dish as well as the orientation of the panels

a. You need to create model panels using mirrors. First, to be clear, the panels of a radio telescope are not mirrors like the ones you will be using, however, they are close enough. But we do need to make sure they are the right size. Remember the scale you made? Well, it applies to the size of the panels as well as the dish. It is very difficult to find the size of one panel online so everyone is going to assume a single panel on their telescope is a square whose sides measure 50 cm. You need to figure out how big that will be using your scale. Let's go back to my earlier example where 1 decimeter in my drawing represented 1 meter in real life. Well, I happen to know that there are 100 cm in a meter so the panel is ½ a meter on each side. So, in my model, a mirror would be ½ decimeters on each side. A decimeter is 10 centimeters so in my model my mirror would be 5 cm on each side.

   Length of each side of the mirror in your model _____

   Now use the masking tape or painter's tape to reduce the size of your mirrors until they match the dimensions you need for your model.

b. You need to create a collection plate for the reflected light. This could be a large sheet of paper or a poster board. It needs to have a width equal to the diameter of your dish and a length twice the diameter of your dish. One group member will hold this in the middle of your dish to collect the reflected light. The paper should be held so that it creates a "wall" in the middle of your antenna.
c. Tape your mirror to the edge of your antenna. With one person holding your collection plate for the light (the piece of paper from the last step) another member of the group should take the laser and stand directly over the mirror. They should point it directly at the mirror (straight down) from a distance of at least four feet. This person should be pointing the laser directly at the mirror and everyone in the group should use caution to avoid getting hit in the eye with the light. The other member of your group should mark where the reflected light hit the collection plate (sheet of paper).
d. If the reflected light did not hit the collecting plate you need to create an angled edge for your antenna. To do that start by placing one thin book just under the edge of the paper so that it causes the mirror to tilt inward slightly. Repeat step c. Continue this process, adding more and more books until the reflected light contacts the collecting plate. Then measure the angle of the dish with your protractor and write it below.

Angle of dish _____

Step 5: Identifying the height of the focus

Now that you have determined the curvature of the dish you need to figure out how far above the dish to place your focus. Remember the focus is the part of the dish that collected the reflected radio waves. To determine this height move the mirror to several places (at least 3) around your antenna. Make sure the curvature is the same as determined for step 4 and repeat the process of shining the light at the mirror and marking the place where it connects with the collecting plate. Do this for each location on your antenna and then calculate the average distance above the antenna. This is the height of the focus.

Height of the focus _____

Step 6: Presentation

All of the above information needs to be included in a presentation for your peers. Your teacher will instruct you on the media to be used for this presentation and will provide a rubric.