Mission 3
Calculating Stellar Distances

Triangulation in the Field–Worksheet

Name: ____________________________________ Date: _____________________________

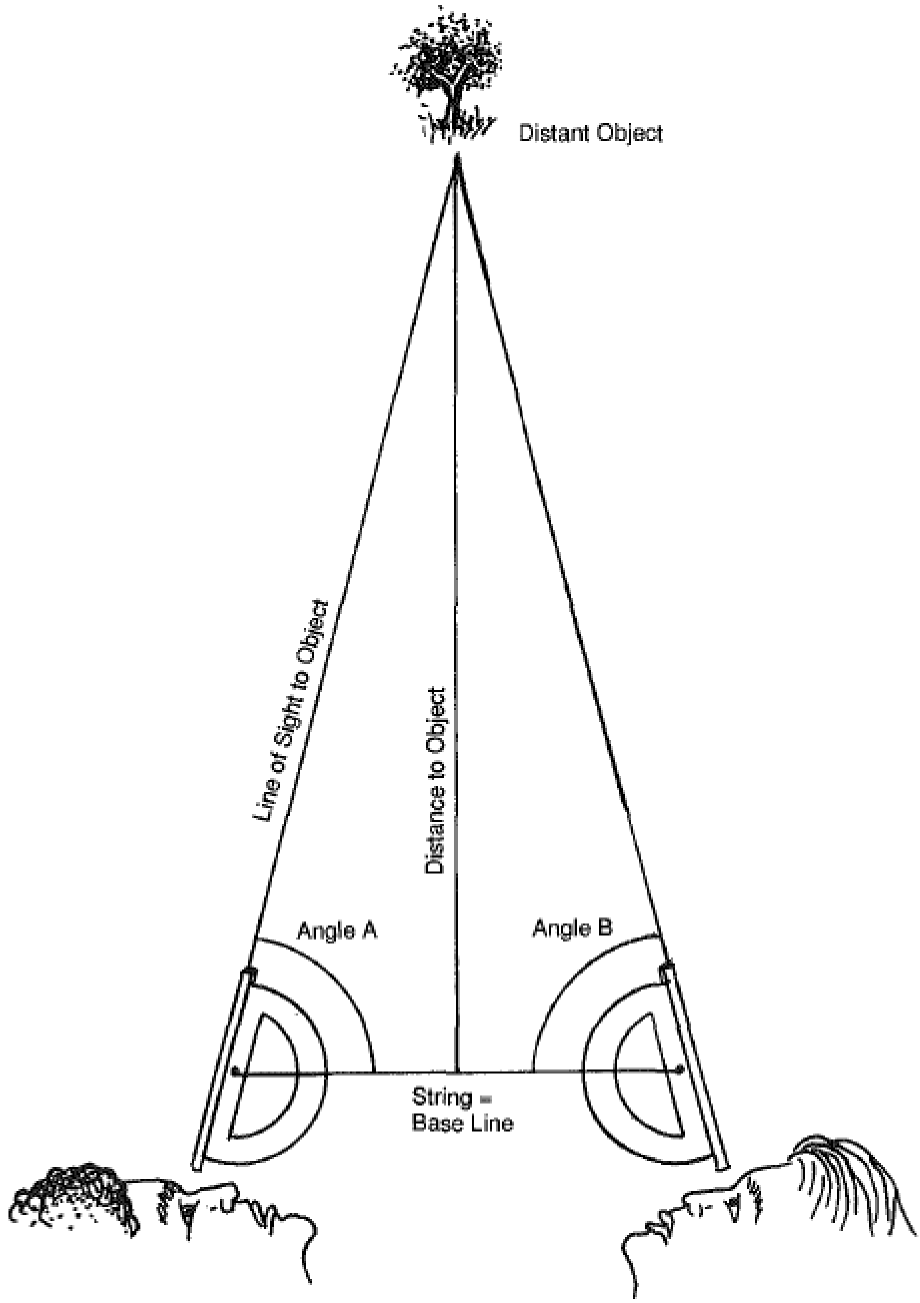
1. To what object are you and your team members measuring the distance?

2. Fill in data on the chart below as you complete your measurements. Do each measurement twice. Switch sides (observer positions) to do the second measurement.

Table 3.1–Triangulation Data.

	Angle Measured From Point A	**Angle Measured From Point B**
Trial 1		
Trial 2		
Trial 3		
Average		

Figure 3.5–Triangulation in the Field.



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Triangulation Data Analysis–Worksheet

Name: ___________________________________ Date: ______________________

Use the directions outlined below to calculate the distance to your object. To accomplish this you will make a scale diagram.

1. The scale of the diagram you are making is 1 centimeter = 1 meter.
2. Use butcher paper for this activity because your diagram will be too large for binder paper.
3. Draw the base of the triangle formed (line AB). It should be 10 centimeters long because your measuring line outdoors was 10 meters long.
4. Take the straw off your protractor and re-create the angles that were formed when you measured them outdoors by laying your protractor down at both of the end points of the line AB.
5. Use a meter stick to mark the line of sight after orienting the protractor to the correct angle. Extend the angle lines out on the butcher paper until they intersect.
6. Now measure the distance in centimeters from the midpoint of line AB to the point where the two lines intersect. Convert this measurement according to the scale to estimate the distance to the object in meters by multiplying the centimeters measurement by 100.

Table 3.2–Calculating the Distance.

Distance from Midpoint of AB to Intersection of Lines	Multiply by 100	Calculated Distance to Object in Meters

Congratulations! You have just *indirectly* measured the distance to an object without actually going to it!

7. If it is possible, go out and measure the distance to your object *directly* using a measuring tape. If this is not possible, get the actual distance from your teacher.

The measured distance to your object is ____________ meters.

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Triangulation Questions–Worksheet

Name: ______________________________________ Date: __________________

1. Record your calculated distance and the measured distance to your object.

   Calculated ____________________: Measured: _________________

   How close was your actual measurement using a measuring tape to your calculated measurement using the triangulation tool?

2. If you did not get the exact same distance using triangulation and direct measurement, why not? What are some of the ways that you could improve the accuracy of this method of calculating distance?

3. One object is at angles 80° and 80°, a second object is at 70° and 70°, and a third object is at 60° and 60° when viewed from the same spots on line AB. Which object is farther away? How do you know?

4. SETI scientists want to study stars that are within a certain distance from Earth. How would this method of triangulation be of value to SETI scientists?

5. Time permitting, do this lab over again, measuring the distance to another object that is considerably farther away. Write all of your data on a separate sheet of paper.

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Making a Triangulation Tool–Directions

These are instructions for making your own triangulation measuring device. You will need two of these sheets to make one tool. You will also need scissors, glue, a piece of string or monofilament fishing line slightly longer than 10 meters, and two straws.

1. Cut out the protractor diagram from this paper.

2. Glue the protractor diagram to a piece of card stock or any thick paper or cardboard.

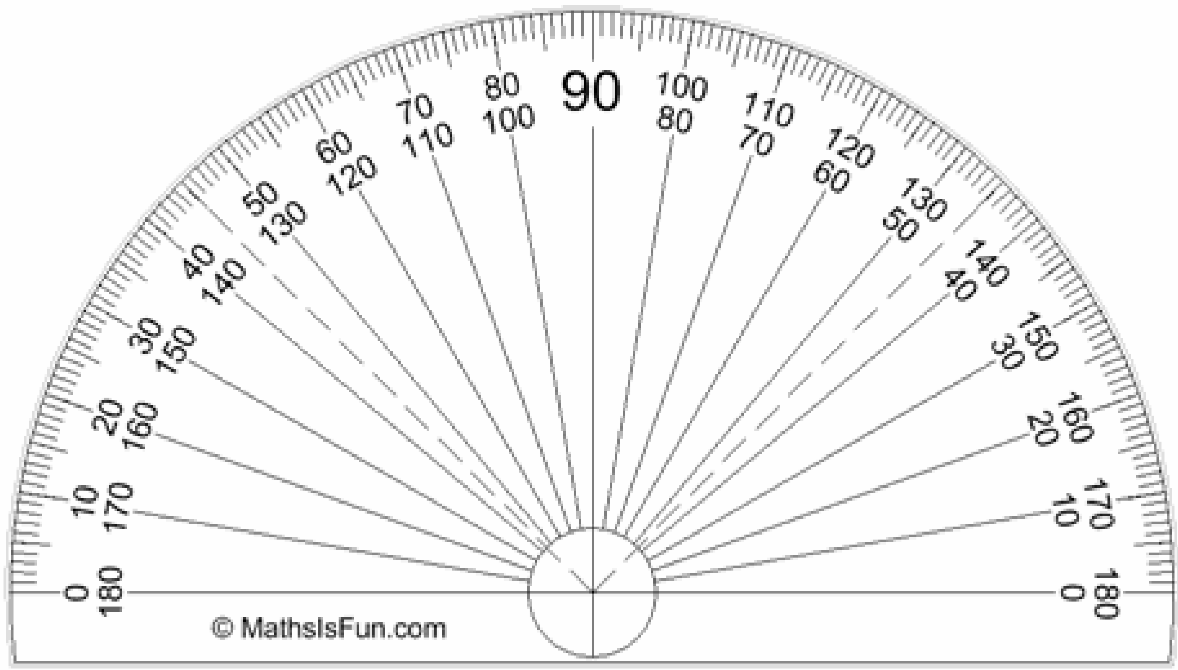
3. Punch a small hole in the area indicated on the protractor diagram and put one end of your 10-meter-long piece of string or fishing line down through the hole. Tape it to the back of the protractor, so the longer part runs across the face of the protractor.

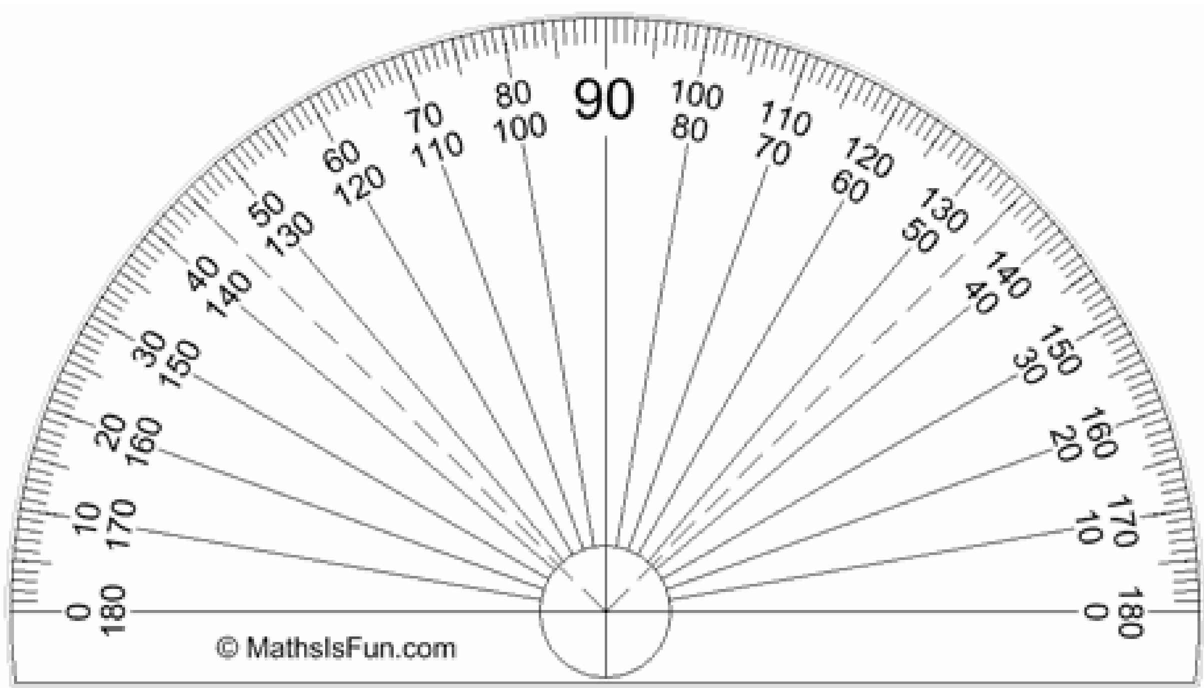
4. Get together with your partner and thread the other end of the string through his or her protractor and again tape it onto the back of the protractor after checking to make sure the length of the string between the two protractors is exactly 10 meters.

5. Tape a straw on the 0-0 line of both protractors, over the hole with the string. The straw acts as a sighting device.

6. Your teacher will demonstrate how this device operates. You must work cooperatively with your partner to make accurate measurements, because you are both taking measurements at the same time. A third member of your team will act as a recorder.

Figure 3–5.





Mission 3
Calculating Stellar Distances

Parallax–Worksheet

Name: ______________________________________ Date: ___________________

1. Write a description of what you did and what you conclude regarding the observations that you made when observing your thumb shift positions.

2. What is the problem that your teacher has asked you to solve regarding the model that is set up in the room?

3. What steps did you take to solve the problem that you described in # 2 above?

4. Using the method that you and your team came up with, which star seemed to have the greatest parallax, or shift the most relative to the background of stars?

5. Using your protractor measuring tool, what distance measurements did you come up with for the following stars?

   Sirius = _____________ meters away

   Alpha Centauri = ______________meters away

6. Make a general statement that relates the distance of a star and the parallax we can observe from Earth.

7. What places in the room should you sit (or stand) to observe Alpha Centauri and Sirius and have the apparent shift of these two stars be the greatest? Explain your answer.

8. Does where you sit or stand to make your observations of these two stars affect the accuracy of your measurements in # 5 above? Why or why not?

9. Because a year is defined as the time it takes Earth to revolve around the Sun, six months from now we will be directly on the other side of the Sun. This will give us a different view of the stars that are closest to Earth relative to the ones that are the farthest away. How will this allow astronomers to calculate the distance to the nearest stars?

Draw a diagram of this on the following page.

Draw your diagram here.

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