

# How Are Maps Created?

## Objectives:

- To help students understand how a map is made using simple surveying instruments
- To Practice linear measurement and estimation
- Review of linear measurement units
- Using a compass and understanding the relationship between the compass directions and angle

By the end of this series of activities, students will have created a map of an irregular pond or lake. We use a pond or lake because its shoreline is at constant elevation (so we don't need to worry about mapping elevation) and, since the kids can't cross it, they will be forced to use indirect measurements. As an extension we have provided an activity for showing how contour maps can be created using a simple surveying tool.

## **I. Estimation and Measurement**

We suggest starting with these activities as the mapping project requires a great deal of estimation and measurement.

### **A. Estimating linear distance**

Materials needed: Rulers, tape measures

1. Have the students estimate the dimensions of the room while they remain sitting at their tables. They should work in groups and discuss what clues they will use to make their estimate.

As a class, discuss the estimates and the clues they used to make their estimates.

2. Have the students revise their estimates, this time based on a standard reference (ruler) that is taped to the table. Again, the students may not leave their tables. We suggest taping the ruler to the tabletop so the students don't simply measure the size of one floor tile and count them up – they will be forced to continue using estimation skills but with one additional piece of information.

Again, discuss their estimates as a class. Raise the question, "is there a *right* answer to this problem?" As, of course, there *is* a right answer to the dimensions of the room, students will be forced to think about ways to improve their estimates.

3. Finally, measure out the dimensions of the room. This can be done with a tape measure, and as a demonstration with one or two student helpers, or you can have all the kids try to measure it out.

Have the students reflect on how close their estimates were to the correct measurements, and some of the reasons why their estimates may or may not have been close.

How to measure "pace": A pace is defined as the distance covered between two consecutive placements of the same foot (measured from the same position on that foot). In other words, start at the heel of the left foot, for example. Begin walking, the next place you put your left foot is the end point of that "pace". Each person has a slightly different length pace; therefore a student must determine the length of their pace, and groups need to be consistent as to who does the pacing measurement. One reliable method for determining a student's pace is having them walk ten paces, measuring the distance and dividing by 10.

4. Measurement practice activity – have kids measure the distance of places around the school by a few different methods – pacing, rulers, tape measures. Key things to consider – how to measure accurately? What are the most appropriate units? This could be a chance to review or introduce unit conversions (feet to meters, etc.). How close were their measurements using paces to those using a tape measure? How large is the uncertainty? What does that tell the students about using paces for measuring distance? Does the overall distance affect the uncertainty of the measurement?

## B. Estimating and measuring Area

Materials: Playing cards, rulers, tape measures

1. Hand out one playing card to each group. Have them estimate the number of playing cards that will fit on their table. As they struggle through this problem, offer to give them one “tool” that will help them (invariably we can expect that they will request a ruler).
2. As in the linear measurement activity, discuss the ways they came up with their estimates, and whether or not there is a “right” answer. Discuss why the answers may vary from group to group.
3. Again, hand out one card to each table. This time, have them estimate the number of cards that will fit on the floor of the room. Again, offer them a single tool to use to make their estimates.
4. Finally, discuss the issues that they had in making the estimates and discuss a method for actually measuring out the number of playing cards that would fit on the floor. This could be done as a class exercise, as a demonstration, or as an “extra credit” assignment.

## II. Creating a Map

### A. Review of Scaling

Materials: Paper, index cards, rulers

1. Tell the students to draw a scale drawing of their tabletop, using a scale of 1 inch = 1 foot (or whatever scale is appropriate for your class). If appropriate, remind them of ratio and proportion.
2. Give the students an index card. Challenge them to make a scale drawing of the tabletop on the index card. They will have to determine an appropriate scale first. (They may not tape any additional cards or paper to the card given.)
3. Discuss with the students what steps are needed to follow when creating a scale drawing.

## B. Mapping the room

Note: This activity should lead to a discussion of *scale* and how to best represent the scale on a map. As kids work through mapping the room and try to make the proportions of the walls and other objects consistent, they'll be reminded of the need for a scale (if that has already been introduced) or this is an opportunity to teach this idea.

Materials: Rulers, tape measures

Tell the students that they are to “map” the room; in other words to represent the shape of the room and its major features on a two dimensional piece of paper.

Have the students discuss for a few minutes what they need to consider in order to make the map.

Things for the students to consider:

- How will you make sure the proportions of the room (i.e., width to length) are the same on the paper as they are in real life? (in other words, how to keep the scale consistent?)
- What's the best way to orient the map?
- What symbols should you use that will best represent the important features in the room?

In their groups, have students draw a map of the room.

When they are done have groups swap maps and critique each other's maps.

Questions to consider when critiquing the maps:

- How well does the map keep the proportions of the objects in the room? How do you know?
- Are there symbols or objects on the map that aren't easily identifiable?

## C. Mapping an irregularly shaped area.

Materials: Rope, rulers

Lay out a rope on the floor in an irregular shape. Tell the kids that this is a “lake” that is not crossable. How will they map out this shape?

Depending on space in the class, this could also be done outside where each group has their own shape to map, or on a large tabletop if the students have large lab tables.

Have the kids brainstorm ways they can solve this problem. Have them make an attempt to do the mapping without crossing the “lake”.

Again, you might have students critique each others' maps which will lead to a discussion of how challenging it is to accurately map an irregular area. Challenge them to think about the fact that although this area is small, in real life a mapmaker would need to map a much larger area.

During or after this discussion is an opportunity to demonstrate to them how to use a simple surveying tool, such as the homemade Theodolite or even just a compass. (More instruction will come later, but it's a nice way to introduce the instrument(s) to them.) Then it will be necessary to review (or introduce) the concept of how a compass works and the connection between the compass directions and angle.

#### D. Using a compass

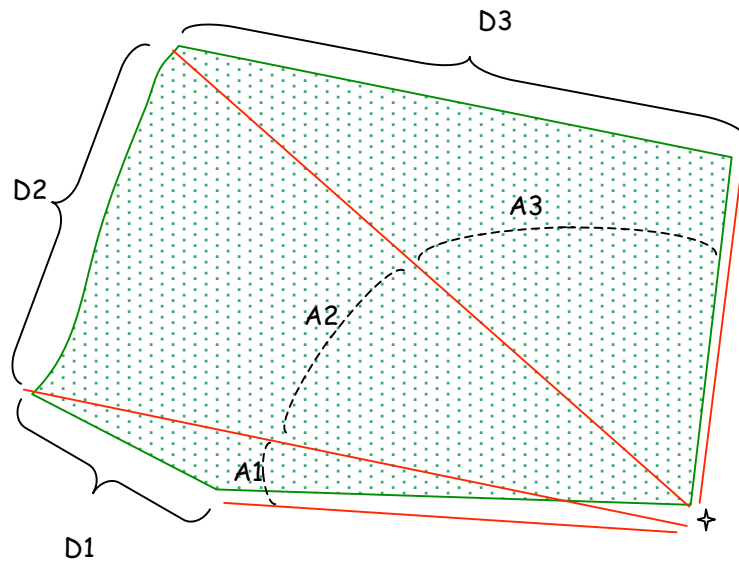
Understanding how to use a compass, or, at the very least, how angles and direction are connected, is essential for the mapping activities that follow. If you have not already done so, lessons on how to use a compass are available.

(See “Compass Lessons”)

#### E. Mapping a regularly shaped area on a field

Materials: Flags, theodolites, compasses, rulers

A simple map can be done by sighting points from a starting place, measuring the angle between them, and measuring the distance between them. A properly created scale drawing of the triangles created by these angles and lines will result in a scaled map of the area of interest.



The angle

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measurements can be made using a simple homemade Theodolite or just a compass.

(insert picture of homemade Theodolite)

Set up a polygon shape on a field. As this is the students' first experience mapping out an area like this, keep the lines straight.

The students' goal is to map out this shape and draw a properly scaled map on a piece of paper. Instruct them on how to do this, and remind them to create their scale first. This can be done by finding the largest distance across the shape and scaling that to the paper.

When students do this activity, they are not allowed to measure the distances using a ruler or tape measure – they must use some other reference, such as pacing, to determine distance.

Give the students time to brainstorm how they will accomplish this task and how they will divide up responsibilities.

As in previous activities, when the maps are finished, give groups time to critique each others' maps.

### F. Mapping out the pond

Mapping the pond is the main activity for this part of the unit.

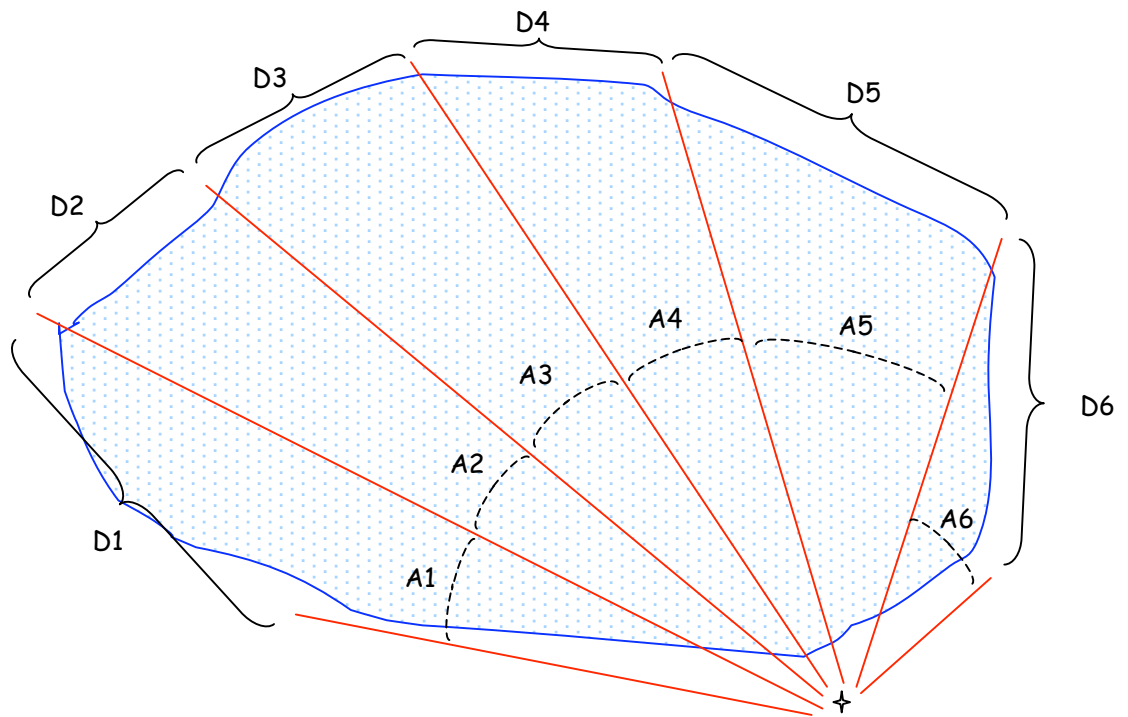
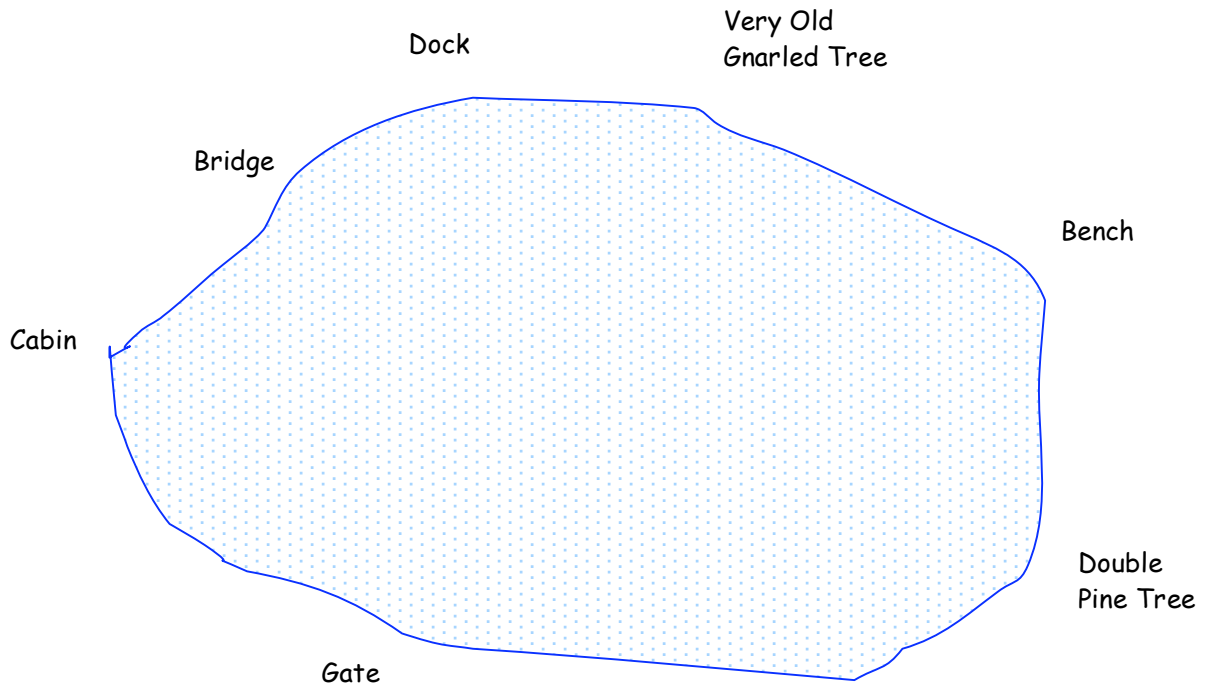
Students will be given instructions to brainstorm how to map the pond and to organize themselves to do so.

One strategy is to have the students submit a “proposal” for how they intend to complete this task, including the various jobs that the group members will take on. Alternatively the teacher could make a list of jobs for the groups.

Things for the group to consider:

- What are the major features that you need to include to make this a “complete” map?
- Where is north on your map?
- How will you measure the distance between major features, or between your sighting points?
- How will you record all your information in an organized fashion so you can bring it back to the classroom to make your map?
- How will you keep your information and equipment dry if it is raining?
- You will not be the only people in the area. How will you respond to others in the area so that they are helpful and cooperative, or at a minimum, not hostile to your efforts?
- How will you insure that you do not damage any of the animals and plants in the area you are mapping?

A suggested first task is to draw a sketch of the pond showing the landmarks they will use to do their sightings:



F. (Extension activity) Making a contour map of a hill

In this activity, we bring together the two parts of mapmaking – the horizontal and vertical. This is probably best done as a whole class.

Get a couple of students to do the sighting, while the rest of the class stands on a hill. Have about the rest of the students stand about 3-4 feet apart on a hill. Have the students doing the sighting instruct those students where to stand so that their feet are at exactly the same altitude. Hand them a long rope and have them place the rope on the ground at their feet. When they walk away, they can see the contour of the hill.

This could also be done by splitting the class up into two or three groups so that they can make a few contour lines at once.