Lesson 4 Mapping and Measuring

Objectives

- Develop the skills needed to create maps to scale using graph paper.

Main Idea

To learn how to measure using the metric system, use a compass, and draw maps to scale.

Essential Skills

- writing
- mapping
- cooperating
- labeling
- decision making
- orienteering

Mathematical Skills

- metric system
- mapping
- compass reading
- problem solving
- scale
- measuring
- basic mathematical skills

Materials

- student journals
- protractors
- metric rulers and/or tape measures
- graph paper
- pencils & erasers
- compasses

Pages to Photocopy

- *Mapping Madness* Student Activity Sheet pages 35-38

The following table aligns this lesson with the Arizona Science (5-24-04) and Mathematics Standards. Most curriculum connections shown are implicit within the lesson. Others are achieved through teacher interaction with the class, including discussion of the background information provided. Teachers are encouraged to expand on the lesson to increase its potential as an educational tool and a fun learning experience.

Curriculum Connections: Archeology Lesson 4 Mapping and Measuring

Arizona Science Standards (5-24-04)					
	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Strand 1: Inquiry Process	C2-PO4 C4-PO2 C4-PO3	C2-PO4 C4-PO2* C4-PO3*	C2-PO4 C2-PO5 C3-PO3 C3-PO4 C4-PO5	C2-PO4* C2-PO5* C4-PO5*	C2-PO4* C2-PO5* C4-PO5*
Strand 2: History & Nature of Science			C2-PO3	C2-PO3*	C2-PO1*

Arizona Mathematics Standards (Grades 4-8)	
Standard 1: Number Sense	1M-E3 1M-E6
Standard 2: Data Analysis & Probability	2M-E1
Standard 4: Geometry	4M-E2 4M-E4
Standard 5: Measurement & Discrete Mathematics	5M-E1 5M-E2 5M-E3
* repetition of a performance objective from an earlier grade level	

Introduction

The ability to measure and map is critical in many scientific endeavors. Because of the importance of context and the destructive nature of archeology, artifacts, features, and structures must be mapped accurately. This enables better interpretation of archeological data.

To create accurate maps in the field, archeologists must know how to use a compass and the metric system. The compass orients a map in the universal directions of north, south, east and west. The metric system is standard in all scientific measurements because it allows scientists from around the world to share their data and findings globally. Maps must also be made to scale to accurately show the size of artifacts and features in comparison to each other and to their placement within a site.

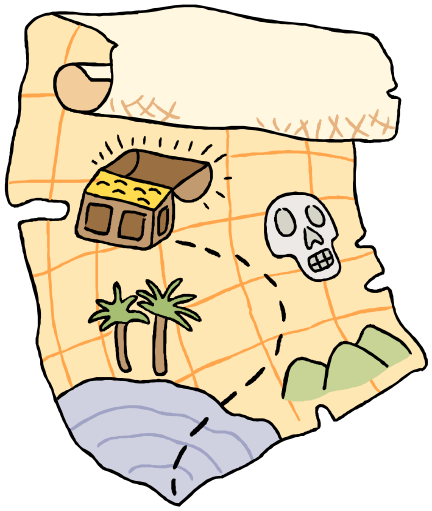
Lesson Framework

1. Terminology
A list of defined terms for teachers.

2. Activity: *Mapping Madness*
An in-class student activity led by the teacher that provides practical experience in using a compass and creating a map.

Terminology

base plate - the flat base of a compass with the direction of travel arrow, often marked with ruler measurements on the top and/or sides
compass dial - moveable portion of a compass, marked by 360 degree increments
compass needle - magnetized needle located inside the dial of a compass and suspended in water so that it can move, orienting the red (positive) end north and the white (negative) end south
direction of travel arrow - arrow located on the base plate outside the dial of a compass indicating the direction of travel
index line - stationary black line under the compass dial located at the base of the direction of travel arrow
legend - a key to symbols used on a map
mapping - a way to graphically represent something, as an exact diagram drawn to scale, so that another person can locate the site and its features at a future date
orienting arrow - arrow inside the dial of a compass in which compass needle should line up when orienting to a designated degree
scale - a series of marks representing fixed distances used when creating maps



Mapping Madness

Teacher Instructions

Objective

To provide orientation to the basic skills of creating maps, including the metric system, compass use, making the map to scale, and a mapping exercise.

Main Idea

In this in-class activity, students will practice measuring using the metric system, learn how to use a compass, practice with a mapping example, and will produce a map to scale.

Materials for *each student cooperative group*:

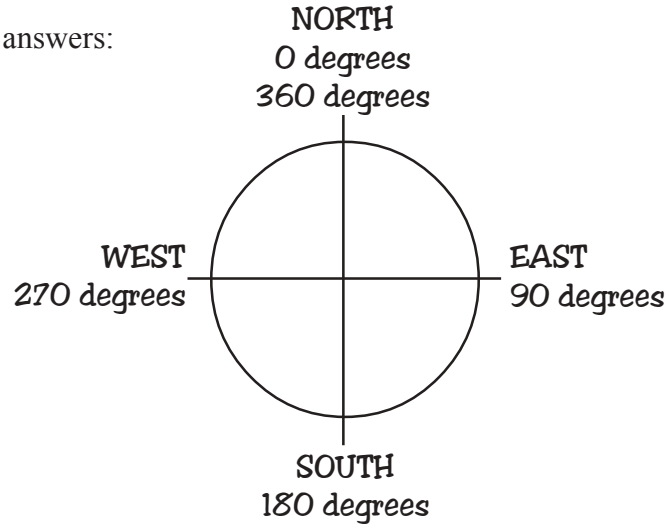
- copies of Student Activity Sheet - one per person or per cooperative group
- metric measuring tape and/or ruler
- compass
- a professionally made map
- graph paper

Procedure

1. Metric System - Allow students to measure items to become familiar with metric units. Introduce them to meters, centimeters, and millimeters. For advanced students, you can practice converting from one unit of measure to another, for example from centimeters to meters.

2. Compass - Orient students to a compass by following the directions on the Student Activity Sheet.

3. Compass diagram answers:



4. Allow students to practice using the compass by calling out degrees for them to set their dials to, then having them orient their bodies in that direction. They should not only have the direction of travel arrow on the compass coming out of their belly button, but their nose and toes should also be lined up at the direction of travel. This reinforces that students should move their *whole* body, not just their upper body. This is good practice if they pursue compass skills with orienteering activities.

5. Scale - It's important for objects on a map to be to scale to accurately show their size. Allow students to examine professionally made maps that show a scale. For example, how many inches on the map equal one mile?

6. Help students create a reproduction of the map from Walnut's Yard using the step by step process provided.

7. Give students different area dimensions and have them calculate the scale needed to map them onto graph paper. The more practice the better! Here are two examples:

- If mapping an area 200cm x 400cm onto graph paper with 26 squares across and 34 squares down, what would be an appropriate scale?
  - Leaving room for margins, 200 (for the number of centimeters) divided by 20 (for the squares to be used across the width of the page) = 10. This would provide a scale of 1 square = 10cm.
  - Now check the longer side to see if it will fit onto the page. 400 divided by 10 = 40. Oh no! The length of the page is only 34 squares! So the scale must be reduced.
  - If the scale is 1 square = 12cm, then to map 200cm would need 17 squares across, and 400cm would need 33 squares down. But this doesn't leave any room for margins! So the scale should once again be reduced.
  - If the scale is 1 square = 14cm, then to map 200cm would need 14 squares across, and 400cm would need 29 squares down. This would work!

- If mapping an area 1500cm x 2000cm onto graph paper with 26 squares across and 34 squares down, what would be an appropriate scale?
  - Leaving room for margins, 1500 (for the number of centimeters) divided by 20 (for the squares to be used across the width of the page) = 75. This would provide a scale of 1 square = 75cm.
  - Now check the longer side to see if it will fit onto the page. 2000 divided by 75 = 27. This would work!

8. You Map It! - Allow students to make a map in an area of their choice, following the directions on the Student Activity Sheet. An alternative is for you to create an area for all student cooperative groups to map. For example, make fossil bone cutouts and place them on the floor as if they had just been excavated. Set the borders of the excavation site, and help students make a map!

9. Discuss the maps that each group made focusing on the chosen scales and how they made the map fit onto the graph paper. Also check that objects within the map are to scale to provide an accurate representation of their size in relation to each other.

Mapping Madness

Student Activity Sheet

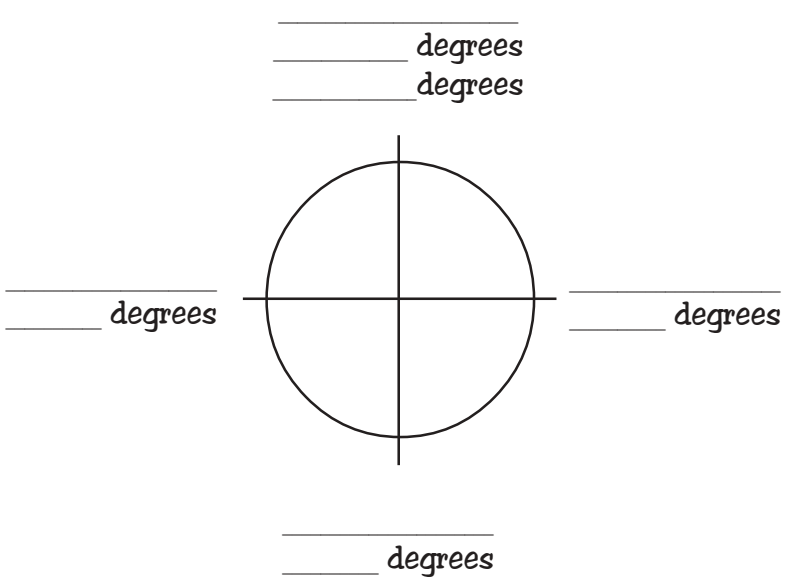
Metric System

Do you understand how to measure things using the **Metric System**? Go ahead and practice. Measure the width of this page. Measure the height of the letters in the title above. Measure a book, your desk, each of your fingers. Got the idea?

Compass

Can you use a **Compass**? The directions on a compass correspond to the degrees of a circle: north is 0 and 360 degrees, east is 90 degrees, south is 180 degrees, and west is 270 degrees.

- Label the diagram below with directions and degrees.



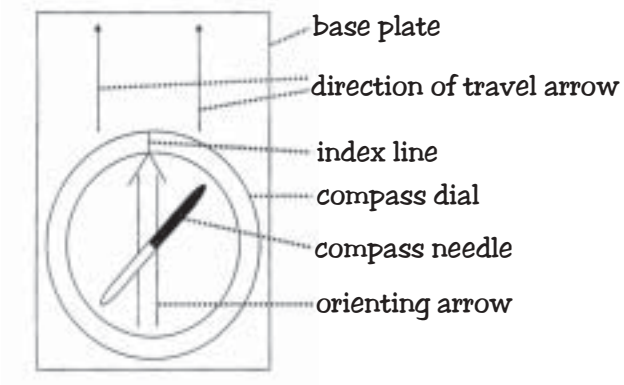
- Label the following directions on the diagram.

Northwest
Northeast
Southwest
Southeast

- Using the diagram and a real compass, find the direction of travel for each of the following degrees. For example, *the direction of travel for 42 degrees is northeast*.

130 degrees
340 degrees
195 degrees
15 degrees

To accurately read a compass, you must hold it correctly. Use the diagram to find the parts of the compass.



1. Hold the compass at waist level so that the **direction of travel arrow** on the **base plate** is coming directly out of your belly button. This arrow should *always* be coming out of your belly button! This reminds you to move your *whole body* and not just the compass when you are taking a reading.

2. Hold the compass flat in the palm of your hand so that the **compass needle** can move freely inside the **compass dial**.

3. Turn the compass dial without moving the base plate so that the direction of travel arrow (and your whole body) is pointed due north. The red end of the compass needle should be inside the **orienting arrow** inside the dial. The dial should show 0 (360) degrees directly over the stationary **index line** at the base of the direction of travel arrow.

4. Now try using the compass. Turn the dial of the compass until 130 degrees is above the index line. With the direction of travel arrow coming out of your belly button, turn your body so that the compass needle lines up with the orienting arrow inside the dial. Are you facing southeast? You did it right! Continue to practice until you are comfortable with using a compass.

Scale

Study a professionally made map. Look for the **Scale**. Do you understand how this was used to make the map and how it is used by the person reading the map? What if you were looking at a trail map. By finding the scale on the map, you can find the length of the trails. Just because the map shows a short line does not always mean that the trail is short!

The following is an example of how to make a map to scale. Follow the below steps one by one and try to recreate the map.

The area mapped in this example was a plot within a yard occupied by a dog named Walnut.
Step 1: Find north using a compass and marked north at the top of the graph paper, south at the bottom, east on the right side, and west on the left side of the graph paper.
Step 2: Measure and mark a 300cm x 300cm area within Walnut's yard.
Step 3: Calculate the scale needed to make the 300cm x 300cm area fit onto the page, still leaving some room at the margins.

- Count the number of squares across the graph paper. There are 26 squares.
- To leave room at the margins, only about 20 squares across the paper can be used.
- Divide 20 (for the squares to be used) into 300 (for the number of centimeters) = 15.
- The scale is 1 square = 15cm.

Step 4: Write the scale, 1 square = 15cm, onto the map.
Step 5: Draw the lines marking the edges of the 300cm (20 squares) x 300cm (20 squares) area to be mapped.

- Count 20 squares across the middle of the page.
- Count 20 squares down the page.
- Connect the lines to make a square.

Step 6: Measure the size of the objects found within the plot and exactly where each is located.

- Doghouse - sits directly in southeast corner. 71cm from east to corner of doghouse. 56cm from south to corner of dog house.
- food bowl - 20 cm in diameter. 15cm from south. 41cm from west.

- water bowl - 23 cm in diameter. 13cm from west. 46cm from south.
- dog bone - 18cm x 5cm. 79cm from south. 132cm from east.
- ball - 3cm in diameter. 58cm from east. 66cm from north.
- rope toy - 36cm long. 86cm from east. 46cm from north.

Step 7: Map each object onto the graph paper.
Step 8: Write a map title, "Area Within Walnut's Yard," onto the graph paper.
Step 9: Write your name, "Marge Post," and the date, "3-1-04," onto the graph paper.
Step 10: See the map that was created on the next page!

You Map It!

Create a map using both your measuring skills and your compass skills. You can use your desk or an area of a work table. You can creatively place items to include in your map, or you can use the area as it normally looks. Each person within your group will help make the map. Each person should have a job. Switch these jobs around so that everyone has a chance to try them all.

Someone will have to **measure**.
Someone will have to **take compass readings**.
Someone will have to **record** the measurements and compass readings for each item.
Someone will have to **create the scale**.
Someone will have to **draw** the map using graph paper.

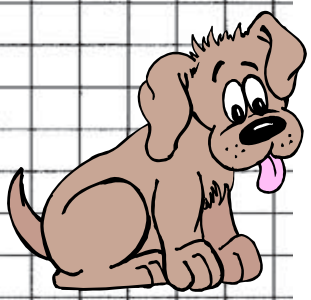
Your map is not complete without a **title**, the **date**, and the **names** of everyone involved. Don't forget the **north arrow**!

When each group has completed a map, trade them around and compare your work with the work of other groups. Did everyone use the same scale? Could you use another group's map to identify their site?

Area Within Walnut's Yard

Marge Post 3-1-04

1 square = 15 cm



N

W E

S

rope toy

ball

dog bone

water bowl

food bowl

dog house