University of Wyoming
AstroCamp

Model of the Solar System
Applications in Scaling

Purpose: To introduce students to the concept of scaling.
To give students a superficial look at the Solar System with each of its bodies.
To help students understand and experience the vast distances in space.
To give students a chance to exercise outdoors.

Wyoming State Science Standards Addressed:

Standard 1:

In the context of unifying concepts and processes, students develop an understanding of scientific content through inquiry. Science is a dynamic process; concepts and content are best learned through inquiry and investigation.

Benchmark 7:

The Earth in the Solar System
Students describe the Earth as the third planet in the Solar System and understand the effects of the sun as a major source of energy, gravitational forces, and motions of objects in the Solar System.

Benchmark 14:

Effects of Motions and Forces
Students describe motion of an object by position, direction, and speed and identify the effects of forces and inertia on an object.

Standard 2:

Students demonstrate knowledge, skills, and habits of mind necessary to safely perform scientific inquiry. Inquiry is the foundation for the development of content, teaching students the use of processes of science that enable them to construct and develop their own knowledge. Inquiry requires appropriate field, classroom, and laboratory experiences with suitable facilities and equipment.

Benchmark 2:

Students use inquiry to conduct scientific investigations.
Ask questions that lead to conducting an investigation.
Collect, organize, and analyze and appropriately represent data.
Draw conclusions based on evidence and make connections to applied scientific concepts.

Wyoming State Math Standards Addressed:

Standard 1:

Students use numbers, numbers sense, and number relationships in a problem-solving situation.

Benchmark 1:

Students represent and apply numbers in a variety of equivalent forms

(such as changing from percent to decimal to fraction, etc.) and in a problem-solving context: prime factors, factors, and multiples; rational numbers and proportions; and square roots and powers.

Benchmark 4:

Students understand properties of operations with rational numbers.

Goals:

Students will be able to scale on a map and apply it to other applications.
Students will understand the scale of the Solar System.
Students will be able to discuss the bodies of the Solar System.
Students will understand the reason why the planets orbit the Sun and the moons orbit the planets.
Students will be able to name the planets in order.
Students will be aware that there are other planets newly discovered or are yet to be discovered.
Students will know what an orbit is.
Students will understand how vast space is.
Students will get some physical exercise.

Entry Level:

Students will need to understand scaling and why it is used.
Students will need to be able to walk approximately 2 miles.
Students will need to be familiar with maps, legends, keys, etc.

Premise:

Many people look at the night sky and are totally unaware what those bright, unblinking lights are. Furthermore they have no concept of how far away they are. This activity combines a scaling exercise with a discussion about the Solar System as the students walk a scaled model of the Solar System. Students will learn how scales are used on maps and then use that information to calculate different distances on a map. Then the students will apply that knowledge to calculate the distances to each planet from the sun using a scale model of the Solar System. Students will walk these distances to come to meaningful conclusions and realizations about the planets and the vastness of space.

Supplies:

Maps of Mars	Prepared models of the planets
A large area	Rulers
Paper & Pencils	Pictures and descriptions of the planets

Activities:

Maps & Scaling

Introduce: Introduce students to the concept of scaling by handing out maps of any sort and discussing scaling.

Instruct: Scaling is used to represent many things. Maps are commonly used by people to represent larger areas of land. It is important to cartographers that their maps represent as accurately as possible the land that they are reproducing. There are several important features on maps such as

lines of contour, elevation, water sites, but most importantly there is the scale. Without the scale a person reading the map would have no idea how much distance there was between two places. Each map has a different scale depending upon the size of the area represented and the size of the map. To estimate the distances in a straight line all you need is a ruler and some basic algebra skills. Note: (Unless the terrain is perfectly flat or you are flying, these measurements are only an estimate.)

Activity: *Map Reading*

Have students pair off.
Hand out maps of Mars to pairs of students.
Have students identify various predetermined sites such as the highest point, the lowest point, the distances between objects using the scale. To make this a bit more difficult have the students identify specific targets using Latitude and Longitude.

Additions/Modifications to Instruction/Activity:

Introduce: Ask the students what they know about the Solar System. Allow a little time for discussion, but as this is an informational hike, most of their questions can be addressed while walking.
Show the students the model of the Sun. Tell them that we will be walking a scaled down version of the Solar System. That is all the information that is required unless you want to make it more challenging by giving the students the opportunity to come up with their own estimations of how many paces it is between planets given that the Sun is as big as the yellow ball. This will take a bit longer, but it is well worth the challenge that this will represent to the students.

Activity: Choosing a point that has about a mile of fairly flat and straight terrain, set the Sun out in a place that can be seen and begin pacing the distance between each planet. Stop at each planet and give a brief synopsis of the planet and any interesting features, moons, facts, etc., about the planets as needed. Ensure that each student has a bottle of water or something else to drink if the weather is warm, and a jacket if the weather is cold. If doing the challenging version of this activity then allow the students to mark off their estimates before you do. It generally adds a degree of enjoyment to allow the students to compete against each other for prizes for the most accurate estimate.

Additions/Modifications to Activity:

Questions:

What are the names of the planets in order from closest to the sun to the furthest?
Why do scientists, cartographers, and people use scaling?
What percent of the Solar System does the Sun represent?
Why do planets orbit the sun and moons orbit their planet?

Teaching Strategy: Conceptual Change Model (Constructivism)

Strengths:

The teaching strategy used in this activity is conceptual change model. The conceptual change model is used to challenge students to confront their beliefs about the Solar System, make predictions about the distance between objects, and then challenge those predictions. Each activity within the lesson is based upon a teaching philosophy called Constructivism, and allows for hands on/minds on interaction by the students. This philosophy tends to engage the most students because it is student-driven and student-focused. Hopefully any misconceptions about the Solar System will be confronted, addressed, and corrected during the lesson. It is important to assess understanding as frequently as possible by using effective inquiry skills.

Weaknesses:

This teaching strategy is prone to allowing students to fall through the cracks if appropriate measures are not taken. Frequent follow up is a necessity and allows for conceptual checks.