Lesson 7 – Coordinate Graphs *(required)*

Background

One of the basic needs of astronomy (and of the physical sciences) is the need to give reasonable descriptions of positions of objects with respect to each other. This is accomplished through the use of coordinates.

For part of their mission, students will be expected to navigate their way through the planets using a coordinate graph. This coordinate graph consists of one quadrant where x is the horizontal axis or line across the plane, and y is the vertical axis or line across the plane. The x and the y-axes are numbered in equal increments starting at the origin or zero. Points can then be plotted at the intersections of the numbered x and y axes. These points are called ordered pairs. Ordered pairs can be used to communicate a location of a point on a coordinate plane.

At the 3rd through 5th grade level, students may have some understanding of a coordinate grid from perhaps the study of maps and latitude and longitude in geography. However, the mathematical concept and vocabulary of ordered pairs and x and y-axes will be relatively new to most students.

This activity will introduce many of the concepts involved in coordinates and will further extend the students' knowledge of graphing. In order for students to be mathematically literate, they must be able to construct and interpret a variety of types of graphs.

Teacher Notes and Hints

Prior to the lesson

- Coordinate graphs and many of the associated vocabulary words will be new to some students. Moon, Mars, and Beyond preparation is a great way to introduce this material. The students will be motivated to learn; the concepts studied will be timely and more meaningful.
- If the students have already completed the "Metrics and Measurements" activity, they will be more comfortable with the graph paper and counting the lines and squares. You will now simply be labeling the lines with numbers for them to count. (Of course, you also add on the vocabulary and concepts that go along with ordered pairs, but you tell them they will now learn another way of finding a location on a map without having to write out all the "sentence directions.")
- Review all vocabulary with the students before beginning this activity. Team teaching with the math teacher or coordinating similar lessons in the math class is a great way to train your "astronauts" while hitting many standards!

- Since some of these concepts may be difficult for third graders, it is helpful if each student draws the quadrants and x and y-axes on their own graph paper as you discuss and teach the lesson.
- Use a transparency with graph lines and an overhead projector to teach the concepts. The students can draw each component of the graph as you draw on the transparency and you can easily watch and check their work without having to turn away from them to the board.
- For third graders, you may want to use color-coded lines to quickly check their understanding of the words "horizontal" and "vertical" as the x- and y-axes.
- You may not want to go into negative numbers in any depth (if at all) with 3rd or 4th graders. It is enough that they recognize the difference between the numbers with and without the negative sign, and they know where to plot the numbers correctly.

Skills and Objectives

Students will be able to:

- Learn the parts of a coordinate graph, including x- and y-axes, ordered pairs, and origin
- Plot points when given the ordered pair
- Name the ordered pair correctly when shown a point on a coordinate graph
- Understand the importance and uses of coordinate graphs in finding locations
- Relate coordinate graphs and ordered pairs to Moon, Mars, and Beyond Mission work
- Construct and interpret coordinate graphs

Activity Overview

In this activity, the students learn about coordinate graphs and extend their knowledge of mapping and scales. They learn the appropriate terminology associated with coordinates and ordered pairs, and practice locating points on x- and y-axes and writing ordered pairs when given the location on the graph.

They also become aware of the role of ordered pairs in their Moon, Mars,and Beyond Mission.

Vocabulary

coordinate – a number that identifies a point on a graph or map

coordinate graph – a graph that displays coordinates for identification

axis - a line that is used to find or draw points; lines of a graph

quadrants – the areas that are formed when two lines intersect to form four quarters.

horizontal – parallel to or in the plane of the horizon

vertical – at right angles to the horizon or ground level

origin – the point where the axes cross

ordered pair – a list of two numbers. For a coordinate graph, the x coordinate is listed first, the y is listed second.

Key Concepts

1. Coordinate graphs are another way to identify a specific point.
2. Ordered pairs are used to find specific locations and are useful in a variety of real-world situations.
3. Coordinate graphs are used in other "forms" (for example, latitude and longitude on a map).
4. Coordinate graphs are used to locate a lost ship in our solar system.

Materials

- Graph paper
- Pencils
- Colored pencils (optional)
- Transparency graph

Procedure

Prepare a transparency of graphing paper (1 cm paper works best).

Distribute graph paper and colored pencils (optional) to the students before you begin the discussion of coordinate graphs.

Review all vocabulary from the previous activity concerning mapping and tell them they are now going to learn another way to locate an object without having to write out all the directions! They will only need to write two numbers in a particular way on a particular kind of graph; the two numbers will automatically take the place of all the words!! (Student will be interested in how two numbers could do all that, happy to "get out of" writing all the words, and motivated to play the same kind of location game).

Begin by drawing x- and y-axes on the graph; review the terms and have the students draw and label axes on their graph paper. You may want younger

students to color code their lines so you can reinforce the horizontal x and the vertical y.

Have the students identify points on each line segment before moving on to ordered pairs. Stress that the x always comes first in the pair.

Work through several examples depending on the grade level and math abilities in the class. You may also have the students report the distance to the origin, if you have constructed a scale.

Extensions

The difficulty of the exercises can be increased with grade level. Higher grade levels can incorporate negative numbers into their graphs on a more involved level.

Fifth graders should work with how graphs may visually change (although the values plotted do not) by applying different scaling units. Fifth graders should begin to understand how graphing choices (scale selection) could affect the display of data. For example, if they are given a set of data, they can be asked to plot the data using two different scales for just the y-axes; if the data is plotted with units of "one," the data will look much different than if the data is plotted by units of "tens" on the y-axis. Fifth graders will also begin to understand that scale selection can influence the interpretation of the data presented.

The lesson can be extended to incorporating changes in both the x- and the y-scales if the students have mastered the concept with scale changes on only one axis.

Fifth graders can work on predicting what a graph looks like before they draw it.