



Lesson Plan Info:

Title: Cartesian Coordinate Graphing
Created By: Cindy Gutierrez
Date Created: 2/18/05
Grade: 6th
Subject: Math
Topic of Study: Graphing
Type of Lesson Plan: Direct Instruction
Class Submitted For: ED 301: Frameworks
Instructor: Cindy Gutierrez

Standards

Content Area: Math

Standard #: 2-- Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

Benchmark/Grade Level Expectancy: As students in grades 5-8 extend their knowledge, what they know and are able to do includes representing, describing, and analyzing patterns and relationships using tables, graphs, verbal rules, and standard algebraic notation.

Overview

Objective: The student will be able to name and graph at least 10 points on a Cartesian coordinate graph using ordered pairs in a game with a partner to accurately find the hidden "Hurkle" within 10 guesses or less.

Assessment Plan: After learning how to graph points on a Cartesian coordinate graph, the students will pair up to play a game of Hurkle whereby each student must use his or her knowledge of ordered pairs to specify points on the graph and accurately locate the Hurkle in 10 guesses or less. After each guess, the student's partner will give a directional clue to help his or her partner know which ordered pair (point) to guess next.

Learning Context: This is an introductory lesson on the Cartesian Coordinate Graph System, whereby students learn about basics such as the x- and y-axis in the first quadrant, ordered pairs, and origin. Students should also have a basic understanding of cardinal directions in order to be successful in the Hurkle game.

Time Allotment: 30-45 minutes

Instructional Materials:

Teacher Materials:

- Flight of the Bumblebee music at <http://www.soundclick.com/bands/0/marisstellaconcertbandmusic.htm>
- Flashlight with fly outline over the light
- Set of 7 Cartesian Coordinate Overheads
- Definition Cards for Math Word Wall
- Hurkle Game Overhead
- Overhead Markers

Student Materials:

- Blank Cartesian Coordinate Graph Handout (1 per student)
- Hurkle Game Sheets (at least 1 per student plus a few extra for students who finish early)
- 4 quadrant Cartesian Graphs for students who are familiar with negative numbers
- Pencils
- Folders for a divider (one per pair of students)

Differentiation of Instruction: I will use a variety of strategies to meet the many needs of diverse learners in this lesson. I will implement tri-modal instruction in the following ways: overhead graphs and new vocabulary definitions on the math word wall for visual learners, oral instruction, questioning, directions and partner discussions for auditory learners, and physically plotting points on graph paper during the Hurkle Game for kinesthetic learners. I have integrated many multiple intelligences to meet the diverse needs of students as well. For example, using music as the “gaining attention” component of my lesson opening appeals to the musical intelligence. The concept being taught (graphing) appeals to mathematical and spatial intelligences because the techniques of graphing on a Cartesian Coordinate System are very sequential, logical, and provide a visual grid to help students understand ordered pairs. Adding new vocabulary to the math word wall supports the linguistic intelligence, as well as the opening story at the beginning of the lesson. Also, giving students numerous opportunities to discuss ideas and explain their thinking with partners before sharing with the whole class supports interpersonal intelligence. Playing the game with a partner also supports this intelligence. In addition, giving students an opportunity to share their thinking with just one other person supports the needs of ESL (linguistically diverse) students because they may be too intimidated to share their idea or pose a question with the whole class, but sharing with a partner provides a safer environment to work with the English language in trying to explain their mathematical understanding. This partner situation can also support students who have a learning disability or are not as strong academically in mathematics. Lastly, providing a four-quadrant graph with negative numbers as an option for the game provides students who know more about graphing an opportunity to extend their knowledge and provide them with more appropriately challenging learning tasks.

BRAINSTORMING of Essential Components (Turn this section in with 1st Draft Only)

Opening: (How are you going to CREATIVELY 1) gain students' attention, 2) get students to recall related prior knowledge or experience and 3) inform them of the learning objective?)

Gain Attention: Share story about Rene' Descartes' discovery of being able to identify the location of an object anywhere on a gridded plane, which led to the development of the Cartesian Coordinate System. Use the music Flight of the Bumblebee to have students reenact.

Recall Prior Knowledge: Have students think of a real-world application of a grid system to locate any place in the world (longitude & latitude)

Learning Objective: Today, we are going to be learning about a new type of graphing system called the Cartesian Coordinate System and you will be able to demonstrate your knowledge at the end of the lesson in a game called "Hurkle".

Guided Practice: (What kind(s) of classroom activity(s) will encourage students to use the material in a nonevaluative atmosphere so that they can practice what you have just taught? Will it be interspersed throughout your presentation of information or will it be a separate activity done right after your presentation? How will you model it? Will it be written or oral or both? How can you provide opportunities for students to work with others (in pairs or groups) as well as individually?)

- Students will be given one ordered pair and asked to graph it. Then they will confer with a partner.
- In partners, students will be given 4 points and they must identify the ordered pairs that go with the points.
- Students will be given 4 sets of ordered pairs and they must graph them (by themselves). Then I will ask for individuals to come to the overhead and graph them while students check it against their own answers.
- I will model one game of Hurkle with the whole class on the overhead.

Independent Practice (Assessment): (This is where you carry out your assessment plan for the lesson)

After modeling a game of Hurkle with the students, they will pair up and play at least one game each trying to locate the Hurkle with fewer than 10 guesses.

Present & Structure New Content (Direct Teaching of NEW Information): (How are you going to break-down and organize the new information into "bite-size" chunks in order to present it clearly and effectively? Think about these possibilities: part-whole relationships (p. 189), sequential relationships (p. 189), or comparative relationships (p. 191))

I will use part to whole relationships to introduce students to all of the components that make up a Cartesian Coordinate graph (axis, origin, ordered pairs). Students will be creating their own graph following along with the overheads.

Checking For Understanding: (What specific prompts and questions will you use to check for student understanding? This should be embedded throughout the lesson.)

- As students work on the guided practice, I will be walking around the room looking at students' work and posing questions such as, "Tell me how you graphed that point?" "Why did you put the (#) before the (#) in your ordered pair?" "Explain to your partner how you knew where that point should go on the graph."
- Before letting students begin on the assessment, I will ask a few students to repeat the directions to make sure they understand.
- I might also use the thumbs-up, sideways, and down to judge understanding throughout the lesson.

Closure: (How will you wrap-up the lesson and give students an opportunity for reflecting about the content or process of their learning?)

I will have the students turn to a partner and share what part of the lesson was most effective for them in helping them understand the Cartesian Coordinate Graph System.

Sequence of Procedures

Opening

1. Gaining Attention: Share the following story with students: ***In the 1600's, there lived a very famous philosopher and mathematician named Rene' Descartes who began attending college at the age of 8. Interestingly, he was very accustomed to staying in bed until 11 a.m. and many of his university professors worked around this idiosyncrasy in order to teach him. One day while he was lying in bed, he saw a fly buzzing around on his ceiling and his mind began to wander in a mathematical direction as he began thinking about how he could describe the location of that fly on his ceiling at any given point.*** [Begin playing Flight of the Bumblebee music]. Tell students that they are to imagine that they are Descartes watching the fly and they are to try and figure out how they would describe the location of it. Use the flashlight to project the fly cutout on the ceiling and have it stop every now and then on an intersection in the ceiling. Ask 2-3 volunteers to share how they might describe the fly's location at any given time. Relate their answers to the solution Descartes came up with which was the Cartesian Coordinate System. This system put an imaginary grid system over a plane so that at any given time, an object could be described by the intersection of the gridded lines on the plane. They called it the Cartesian system because his last name was 'Cartesius' in Latin. Without Descartes' work, the study of calculus would be obsolete as it linked algebra with geometry.
2. Prior Knowledge: Ask students if they can think of a real-world application of this "gridded" system. One example might be longitude and latitude.
3. Purpose (Objective) of Lesson: Explain to students that today they will be learning about this Cartesian Coordinate system, which is a new type of graphing. They will be able to demonstrate their knowledge at the end of the lesson in a game called "Hurkle".

Body

Teacher Input (Guided Practice & Checks for Understanding Embedded Throughout Teacher Input)

4. Display overhead (OH) #1. Tell students this is a model of the grid pattern that Descartes imagined and we call it the Cartesian Coordinate Graph. Ask a student to put this definition card on the Math Word Wall.
5. Pass out the Cartesian Coordinate Graph handout to students and ask them to add elements to their graph as you teach them on the overhead.
6. Display OH #2. Describe that the outer edges of the graph are called axis and are numbered starting with 0 and increasing by one for each line. Explain that the bottom axis is called the "Horizontal Axis" or the "X-Axis" which will be important in algebra and calculus later. Ask students if the word "horizontal" sounds like another word in they know. (It is similar to the word "horizon" and this can help them remember which axis is the horizontal axis). Have students copy this information onto their handouts and ask another student to put this definition card on the Math Word Wall.

7. Display OH #3. Explain that the side axis is called the “Vertical Axis” or the “Y-Axis”. It is also numbered starting from 0. Have students copy this information onto their handout and ask a third student to put this definition card on the Math Word Wall.
8. Use a Think-Pair-Share with the following question: Do you think that the Cartesian Coordinate Graph System only goes out as far as 6 on the horizontal axis and as far as 8 on the vertical axis? Students will think about the question for 30 seconds first, then share with a partner, and then a few students can share with the whole class what they said or what they heard their partner say. Encourage students to explain their thinking behind their answer. Help students connect the arrows on the ends of the axis with the concept that the graph can be infinite in size.
9. Display OH #4. Explain that the graph allows us to plot points on the graph that can be named by an ordered pair with the first number of the ordered pair being the distance on the horizontal axis and the second number being the distance on the vertical axis. Tell students that an easy way to remember which number goes first is that ‘horizontal’ starts with an ‘h’ which comes before the ‘v’ in ‘vertical’. Or, another way to think about it, is when plotting a point, you go over first on the horizontal axis and then up on the vertical axis; ‘over’ and ‘ordered pair’ both start with ‘o’.
10. Explain that a special name is given to the ordered pair (0,0) which is called the origin. It is called this because that is where the graph originates from, like a starting point. Have students copy this information onto their handout and ask another student to place the definitions for ordered pair and origin on the word wall.
11. Display OH #5. Ask students to work with a partner to plot the point that matches the ordered pair (4,5). Ask for one student to describe to you how to plot the point. Model on the overhead. Ask students to give you a thumbs up or thumbs down sign signifying whether they agree with that student’s answer. If some students do not agree, ask another student to explain his or her answer. Help students clarify their thinking and make sure the correct procedure is used and point graphed.
12. Display OH #6. Ask students to work with their partner to write the ordered pair that goes with each point, A-D. They can do this right on their handout. As students are working on this guided practice, move about the room making sure students understand. Probe students to explain their thinking in how they come up with their answer using questions such as, “Explain how you came up with those numbers?” or “How did you know to put the (#) first and the (#) second?”
13. Ask four different students to share their solutions and probe students to explain their thinking as in step 12 above.
14. Display OH #7. Ask students to *individually* plot the points (6,2), (1,4), (6,6), and (0,8) on their handout. As students are working on this guided practice, move about the room making sure students understand. Probe students to explain their thinking in how they come up with their answer using questions such as, “Which direction do you go for the first number?” or “What are these sets of numbers called again?” or “Why didn’t you go up first and then over?”

15. Ask four different students to come to the front of the room and plot a point on the overhead. As they do so, probe them to share their thinking about how they came up with their solution the same as before in the guided practice so all students can understand.
16. Ask students for thumbs up, thumbs down, or thumbs sideways signal to see how well they think they understand ordered pairs and plotting points on the Cartesian Coordinate System.

Assessment

17. Ask students if they have ever played the game, *Battleship*. Explain that the game they are going to play now to demonstrate their understanding of plotting ordered pairs on the Cartesian Coordinate System is similar to Battleship. Display the Hurkle Game overhead. Explain to students the following directions for the game. ***The game is played with a partner where one person decides where the Hurkle is located and the other person will guess ordered pairs to try and find the location of the Hurkle. After each guess, the person who hid the Hurkle provides a cardinal direction clue to help his or her partner make their next guess. Students will probably need a divider like a folder between them so the partner guessing does not see where the Hurkle is hidden. The first person begins by marking on their paper where the Hurkle is and circles it. The partner then makes their first guess and BOTH students plot it on their papers. They BOTH also label the ordered pair guess in the column on the right. Then the first person gives a directional clue to help the partner with their second guess. The object of the game is to guess the Hurkle within 10 guesses.***
18. Model one game with the class whereby you hide the Hurkle and different students make guesses using ordered pairs.
19. Explain to students that they are now going to play 2 games with a partner where each person will get the chance to hide the Hurkle and provide clues in one game and each will get to make the guesses in another game. Before beginning, ask a student to explain the directions to the game.
20. Have students select a partner and have one partner come to the front of the room to get 2 Hurkle game sheets and a folder for a divider. If students are more advanced and are familiar with negative numbers, have them play on the game sheets that have a 4-quadrant Cartesian Coordinate Graph. If students finish early, they can play another game.

Closure

21. Remind students that they learned about using ordered pairs to graph points on the Cartesian Coordinate System. Have students turn to their partner and share the part of the lesson where they felt that they “GOT IT” during the lesson—when the information became very clear and understandable.

[Reteaching Activities:](#)

If students do not understand this concept, another way to reteach it might be to use a more kinesthetic approach. Make a variety of cut-out numbers and have a larger size (11x17) Cartesian Coordinate Graph with axis labeled and numbered for each student. Sitting down with the students, pick two numbers to be the ordered pair. Use the first number to physically count across the x-axis starting at the origin the distance indicated by the number. Take the second number and place it on top of the first and physically move it up the graph along that particular vertical grid line the distance indicated by the second number. Once they find the right point, have students put a sticky dot at that point and write on the dot the ordered pair.

Extension Activities:

Have students take home the Hurkle game and teach and play it with a parent or older sibling. They must be able to explain all the new vocabulary to them and play at least one game.

Sample Student Products:

Sample Products Attached

Teaching Materials:

Teaching Materials Attached

References:

Flight of the Bumblebee Music at

<http://www.soundclick.com/bands/0/marisstellaconcertbandmusic.htm>

Stenmark, J.K., Thompson, V., & Cassey, R. (1986). *Family math*. Lawrence Hall of Science, University of California: Berkley, CA.