Civil Air Patrol's ACE Program
Plot Your Plane
Grade 5 Additional Balsa Power Plane
Drug Demand Reduction Manipulative Item Lesson

Topics: forces, motion, plot coordinates (science, math)

Length of Lesson: 60 minutes

Objectives:
- Students will identify longitude and latitude.
- Students will plot ordered pairs on a Cartesian Plane.
- Students will experiment with flight.

<u>National Standards:</u>

Next Generation Science Standards:
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

CCSS Math:
- 5.OA.B.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.
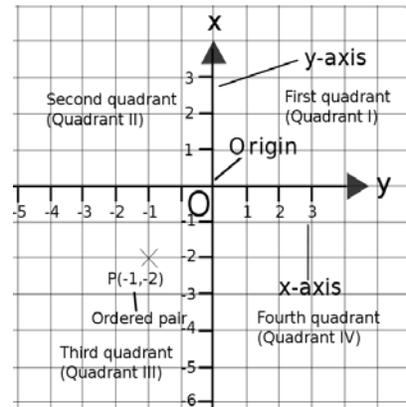
CCSS ELA:
- RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Background Information:
Most of the maps we use include lines of <u>Latitude and Longitude</u>. These lines allow us to quickly and accurately locate places and features on the earth's surface.

- To identify a point on the surface of the earth, a geographic coordinate, or "grid" system was devised. By reference to meridians of longitude and parallels of latitude, any position may be accurately located when using the grid system.

People use modern technology to help locate buildings, places to eat, and new destinations. GPS (global positioning system) technology uses longitude and latitude to pinpoint locations and guide users to their desired destination. However, students need to know that sometimes these modern conveniences may not work, and their knowledge of plotting points on a map or globe will come in handy.

Pilots, navigators, and astronauts use their knowledge of plotting points to assist them when flying. Aeronautical charts, which include lines of longitude and latitude, help to plan flights and keep track of their progress. Latitude and longitude also play an important role in determining times and dates as one travels from one time zone to another.

In this lesson, students will understand the similarities between plotting longitude and latitude and plotting on a Cartesian Plane. A Cartesian Plane (or a coordinate plane, as it is sometimes called) is a basic concept for coordinate geometry. It describes a two-dimensional plane in terms of two perpendicular lines or axes: x-axis and y-axis. The x-axis forms a horizontal number and the y-axis forms a vertical number line. The students will be using a Cartesian Plane to plot their airplane coordinates.

Materials:
- wall map or map on a projector for whole group instruction
- Cartesian Plane on a projector (or chalk or white board, or chart paper) for whole group instruction
- "Plot Your Plane" copies for the students
- balsa power plane kits (provided by CAP for students)
- masking tape
- pencils
- copies of article "The Coordinate System" from ReadWorks (for ELA standards)

Lesson Preparation:
1. If the students have not assembled their balsa power planes in Academic Lesson #2, Forces of Flight, have them assemble their planes before this lesson.
2. Set up a space in the room for a Cartesian Plane by dividing the area into four quadrants, using masking tape. (Make sure there is room beside the end of each line for students to stand back and fly their balsa powered planes.)
3. Label the axes with either x-axis or y-axis.
4. Number each quadrant: I (top right corner); II (top left corner); III (bottom left corner); and IV (bottom right corner).
5. Mark off numbers in all four quadrants from 1-6.. Indicate (+) or (-) for each #.

Lesson Presentation:

1. Display a map that has lines of longitude and latitude. Discuss with students their knowledge of and questions about lines of longitude and latitude. Explain that lines of longitude and latitude are used to plot the point for which we are looking or where we want to go.

2. Ask students if they know another easy way to find out where something is or where we want to go. (They will probably say the navigation system on their cars or their phones.) Explain to students that, yes, the GPS (global positioning system) in their phones do provide accurate directions, most of the time, but, sometimes we need to use maps and the important lines of longitude and latitude to find where "X marks the spot!" Tell students that even with all the modern technology that is available today, pilots, navigators, astronauts, and even students need to be able to plot points using longitude and latitude. Pilots may want to find a landmark that is not found on their instruments. Astronauts may need to plot a landing path on the Moon, or even Mars! Students may want to find a specific store that sells their favorite candy, or, participate in a Geocaching game. Understanding how to use longitude and latitude is a very useful tool- even if we do have GPS!. Show the video, <u>Dr. Nagler's Laboratory: Longitude and Latitude,</u> for a great description of how pilots use these two lines on maps.

3. To get an idea of how to use longitude and latitude to locate points, students will begin with locating and plotting points on a Cartesian Plane. To give them a quick (and interesting) understanding of the x and y-axes on a Cartesian Plane (or, as it is also called, a coordinate plane), have them watch the video/song, _Coordinate Plane._

4. Explain to students the difference in the numbers of longitude and latitude and the numbers on a Cartesian Plane. (Longitude and latitude do not have positive and negative numbers, only numbers going in different directions, such as east-west and north-south. Cartesian Plane numbers are positive in Quadrants 1 and IV and negative in Quadrants II and III.)

5. Demonstrate the following on a white board, chalk board, or chart paper, or from a projector.

    a. Draw a large plus sign on the board. Tell students the horizontal line is the x-axis and the vertical line is the y-axis. (Label the lines.) Show how the x-axis can be compared to lines of latitude and the y-axis can be compared to lines of longitude in their directions.
    b. Place a circle where the x-axis and y-axis meet. Tell the students this is called the Origin. (Label this point.)

c. As shown in the video, label the top right quadrant- I (+), the top left quadrant- II (-), the bottom left quadrant- III (-), and the bottom right quadrant- IV (+). Tell students that you have drawn a very simple Cartesian Plane.

d. Point out that Quadrants I and IV will be "positive numbers," while Quadrants II and III will be "negative numbers." (Make some marks along each of the four lines and label the marks with numbers that you explain are either + or -.)

e. Tell students that now you will demonstrate how to plot numbers on the Cartesian Plane called "ordered pairs."
   (1) The first number of the ordered pair will be plotted on the x-axis. (either positive or negative)
   (2) The second number will be plotted on the y-axis. (either positive or negative) Demonstrate this for whole group to see on both the positive and negative sides, and then allow students to plot points on the board, as you direct examples of ordered pairs.

6. Distribute "Plot Your Plane" sheets to each student to keep at their desk with their pencils.

7. Next, distribute the students' pre-assembled balsa power planes to them. Tell the students that they will be using their power planes to plot ordered pairs on a Cartesian Plane on their paper.

8. Divide the students into 4 groups. Then, have each group line up at the end of one of the four axis lines with their balsa planes. Tell them they will be taking turns (one person per group at a time) flying their planes and allowing them to land inside the Cartesian Plane on the floor. (The students will be lined up several feet behind their axis line to fly their planes.)

9. Tell students that when it is their turn, they will wind up their power plane and release it towards their axis line.
   a. They will count how long their power plane stays in the air. This number is the number they will use to begin formulating their ordered pair.
   b. Their number will be either positive or negative, depending on which Quadrant the airplane lands.
   c. Thus, their first number will be the # of seconds flown, and either positive or negative. Have them write their number on their "Plot Your Plane" sheet in the Flight 1 box at their desk and then get back in their line to do their second flight.

10. Students will fly their power plane two separate times in order to get both numbers for their ordered pair. The first flight is the first number of the ordered pair. The second flight is the second number of the ordered pair. When a student has

successfully flown his/her plane twice, he/she should have an ordered pair that they have written in the boxes on their "Plot Your Plane' sheets.

11. Students can then plot the numbers on their Cartesian Plane and draw lines connecting the ordered pair. They should label the Origin, where their x-axis meets their y-axis, with a letter or name of their choice.

12. After all students have completed the process, have students write the directions for plotting ordered pairs on a Cartesian Plane (on the back of their "Plot Your Plane" sheets.) Have students share their directions with the whole group.

Summarization:
Ask students the following review questions.
- Why do students need to understand longitude and latitude?
- Why do pilots need to be able to use longitude and latitude?
- How is a Cartesian Plane similar/different to/from map/globe?
- Why is it important for students to know how to plot points on a map?

Character Connection: Remind students that when working in groups, everyone must take turns and be patient with one another. Group members must also be willing to help each other with tasks to work toward the ultimate goal of the group. Also, in life, each step to reach a personal goal should be plotted and planned well in advance. If one desires to become a pilot, he/she has to set the plan using points going in the directions they wish to go. (Such as they need to understand math and science before they can take a test to become a pilot. They need to find a way to earn the money needed to take classes to become a pilot.) If they do not plot a plan for their life, they will not be able to reach goals that will make them happy and productive adults.

Drug Demand Reduction (DDR) Connection: See page 10.

Assessment:
- teacher observation
- "Plot Your Plane" worksheet

Additional activity ideas to enrich and extend the primary lesson (optional):
- Have students develop different ways to use their airplane, a Cartesian Plane, and ordered pairs to practice plotting on a grid.

- Divide students into small groups. Have groups determine other ways that they can use ordered pairs in everyday life. Have students share ideas with the whole group.

- "Introduction to Latitude and Longitude" (National Geographic activity)

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- "A Latitude/Longitude Puzzle" (National Geographic activity)

- Have students try to aim their balsa power plane to hit a specific mark (target) on the floor's Cartesian Plane. Have them determine if they needed more or less force to make it to the desired target.

- Have the students read the article "The Coordinate System" from ReadWorks to continue the work on coordinates.

- Create a Geocaching activity around your campus. You will need GPS receivers for students to use in locating the caches. Find suggestions at 10 ideas for geocaching at your school.

Additional Resources:
- Articles "The Meridians of Longitude" or "Latitude" from ReadWorks for further reading on the use of latitude and longitude in using maps.
- "Coordinate Planes – Plotting Points on a Four Quadrant Graph" (video)
- "Coordinate Plane Song ★ Plotting Points on all 4 Quadrants" (video)
- "Latitude and Longitude is Useful One Direction Remix HD" (video)
- "Dr. Nagler's Laboratory: Longitude and Latitude" (video)
- "What is Geocaching?" (video)

Plot Your Plane

Name _____

Label your axes as x-axis and y-axis. Conduct 2 flights with your balsa power plane. For each flight, count the seconds your plane stays in the air and then determine if the plane landed in a positive or negative Quadrant of the Cartesian Plane on the floor. Write your two numbers and whether each is (+) or (–) in the boxes below. Then, plot your numbers on the grid, below. Finally, draw lines to have your x-axis number meet your y-axis number to plot your plane.

Flight 1	Flight 2
# and whether (+) or (-) _____	# and whether (+) or (-) _____