Geometry Station Activities

for NCTM Standards

WALCH EDUCATION®

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Introduction

This book includes a collection of station-based activities to provide students with opportunities to practice and apply the mathematical skills and concepts they are learning. It contains several sets of activities for each of the twelve topics: Points and Lines; Congruent Triangles; Relationships in Triangles; Proportions and Similarity; Right Triangles and Trigonometry; Quadrilaterals; Transformations; Coordinate Proof; Circles; Area; Surface Area; and Volume and 3-D Figures. You may use these activities as a complement to your regular lessons or in place of your regular lessons, if formative assessment suggests students have the basic concepts but need practice. The debriefing discussions after each set of activities provide an important opportunity to help students reflect on their experiences and synthesize their thinking. It also provides an additional opportunity for ongoing, informal assessment to inform instructional planning.

Implementation Guide

The following guidelines will help you prepare for and use the activity sets in this book.

Setting Up the Stations

Each activity set consists of four stations. Set up each station at a desk, or at several desks pushed together, with enough chairs for a small group of students. Place a card with the number of the station on the desk. Each station should also contain the materials specified in the teacher's notes, and a stack of student activity sheets (one copy per student). Place the required materials (as listed) at each station.

When a group of students arrives at a station, each student should take one of the activity sheets to record the group's work. Although students should work together to develop one set of answers for the entire group, each student should record the answers on his or her own activity sheet. This helps keep students engaged in the activity and gives each student a record of the activity for future reference.

Forming Groups of Students

All activity sets consist of four stations. You might divide the class into four groups by having students count off from 1 to 4. If you have a large class and want to have students working in small groups, you might set up two identical sets of stations, labeled A and B. In this way, the class can be divided into eight groups, with each group of students rotating through the "A" stations or "B" stations.

Assigning Roles to Students

Students often work most productively in groups when each student has an assigned role. You may want to assign roles to students when they are assigned to groups and change the roles occasionally. Some possible roles are as follows:

- Reader—reads the steps of the activity aloud
- Facilitator—makes sure that each student in the group has a chance to speak and pose questions; also makes sure that each student agrees on each answer before it is written down
- Materials Manager—handles the materials at the station and makes sure the materials are put back in place at the end of the activity
- Timekeeper—tracks the group's progress to ensure that the activity is completed in the allotted time
- Spokesperson—speaks for the group during the debriefing session after the activities

Timing the Activities

The activities in this book are designed to take approximately 15 minutes per station. Therefore, you might plan on having groups change stations every 15 minutes, with a two-minute interval for moving from one station to the next. It is helpful to give students a "5-minute warning" before it is time to change stations.

Since the activity sets consist of four stations, the above timeframe means that it will take about an hour and 10 minutes for groups to work through all stations. If this is followed by a 20-minute class discussion as described below, an entire activity set can be completed in about 90 minutes.

Guidelines for Students

Before starting the first activity set, you may want to review the following "ground rules" with students. You might also post the rules in the classroom.

- All students in a group should agree on each answer before it is written down. If there is a disagreement within the group, discuss it with one another.
- You can ask your teacher a question only if everyone in the group has the same question.
- If you finish early, work together to write problems of your own that are similar to the ones on the student activity sheet.
- Leave the station exactly as you found it. All materials should be in the same place and in the same condition as when you arrived.

Debriefing the Activities

After each group has rotated through every station, bring students together for a brief class discussion. At this time you might have the groups' spokespersons pose any questions they had about the activities. Before responding, ask if students in other groups encountered the same difficulty or if they have a response to the question. The class discussion is also a good time to reinforce the essential ideas of the activities. The questions that are provided in the teacher's notes for each activity set can serve as a guide to initiating this type of discussion.

You may want to collect the student activity sheets before beginning the class discussion. However, it can be beneficial to collect the sheets afterward so that students can refer to them during the discussion. This also gives students a chance to revisit and refine their work based on the debriefing session.

Materials List

Class Sets

- calculators
- rulers
- scissors
- protractors
- compasses

Station Sets

- colored markers (red, blue, green, and black specifically)
- spaghetti noodles
- rubber bands
- cardboard triangle created from a triangle with the vertices (4, 4), (10, 4), and (6, 12) in the coordinate plane
- piece of yarn that is 12 inches long
- graphing calculators
- tape measure
- 8.5" by 11.5" colored sheet of paper
- cork board
- small and large piece of poster board
- plastic coffee can lid
- paper pyramids in the following shapes: square pyramid, triangular pyramid, and pentagonal pyramid
- soup can, tuna fish can, and a large coffee can
- paper cone cup
- small and large mailing box, both in the shape of a rectangular pyramid
- the following wooden geometric solids: square pyramid, cone, rectangular pyramid, and triangular pyramid
- quarters, nickels, and pennies
- tennis ball, basketball, and golf ball
- at least 30 building blocks
- student activity sheets
- hollow plastic sphere, such as a Ping-Pong ball
- peeled orange
- rectangular box of tissues
- other wooden cubes and blocks
- rectangular prisms made out of construction paper with the following dimensions: a red one that is 6" by 2" by 4", a black one that is 3" by 1" by 2", and a yellow one that is 7" by 3" by 5"

Ongoing Use

- index cards (need to be prepared according to specifications in teacher notes for many of the station activities)
- number cubes
- colored pencils
- tape
- graph paper
- tracing paper
- push pins
- drinking straws
- white computer paper

Other

- boxes of toothpicks

Points and Lines

Set 1: Distance and Midpoint

Instruction

Goal: To provide opportunities for students to develop concepts and skills related to finding the lengths and midpoints of line segments in two-dimensional coordinate systems

NCTM Standards

Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

- Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations.

Student Activities Overview and Answer Key

Station 1

Students will be given graph paper and a ruler. Students will work together to construct horizontal, vertical, and diagonal line segments. They will find the lengths of horizontal and vertical line segments using graph paper. Then they will construct a triangle and use the Pythagorean theorem to find the length of a diagonal line segment.

Answers

1. horizontal line
2. 6 units
3. Answers will vary.
4. vertical line
5. 11 units
6. Answers will vary.
7. diagonal line
8. No, because it is a diagonal line.
9. triangle
10. Use the Pythagorean theorem.
11. $3^2 + 4^2 = c^2$; $c = 5$

Instruction

Station 2

Students will be given graph paper, a ruler, and the distance formula. Students will construct diagonal line segments and use the distance formula to find the length of the line segment. They will reverse the values of (x_1, y_1) and (x_2, y_2) to show that the start and end points don't matter. They will explain how the distance formula can also be used on horizontal and vertical line segments.

Answers

1. $d = \sqrt{(2-(-5))^2 + (4-(-7))^2}$
   $d = \sqrt{170}$
2. Yes, because it is the same line.
3. $d = \sqrt{(-5-2)^2 + (-7-4)^2}$
   $d = \sqrt{170}$
4. Yes, because the start point and end point don't matter. It is the same line.
5. Answers will vary. Possible answer:
   $d = \sqrt{(2-2)^2 + (8-5)^2}$
   $d = \sqrt{9} = 3$

Station 3

Students will be given graph paper, a ruler, and the midpoint formula. Students will find the midpoint of a horizontal line segment by counting the units on the graph paper. Then they will use the midpoint formula to find the midpoint of this horizontal line segment. They will use the midpoint formula to find the midpoint of a diagonal line segment. They will explain why you can't simply count the units on the graph paper for a diagonal line segment.

Answers

1. horizontal line
2. (1, –4)
3. Answers will vary. Possible answer: We counted units and found the coordinate halfway between the start point and the end point.
4. $\left(\frac{-2+4}{2}, \frac{-4+-4}{2}\right) = (1, -4)$
5. yes
6. $\left(\frac{-4+3}{2}, \frac{5+-2}{2}\right) = \left(\frac{-1}{2}, \frac{3}{2}\right)$
7. because it is a diagonal line segment and the midpoint values are fractions of units

Instruction

Station 4

Students will be given graph paper and a ruler. Students will construct a vertical line segment and find the midpoint of the line segment by counting units on the graph paper. Then students will construct a diagonal line segment. They will find the slope of the line and use it to construct two congruent triangles. They will find the midpoint of the line segment by finding the intersection of the two congruent triangles.

Answers

1. vertical line
2. (–4, 0)
3. Answers will vary. Possible answer: We found the answer by counting the units halfway between the start point and the end point.
4. diagonal line
5. $m = \frac{4}{8} = \frac{1}{2}$
6. The slope is equal to the rise/run. Using this concept, you can draw a right triangle using the slope of 1/2 with a rise of 1 and a run of 2. However, to use the entire length of the segment, use a rise of 2 and a run of 4 to draw the right triangle. The intersection of the two congruent triangles is the midpoint of the diagonal line.
7. (4, 2)

Materials List/Setup

Station 1 graph paper; ruler

Station 2 graph paper; ruler

Station 3 graph paper; ruler

Station 4 graph paper; ruler

Instruction

Discussion Guide

To support students in reflecting on the activities and to gather some formative information about student learning, use the following prompts to facilitate a class discussion to "debrief" the station activities.

Prompts/Questions

1. How can you find the length of a vertical or horizontal line segment using graph paper?
2. How can you find the midpoint of a vertical or horizontal line segment using graph paper?
3. How can you find the length of a diagonal line segment using the Pythagorean theorem?
4. How can you find the length of a diagonal line segment using the distance formula?
5. How can you find the midpoint of a diagonal line segment using the midpoint formula?
6. How can you find the midpoint of a diagonal line segment using congruent triangles?

Think, Pair, Share

Have students jot down their own responses to questions, then discuss with a partner (who was not in their station group), and then discuss as a whole class.

Suggested Appropriate Responses

1. Count the number of units in the line.
2. Count the number of units halfway between the start point and end point.
3. Draw a right triangle. The length of the diagonal line segment is the hypotenuse of the triangle. Use the Pythagorean theorem to find the length of the hypotenuse of the triangle.
4. Use the distance formula, which is $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.
5. Use the midpoint formula, which is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$.
6. Find the slope. Create two congruent right triangles using this slope. The intersection of the two congruent triangles is the midpoint of the line segment.

Instruction

Possible Misunderstandings/Mistakes

- Not realizing that you can't simply count the units for diagonal line segments when finding the length or midpoint of the line segment
- Not realizing that the start point and end point can be reversed when finding the length or midpoint of the line, which will result in the same answer
- Not finding the slope of the diagonal line segment correctly
- Not creating two congruent right triangles to find the midpoint of the diagonal line segment

NAME:

Points and Lines

Set 1: Distance and Midpoint

Station 1

At this station, you will find graph paper and a ruler. Follow the directions below, and then answer the questions.

- Draw an *x*- and *y*-axis on the graph paper.
- On the graph, plot the points (2, 5) and (8, 5).
- Use the ruler to draw a straight line between the points.

1. What type of line have you created? _____

2. If each square on the graph paper represents one unit, what is the distance of the line?

   _____

3. How did you find the distance of the line?

4. On the graph, plot points (1, 1) and (1, 12). Use the ruler to draw a straight line between the points. What type of line have you created?

   _____

5. If each square on the graph paper represents one unit, what is the distance of the line?

   _____

6. How did you find the distance of the line?

continued

Points and Lines

Set 1: Distance and Midpoint

7. On a new graph, plot the points (2, 2) and (5, 6). Use a ruler to draw a straight line between the points. What type of line have you created?

   _____

8. Can you find the distance of this line using the same methods you used in problems 2 and 5? Why or why not?

9. On the graph used in problem 7, plot the point (5, 2). Draw a straight line to point (5, 2) from each point (2, 2) and (5, 6). What shape have you created?

   _____

10. How can you use the shape in problem 9 to find the length of the line from points (2, 2) to (5, 6)?

11. What is the length of the line from points (2, 2) to (5, 6)? Show your work and answer in the space below.

    Length of the line: _____

Points and Lines

Set 1: Distance and Midpoint

Station 2

At this station, you will find graph paper and a ruler. Follow the directions below, and then answer the questions.

- On the graph paper, construct an *x*- and *y*-axis.
- Plot the points (–5, –7) and (2, 4).
- Use the ruler to construct a straight line through the points.
- Remember the distance formula for a line: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

1. How can you use the distance formula to find the length of the line if $(x_1, y_1) = (-5, -7)$, and $(x_2, y_2) = (2, 4)$? Show your work and answer in the space below.

2. Do you think you will find the same length as problem 1 if $(x_1, y_1) = (2, 4)$ and $(x_2, y_2) = (-5, -7)$? Why or why not?

3. Use the distance formula to find the length of the line if $(x_1, y_1) = (2, 4)$ and $(x_2, y_2) = (-5, -7)$. Show your work and answer in the space below.

   Length of the line: _____

continued

Points and Lines

Set 1: Distance and Midpoint

4. Did your answers to problems 1 and 3 match? Why or why not?

5. Can you use the distance formula on horizontal and vertical lines? Why or why not? Provide an example to justify your answer.

Points and Lines

Set 1: Distance and Midpoint

Station 3

At this station, you will find graph paper and a ruler. Follow the directions below, and then answer the questions.

- Draw an *x*- and *y*-axis on the graph paper.
- On the graph, plot the points (–2, –4) and (4, –4).
- Use the ruler to draw a straight line between the points.
- Remember the midpoint formula for a line: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

1. What type of line have you created? _____

2. Without using the midpoint formula, what coordinate is at the midpoint of the line?

   _____

3. How did you find the midpoint of the line?

4. Use the midpoint formula to find the midpoint of (–2, –4) and (4, –4). Show your work and answer in the space below.

   Midpoint: _____

continued

5. Did your answers match for problems 2 and 4? Why or why not?

6. On a new graph, plot the points (–4, 5) and (3, –2). Use the ruler to construct a line between the points. Find the midpoint of the line using the midpoint formula. Show your work and answer in the space below.

   Midpoint: _____

7. Why can't you simply count the units between the points of the line in problem 6?

Points and Lines

Set 1: Distance and Midpoint

Station 4

At this station, you will find graph paper and a ruler. Follow the directions below, and then answer the questions.

- Draw an *x*- and *y*-axis on the graph paper.
- On the graph, plot the points (–4, –5) and (–4, 5).
- Use the ruler to draw a straight line between the points.

1. What type of line have you created? _____

2. If each square on the graph paper represents one unit, what coordinate is at the midpoint of the line?

   _____

3. How did you find the midpoint of the line?

4. On a new graph, plot points (0, 0) and (8, 4). Use the ruler to draw a straight line between the points. What type of line have you created?

   _____

5. What is the slope of this line? Show your work and answer in the space below.

   Slope: _____

continued

Points and Lines

Set 1: Distance and Midpoint

6. How can you use the slope to create two congruent triangles between points (0, 0) and (8, 4)?

   Draw these two congruent triangles on your graph.

7. What is the midpoint of the line? _____