

Lesson Title: Points, Lines, Planes, Space**Geo 2.4****Utah State Core Standard and Indicators****Summary**

This is the introductory lesson to using Geometer’s Sketchpad and exploring the basic geometry terms. It helps students understand basic ideas about points, lines, segment, rays, and angles, and how they are named and measured. There is a group and individual assessment included in this lesson that will demonstrate that students have the ability to use the basic tools in Sketchpad and know the geometric terms.

Enduring Understanding

Geometry enables us to orient ourselves in space. Points, lines, planes and space are the basic units of geometric orientation

Essential Questions

Why was geometry developed and how do we use geometry in our world?

Skill Focus

- Differentiating among lines, segments and rays,
- Angles, acute, obtuse, right and straight angles?
- Duplicating a line segment, creating a midpoint
- Duplicating an angle, congruency
- Bisecting an angle
- Linear and collinear, planer and coplanar, skew
- Vertical angles
- Perpendicular lines
- Vertical angles
- Perpendicular lines and their angles
- Linear pairs of angles, supplementary and complementary angles

Vocabulary Focus

“Make sure students already have understanding of parallel and transversals with the appropriate angle terminology.”

Assessment Evidence:

- After students have learned the basics of Geometer’s Sketchpad through the activities described below, they will do the 1.2 Group assessment (see below). Groups will print and submit 1 copy.
- Individual essay test. See below. Make certain you have discussed the group assessment completely and students understand what is required for the essay test. Evaluate using the understanding rubric found on the Teacher Info link under authentic assessment.

Materials: Computers with Geometer’s Sketchpad

Launch ideas:

“You could use as your launch a discussion of the angles created in the triangle tessellation (Geo 1.1).”

Explore**Summarize****Apply**

Directions: Be certain to access the assessment rubric for this activity below!!

Since these activities are done as a group, students must be accountable for their individual learning. Before beginning the Geometer's Sketchpad explorations and the group assessment, inform students they are to keep a record of personal learning while using Geometer's Sketchpad. They should know that the individual grades will include

- An individual record of learning.
 - 1) Prepare a list of vocabulary words learned while exploring on sketchpad.
 - 2) Keep a record of important concepts learned using the computer.
- An in-class essay test after all computer activities are completed (see below).

Students are meant to explore with the geometry program to learn how to use it and to learn about the basics of geometry. You might use an LCD projector and point to the most important access points on the program. Then let the students explore while the teacher circulates answering questions and giving suggestions.

Discuss the essential questions during or at the conclusion of the activity.

Have students explore using Geometer's Sketchpad by using the following activities from Exploring Geometry with the Geometer's Sketchpad pages 3-9, 13-14, 26. Prepare enough packets as there are student groups.

- Introducing Points, Segments, rays, and Lines pages 3-6
- Introducing Angles
- Duplicating a Line Segment
- Duplicating an Angle
- Angle Bisectors

Once students have become acquainted with Geometer's Sketchpad, they may wish to begin work on the group assessment below by using the activity exploration packets above as instructional tools. Or you may find it best to let students complete the learning activities before starting the assessment.

After students complete the group assessment, it is most important to facilitate a large group discussion and direct students toward critical understandings. Students have been working in groups on the computers and keeping their own record of what is important to remember. The teacher's job at this point is to formalize the experiential learning and guide students to make certain they have noted all that is important in their records of learning. (Use the individual assessment as a discussion guide.)

Have students submit their individual records of learning. Evaluate as needed.

Have students write the in-class essay assessment. Assess as desired.

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Geometry Basics Group Assessment

- Create a new document and write your names and the assignment title.
- Label the problems as 1, 2, 3 etc.
- In addition to drawing, you will need to write answers for some problems. Write your answers in complete sentences. (You may need to access your textbook)
- Rotate control of the keyboard and mouse among members of the group.
- Every bulleted point or question below counts for points on your grade.

1) Create a line, a line segment, a ray and an angle.

- Label all points.
- Measure the line segment .
- Label the lines.
- Measure the segment by selecting the segment instead of the endpoints.
- Measure the angle.

2) What are the differences among lines, line segments, rays, and angles?

What are the symbols for a line, a line segment, a ray, and an angle?

Why do these symbols need to be universal?

3) Create another line segment.

- Construct the line segment's midpoint.
- Measure the distance from each endpoint to the midpoint. Drag one of the endpoints three times, measuring distances each time.
- How can you prove you have the midpoint?

4) Create a segment which is congruent to another segment without using the copy and paste tools under edit.

- What does congruent mean?
- Show the steps you used.
- How do you know the segments are congruent?
- How do you show two segments are congruent? Two angles?

5) Create an angle using two rays. Label the angle $\angle EFG$.

- Create a point P in the interior of the angle. Create ray FP.
- Measure $\angle EFG$, $\angle EFP$, and $\angle GFP$.
- Drag point P around the interior of the original angle. What is the relationship among the three angle measures?
- How do you describe angles that are next to each other?
- What happens if you drag point P to the exterior of the angle?

6) Create another angle. Label it $\angle HKL$.

- Construct an angle bisector of $\angle HKL$. Create point Q on this bisector in the interior of the angle.
 - Measure $\angle HKL$, $\angle HKQ$, and $\angle LKQ$.
 - What happens when an angle is bisected?
 - What happens if you drag Q to the exterior of $\angle HKL$?
- 7) Make an angle congruent to $\angle HKL$.
- Show all steps.
 - Explain why you know that the angles are congruent.
- 8) In real-life situations when would someone need to copy a segment or angle?

Lines, Planes, and Space

- 9) Create a line segment. Place two points on the segment. Label them C and D. Place a point not on the line segment and label it E. C and D are collinear, but D and E are not.
- Explain what collinear means.
 - Define a line
 - Place one more point on the line and one more point not on the line. Label them. Note two different sets of collinear points and two different sets of non-collinear points.
Collinear points _____ Non-collinear points _____
- 10) Create a representation of a plane.
- Define a plane.
 - What is the universal symbol for a plane?
 - Place three points in the interior of the plane. Label them. Place two points in the exterior of the plane. Label them. Note sets of coplanar and non-coplanar points below.
Coplanar points _____ Non-coplanar points _____
- 11) Look around the room. List three objects that can represent a point, a line, and a plane. Are there any collinear or coplanar points on the objects selected?
- 12) Skew lines are lines that do not intersect and are not in the same plane. Draw a cube, label the vertices. Name a pair of skew lines.

More Lines and Angles

- 13) Create two lines through the same point A. (Intersecting lines)
- Create points B, C, D, and E on the lines with B-A-C and D-A-E.
 - Measure $\angle BAD$, $\angle DAC$, $\angle CAE$, and $\angle EAB$.
 - What do you observe about the measurements?
 - Drag point A. Record the angle measurements. Drag and record again.
 - What did you observe?
- 14) Vertical angles are two nonadjacent angles formed by two intersecting lines.
- What is true about vertical angles?
 - Name the sets of vertical angles from problem 12 above.

- 15) Create perpendicular lines. First create a line. Place a third point on that line. Select 1 point and your line, and then select perpendicular line. Place two points on this line making sure the intersection point is between them. Measure the four angles formed.
- What is true about angles formed by perpendicular lines?
 - Drag one of the points that created one of the lines. What changes do you observe? Do the angles measures change?
- 16) Create a ray. Label the endpoint of the ray K and the point on the ray L. Create ray KM. Measure $\angle MKL$. Drag point M until the angle measure is 180° . You have created a **straight angle**. How would you define a straight angle?
- 17) Create a point P on a line. Create points W and C on the line so that P is between W and C. Create a ray through P not on the line. Create point F on the ray. Measure $\angle FPW$ and $\angle FPC$. Drag the ray about.
- What do you observe about the angle measurements?
 - You have created a linear pair. How would you define the set of angles that form a linear pair?
- 18) **Supplementary angles** are two angles whose measure is the sum of 180. Draw at least three different examples of supplementary angles.
- One with the supplementary angles adjacent and equal.
 - One with the supplementary angles adjacent but unequal.
 - One with the supplementary angles nonadjacent.
- 19) Draw an **acute** angle, an **obtuse** angle and a **right** angle.
- Label and measure each angle.
- 20) **Complementary angles** are two angles whose measure is the sum of 90. Draw at least three different examples of complementary angles.
- One with the complementary angles adjacent and equal.
 - One with the complementary angles adjacent but unequal.
 - One with the complementary angles nonadjacent

Group Assessment Names _____

Each problem is worth 5 points. When there are less than 5 lines, some questions will be more valuable than others.

1. Label the points
 Measure the line segment
 Label the lines
 Measure the segment using the segment
 Measure the angle
2. Differences among lines, segments, rays, angles
 Symbols for a line, segment, ray, and angle.
 Label the lines
3. Construct mid-point
 Measure distances from endpoint to midpoint
 Proof of mid-point
4. Meaning of Congruence
 Steps
 How do you know congruence
 Showing congruent segments
 Showing congruent angles
5. Create P
 Measure the angles
 Relationship among the angle measures
 Describe angles next to each other
 Drag P to the exterior, what happens?
6. Construct angle bisector and Q
 Measure angles
 What happens when bisected?
 Drag Q to exterior, what happens?
7. Show steps for copying angles
 Why do you know they are congruent?
8. Why would you need to copy and angle?
9. Definition of Collinear
 Define a line
 Collinear Points
 Noncollinear points
10. Definition of a plane
 Universal symbol
 Coplanar points
 Noncoplanar points
11. Object for point
 Object for line
 Object for plane
 Coplanar points
 Collinear points
12. Draw cube
 label vertices
 Skew lines
13. Create lines with B-A-C and D-A-E
 Measure angles
 Observation of measurements
 Observation of Dragging
14. Truth about vertical angles
 Sets of Vertical Angles from #13
15. Construct Perpendicular lines
 Measure angles
 Definition of Perpendicular lines
 Changes observed from dragging
16. Ray KM
 Make a straight angle MKL
 Definition of a straight angle
17. Followed directions (linear pair)
 Observation of angle measures
 Definition of a linear pair
18. All are supplementary
 Adjacent and equal
 Adjacent and unequal
 Nonadjacent
19. Acute
 Obtuse
 Right
 Label all
 Measure all
20. All are complementary
 Adjacent and equal
 Adjacent and unequal
 Nonadjacent

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Geometry Basics Individual Assessment

Prove what you know!

- **Draw examples**
- **Write explanations**
- **Make connections**
- **Reread your answers. If the answers could teach someone who doesn't know, then they are good answers. If not, then rewrite your answers.**

- 1) What are the differences among lines, line segments, rays, and angles?
What are the symbols for a line segment, a line, a ray?
Why do these symbols need to be universal?
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Show and tell all you know about:

- 2) Segment midpoints
 - 3) Congruency
 - 4) Angle bisectors
 - 5) Collinear, Coplaner, Skew
 - 6) Acute, obtuse, right and straight angles?
 - 7) Vertical angles
 - 8) Perpendicular lines and their angles
 - 9) Linear pairs of angles, Supplementary and Complementary angles
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- 10) In real-life situations when would someone need to copy a segment or angle?
- 11) Look around the room. List three objects that can represent a point, a line, and a plane.
Are there any collinear or coplanar points on the objects selected?
- 12) Write a brief paragraph describing why study of geometry is important. You may wish to discuss why geometry was developed and how geometry is used in our world.