TITLE OF LESSON

Geometry Unit 1 Lesson 31 – Parallel Lines, Part 1
Prove it! What's on the outside? What's on the inside? Of Geometry

TIME ESTIMATE FOR THIS LESSON

One class period

ALIGNMENT WITH STANDARDS

California – Geometry
4.0 Students prove basic theorems involving congruence and similarity.
7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.

MATERIALS

String

LESSON OBJECTIVES

To Introduce

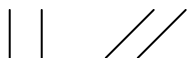
- Parallel Lines
- Corresponding angles
- Alternate interior angles
- Alternate exterior angles
- Consecutive interior angles
- Consecutive exterior angles

FOCUS AND MOTIVATE STUDENTS

1) Homework Check – Pass back binders. Pass back graded work and have students place in the appropriate sections of their binders.
2) Agenda – Have students copy the agenda.
3) Discussion: Jigsaw – (2 minutes) Ask students how they liked the jigsaw. Is there anyway that we could have done it better? Did you learn more from explaining the proof or from having it explained to you? Do you think that you could be a math teacher someday?

ACTIVITIES – INDIVIDUAL AND GROUP

1. Definitions: Parallel Lines and Intersecting Lines – (4 minutes) Write the following definition on the board and have the students copy it into the Terms and Definitions section of their notebooks.
   Two lines that lie in the same plane but do not intersect are called parallel lines*. Two or more lines that meet in a single point are known as* intersecting lines.
   Draw two diagrams, one to demonstrate each concept. In a plane, lines are either parallel or they meet.



These two sets of lines are parallel. They will never meet. (We're not addressing non-Euclidean here.)

This set of lines is not parallel. They will meet.

2. Discuss: Real World Examples – Discuss what it might mean that two lines are parallel. Do you think that there is anything like this in the world? Where do you see examples of what might be represented by parallel lines? How about railroad tracks?

How about the lines drawn for music notes? What about streets? Some are parallel. What are some of the others? (Some are perpendicular.) Are all streets parallel or perpendicular? Have students form two lines that are parallel. Have students form two lines that are not parallel.

3. Postulate – (3 minutes): *Given a line in a plane and a point in the plane not on the line, there is one and only one line that can be drawn through the point that is parallel to the line*. What does this mean? Can anyone demonstrate this idea by a drawing on the board? Can anyone draw more than one line through the point? Have the students enter the postulate into their binders in the *postulate* section. Have two students form a line. Have a third student be a point not in that line. Ask two or three other students to form the parallel line that goes through the point.

4. Definition: Transversal – (3 minutes) Write the following definition on the board and have the students copy it into the *terms and definitions* section of their binders. *A* transversal *is any line that intersects two or more lines in the same plane but at different points*. Put the following drawing on the board. Point out that the lines B and C are meant to be parallel and A is the transversal.

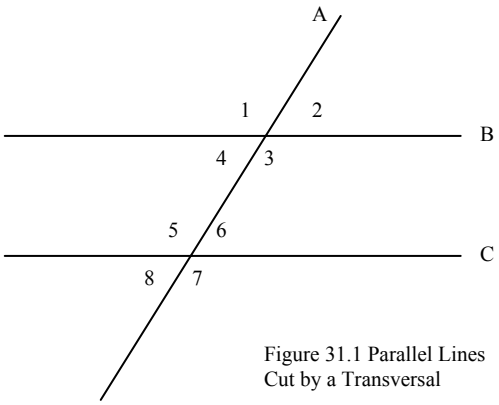


Figure 31.1 Parallel Lines Cut by a Transversal

Can they picture something that looks like this in their everyday lives? How about an escalator running between floors? Although the two parallel lines may be part of other planes, at the exact point that they intersect the transversal, they and the transversal are all on the same plane.

As you go through the following, make sure students are recording the definitions and drawing the pictures that go with each.

5. (3 minutes) Corresponding angles – you've heard that before! – and with parallel lines, they are not only equal, but are the angles in comparable positions, if you look at the drawing as two sets of four angles.

On the board, separate the drawing above into two parts (as below), being sure to put the labels on the lines (A, B, and C). Using colored chalk or something similar, indicate that angles 1 and 5 are corresponding angles. Ask the students to draw this picture, and, as they do, ask for volunteers to come up and show the other three sets of corresponding angles in this drawing.

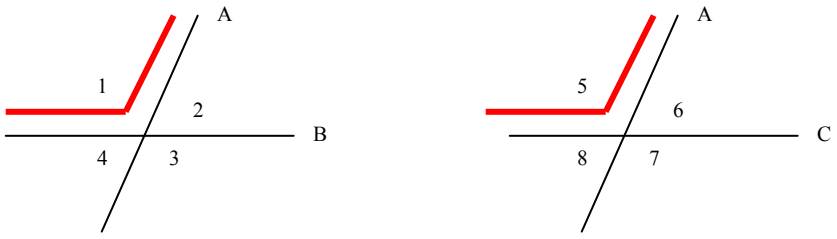


Figure 31.2 Corresponding Angles

(Yep, in this case the corresponding angles are angle pairs (1, 5) (2, 6) (4, 8) and (3, 7)!)

So, you know that $\angle 1 \cong \angle 5$, $\angle 2 \cong \angle 6$, $\angle 4 \cong \angle 8$, and $\angle 3 \cong \angle 7$. Now, based on what they know about angles

and their own innate intelligence (and of course, their abilities to formulate strong, persuasive arguments), have students—one at a time—come to the board to show the class which other angles in this drawing are congruent. As they try (and do), ask them why—what postulates can they use to defend their answers? They should come up with the fact that (1, 3) and (5, 7), and (2, 4) and (6, 8) are congruent (Vertical angles). (Erase this drawing now, since you'll be using Figure 31.1 for the rest of class.)

6. Lecture – (5 minutes) But now, let's look at all the things we know about transversals and parallel lines. Angles have special terms in this situation, based upon their relationship to one another and the lines. So first, let the students know that all of these definitions have to do with which side of the lines the angles are on—both the parallel lines and the transversal. You can tie string across your room, or use desks to help students visualize this. Put both parallel lines and the transversal crossing them. Then, as you teach them the terms, challenge them to stand on the correct side of the correct line(s) as you call out the terms. The more practice, practice, practice, they get with these terms, the more quickly they'll be able to use them easily.

   ALTERNATE: This means on OPPOSITE sides of the TRANSVERSAL.
   CONSECUTIVE: This means on the SAME side of the TRANSVERSAL.

   INTERIOR: This means between the two PARALLEL LINES.
   EXTERIOR: This means OUTSIDE the TRANSVERSAL.

7. Game: Human Transversal – After they've written this down, make it into a quick game. First, divide the class in half. They should stay in their seats, but tell them everyone on one side of the room will act as one (in the pair of angles) and everyone on the other side of the room will act as the other. To demonstrate what you mean, have two students (each from a different half) come to your life-size 'transversal with parallel lines' and stand in the positions of $\angle 1$ and $\angle 5$. So if you say *transversal*, half the class should go to one side of the transversal, the other half should go to the other side. You'll call out the terms (singly at first: interior, alternate, and so on), and all students (or the two whose names you say), have to run to the appropriate side of the appropriate line(s) in your life-size 'transversal with parallel lines'.

   When they seem to all be quick with the individual terms, start to pair them, as in the definitions they'll be getting in a minute: alternate interior, consecutive exterior. Do this until they have a pretty good sense of the terms work.

8. Student Demonstration – (2 minutes) Now that the terms don't sound like gibberish, ask for students to volunteer, as you call out the terms, to show the class—using the drawing on the board—one example of an angle pair that fits the term you've just said. For example, call out *consecutive interior*, and have someone go to the board and point to two consecutive interior angles.

9. Definitions – (2 minutes) Now it's time to have students write the full definitions in the *terms and definitions* sections of their binders.

   Alternate interior angles: They are on opposite sides of the transversal and are therefore alternate. They are on the inside of the two parallel lines and are therefore interior. Angles 3 and 5 and angles 4 and 6 are alternate interior angles.

   (2 minutes) *Alternate exterior angles*: They are on opposite sides of the transversal and are therefore alternate. They are on the outside of the two parallel lines and are therefore exterior. Angles 1 and 7 and angles 2 and 8 are alternate exterior angles.

   (2 minutes) *Consecutive interior angles*: They are on the same side of the transversal and are therefore consecutive. They are on the inside of the two parallel lines and are therefore interior. Angels 3 and 6 and angels 4 and 5 are consecutive interior angles.

   (2 minutes) *Consecutive exterior angles*: They are on the same side of the transversal and are therefore consecutive. They are on the outside of the two parallel lines and are therefore exterior. Angels 1 and 8 and angles 2 and 7 are consecutive exterior angles.

10. Postulates – (5 minutes) The parallel postulate: *If two parallel lines are cut by a transversal then the corresponding angles are equal*. Which angles are these? We have already listed them so it should be easy to answer this question. Ask four different students to give the four different pairs. Which of the pairs are exterior angles and which are interior angles? (In all cases the angles are either both interior or both exterior.)

    Write each of the next three postulates on the board. Have the students write the postulates in their binders under *theorems and postulates*. Ask for a student to go to the board and to identify the appropriate angles for the postulate. In each case there are two pairs that satisfy the postulate. Let one student identify the first pair and another identifies the second pair.

    (3 minutes) *If two parallel lines are cut by a transversal then the alternative interior angles are equal*.

    (3 minutes) *If two parallel lines are cut by a transversal then the alternative exterior angles are equal*.

    (5 minutes) *If two parallel lines are cut by a transversal then the consecutive interior angles are supplementary*. In this case, we first have to define the consecutive interior angles. The consecutive interior angles are the pairs (4, 5) and (3, 6). Ask what it means that the two pairs of consecutive interior angles are supplementary. A student should come up with the fact that, added together, the measurements of the two angles equal 180º.

11. Discussion – (2 minutes) With these postulates in mind, walk through with the students which other angles are supplementary.

12. Homework – (2 minutes) Have students copy down their homework assignment, if they did not do it at the beginning of class.

HOMEWORK

1) Draw two parallel lines cut by a transversal. Label all of the angles. Then write down all of the appropriate pairs and label them. Try to do this without looking at your notes! Label the following:
   Alternate interior angles
   Alternate exterior angles
   Consecutive interior angles
   Consecutive exterior angles
2) Describe in your own words what the parallel postulate means.
3) Come up with 5 situations where reality offers us a good approximation of parallel lines.

GROUP ROLES

None

DOCUMENTATION FOR PORTFOLIO

None