Lesson 1 – Section 2.5 Angle Relationships

Creator: Heather McNeill
Grade: 10^{th} grade
Course: Geometry Honors
Length: 50 minutes

1. Prior Knowledge, Skills, and Dispositions: In this lesson, students should already have an understanding about what congruent, complementary, supplementary, vertical angles and linear pair of angles are since they covered these concepts in section 1.3. To understand the Linear Pair Conjecture, students need to recognize that any two angles which form a linear pair will sum to be 180º. From there students will be guided through discovery to learn about the Vertical Angles Conjecture.

2. Academic Content Standards:

Benchmark	Description
MA.912.G.1.3	Identify and use the relationships between special pairs of angles formed by parallel lines and transversals.
MA.912.G.8.1	Analyze the structure of Euclidean geometry as an axiomatic system. Distinguish between undefined terms, definitions, postulates, and theorems.
MA.912.G.8.3	Determine whether a solution is reasonable in the context of the original situation.
MA.912.G.8.4	Make conjectures with justifications about geometric ideas. Distinguish between information that supports a conjecture and the proof of a conjecture.

Students will be able to discover relationships between different pairs of angles.

Student will be able to practice measurement skills using a protractor.

Students will be able to develop inductive and deductive reasoning skills and practice cooperative behavior.

3. Description of Pedagogy: The lesson will be taught using a variety of techniques. Parts of the lesson will include independent work, partner, group and whole class work. These techniques will work fine for George; he has no problem working well with other male students, whom he already sits around and will be grouped up with.

4. Assessment: During the lesson, I will walk around the room monitoring students' progress, making sure each student is on task and participating in the task. During each section of the lesson I will ask the students to explain what they have found. From the student answers I should be able to judge where their level of understanding is and whether or not I should proceed onto the next section. I am looking to see that they understand that two linear pairs will sum to be 180º as well as how the Vertical Angle conjecture is formed and how it works. Once the lesson is complete I will assign the corresponding homework problems. (Section 2.5 # 1-10, 13-18) Their answers in reviewing their worksheet at the end of the period and the work they show in answering the homework problems should help me in understanding what the students left the lesson knowing.

5. Detailed Lesson Sequence:

What the teacher will do:	**Statements the teacher will say/Questions the teacher will ask:**	**Possible student responses:**
Warm-Up		**10 minutes**
Pass out the Warm-Up worksheet and put the matching transparency on the overhead. Title: Lesson Terminology Allow the students 5-7 minutes to fill in their 4 words. On overhead go over the 4 words. (3-5 minutes)	Please come in sit down and begin filling out the paper on your desk. You may use your book, and some of these terms may seem familiar to you. Be sure you also come up with an example or a picture that represents your description. This should help you in remembering what the words mean.	N/A
Engagement		**5 minutes**
Please take out a piece of paper and *without drawing any people*, draw your bathroom shower. You have one minute! You probably either have a stand-alone shower or a shower inside of a bath tub; draw what your shower looks like. How do you turn on and off the water? Where does the water come from the wall?	How do you turn on and off the water? Where does the water come from the wall? What does your shower look like?	
	Did you draw the shower head? Be sure to include the shower head. (How else are you going to rinse the shampoo out of your hair?)	Yes/No.
	Is your shower head attached to the side of the wall, or to the ceiling?	The side of the wall. The ceiling if a fancy bathroom, simulating rain.
Now take your protractor (some may need to be passed	At what angle does your shower head come out of the	Multiple different answers.

out for those students who didn't bring their own) and find the angle at which your shower head comes out of the wall or ceiling. Write the angle down in your picture. Now measure the other angle between the shower head and the wall.	wall/ceiling? What is your second angle? Do your angles match your neighbor's? Why or why not? What do your two angles sum to be? What do your neighbor's angles sum to be? What do you notice? Why is that? Will this always be the case? Why or why not?	(e.g. 125º). Multiple different answers. (55º). No, we drew our pictures differently. 180º. 180º. Our angles sum to be the same. Yes this will always be the case considering the wall is straight and therefore forms a line. The shower head serves as the ray originating from the line (wall) and our two angles formed by our ray will sum to be 180º. We have created a linear pair!
The Linear Pair Conjecture		**7 minutes**
Place the Linear Pair transparency on the over head (with the words Linear Pair covered up) and have a class discussion about how this picture is similar to the shower head engagement.	What can you tell me about this picture? Does it remind you of something we just talked about? What is that? How is it similar? How is it different?	It has a line, a ray, two angles, letters, points, it is a linear pair of angles. Yes, the shower head example. We have a linear pair of angles, it is just oriented differently.
Talk about other real-life connections.	What are other real-life examples using Linear Pairs, similar to our shower head example?	A blade of grass coming out of the ground, a light switch on the wall, etc.
Formally state what the Linear	Who will explain to the class	A generalization resulting

Pair Conjecture is.	what they think a conjecture is? Who wants to try to state in words what they think the Linear Pair conjecture might be.	from inductive reasoning. If two angles form a linear pair, then the measures of the angles will add up to 180º.
Vertical Angles Conjecture		**15 minutes**
Now we are going to move on to another type of angles. But before we do, I want you to draw two intersecting lines on this wax paper. (Pass out wax paper and sharpies.) (Place Vertical angles transparency on the overhead) Now label your angles as shown on the overhead, with the number one oriented at the top of your paper and number from 1 to 4 moving clockwise from angle to angle. Now I want you to label your four different angles, *without* using your protractors what do you think each angle measures? Write the degrees near the angle.	Now I'm sure we didn't all draw the exact same picture. Right? Look at your table partner's picture, is it exactly the same as yours? Great! Now *without* using your protractor I want you to label the angle measures for your picture. Think about what each angle measure is? Write each measure near its corresponding angle. Now I want you to trade wax paper with someone at your table. Look at your partner's picture and what they labeled for their angles, do you agree with them? Why or why not? Take a few minutes now to discuss your thoughts about each other's picture. If you wish, you may change what you wrote for the angle	Nope! Yes/No.

	measures.	
Bring the class back together for a whole group discussion.	Okay, now if you haven't already, please return your partner's paper. Everybody should have their own now.	
(The goal is that the students used what they know about linear pair of angles to figure out that each of their angles must be congruent to the one across from it.)	What did you and your partner talk about?	How certain angles must be the same. (Correct the word same with congruent, they are not the same angles, the angle measures are congruent.)
	Did anybody end up changing what they had down for their angle measures? Why?	Yes, I forgot that 2 angles must add up to equal 180º.
When it arises in the discussion that the vertical angles are congruent show the class how they can fold their wax paper over to see this.	Which angles are vertical angles?	1 and 3 are vertical angles and so are 2 and 4.
	What do you notice about their measures?	They are congruent.
Fold the paper so that the vertical angles lie over each other.	Is it weird that these angles are congruent? Why Not?	(Explain how using deductive reasoning we can see which angles must be congruent.)
Make real-life applications	What are some real-life examples of vertical angles?	Railroad tracks crossing each other, the letter X, etc.
Formally state what the Vertical Angles Conjecture is.	Who would like to state what they think the Vertical Angles conjecture is?	If two angles are vertical angles, then they are congruent.
Wrap-Up		**23 minutes**
Pass out student worksheet (Angle Relationships) and ask the class to begin working on it. They may work together as long as both people are engaged. If I see you simply copying answers we will all have to work individually. After about 15 minutes we	I want you to work on the side that says Angle relationships on the top, not the side that says Angle Relationships Practice.	

will go over some of these. Wander around the room working with students and asking questions. As a class go over the front side of the paper. If time permits we may turn to the other side. Ask student to provide the reasoning and examples they came up with for numbers 3-6. Your homework for tonight is Section 2.5 # 1-10, 13-18	How did you figure that out? Did you use a conjecture? Which one? (Place conjecture transparency on the overhead while reviewing the conjectures.)	

6. **Materials:** Pencil, notebook paper, wax paper, protractor, Discovering Geometry textbook, blank transparencies, overhead markers, class worksheet, Conjecture transparencies, sharpies
7. **Resources*:**
   http://www.glencoe.com/sec/math/prealg/prealg05/study_guide/pdfs/prealg_pssg_G081.pdf

   http://education.ti.com/educationportal/activityexchange/Activity.do?cid=US&aId=8670

   http://www.pas.k12.mn.us/1936208261569450/lib/1936208261569450/parallel_lines_and_vertical_angles.pdf

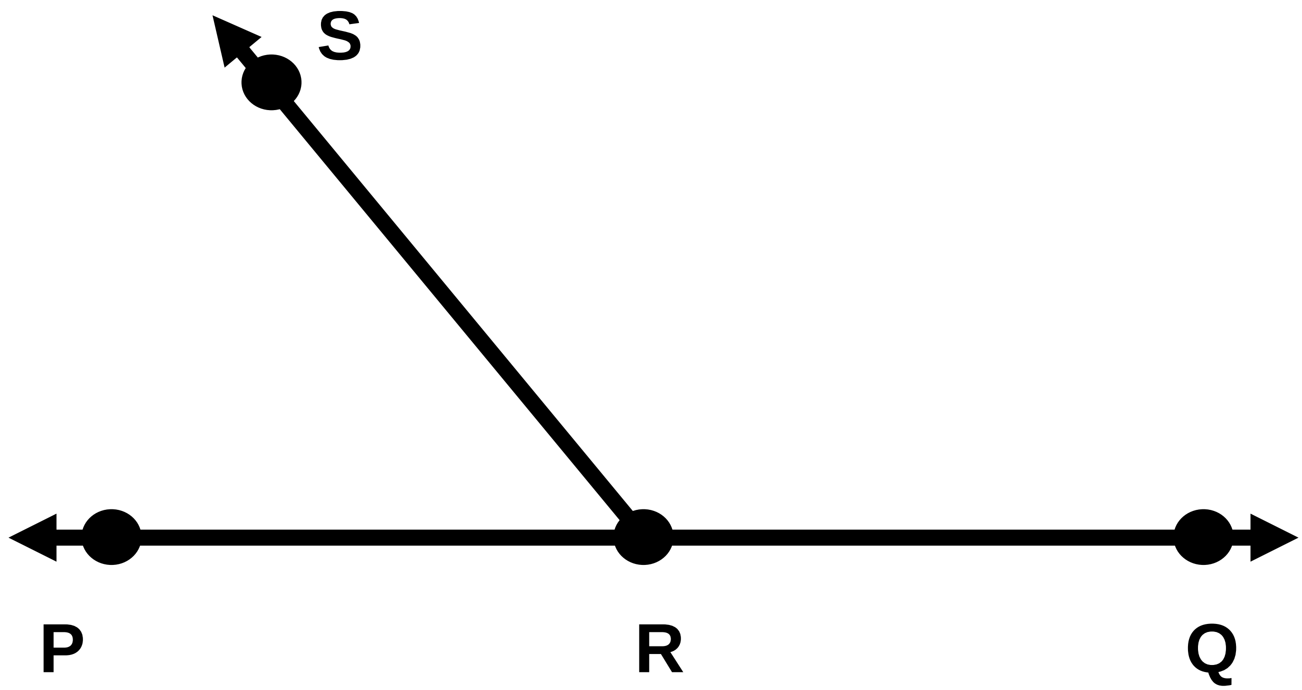
8. **Lesson Starter:** See attached PDF. It is the pages from the teacher addition in their textbook.

(The student worksheets have a spot for the student's name, just not on here (below) because I copied and pasted these from the originals where the 'name' line is in the header.)

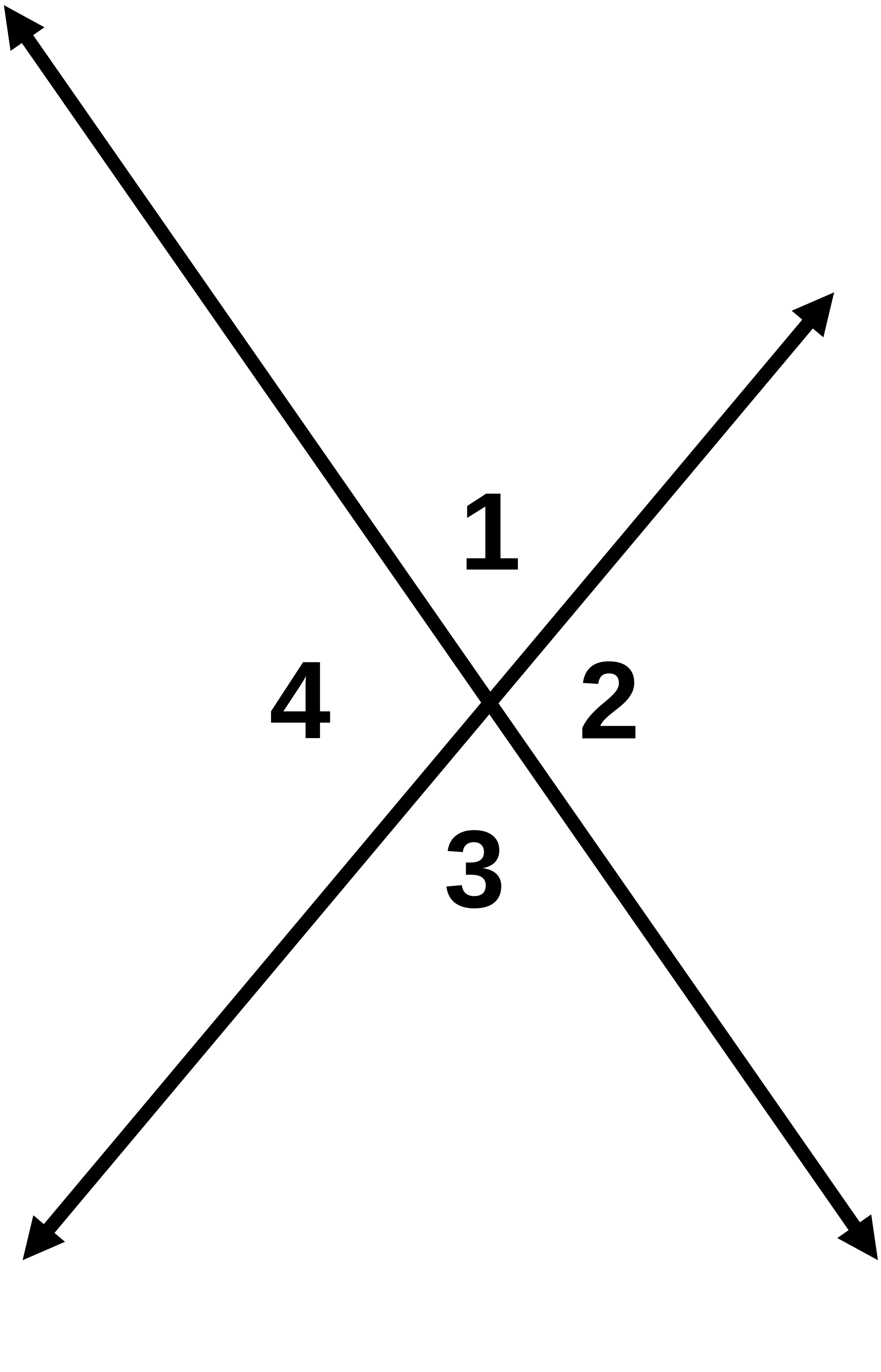
Lesson Terminology

Term	Description	Example/Picture
Supplementary Angles		
Vertical Angles		
Linear Pair of Angles		
Inductive Reasoning		

Linear Pair



Vertical Angles



Angle Relationships

Fill in the blanks to complete the conjectures.

1. Linear Pair Conjecture – *If* two __________ form a ________ ________, *then* the measures of the angles add up to _________.

Picture:

2. Vertical Angles Conjecture – *If* two angles are ____________ angles, *then* they are ___________.

Picture:

Decide whether each statement is always (A),sometimes (S), or never (N) true. Then provide examples for each possible case.

3._____ The sum of the measures of two acute angles equals the measure of an obtuse angle.

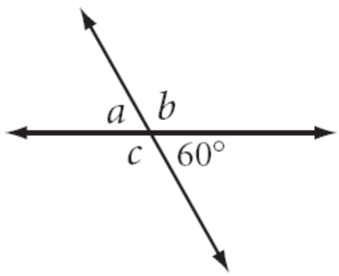
4. _____ If $\angle XAY$ and $\angle PAQ$ are vertical angles, then either *X, A,* and *P* or *X, A,* and *Q* are collinear.

5. _____ If two angles form a linear pair, then they are complementary.

6. _____ If a statement is true, then its converse is true.

Angle Relationships Practice

Find the angle measures for each letter.

1.


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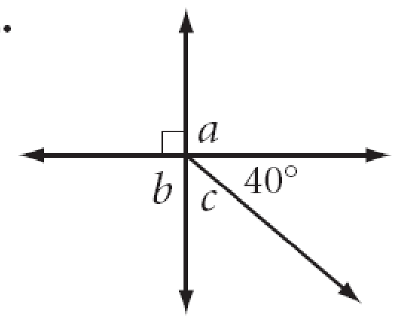

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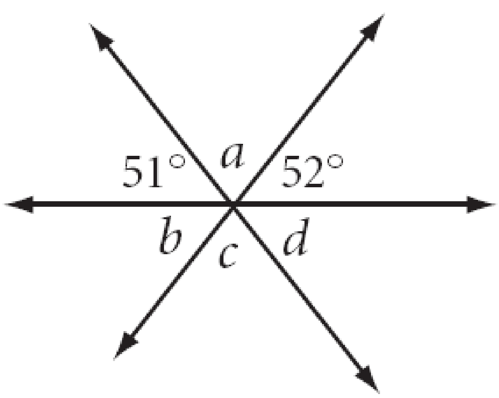
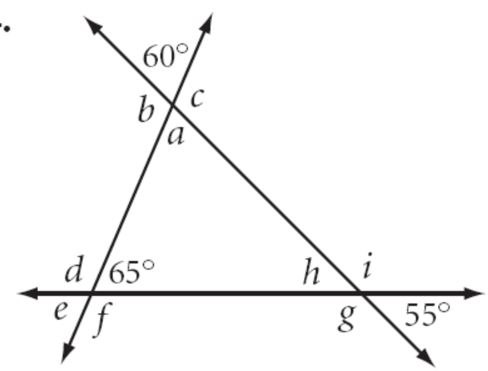
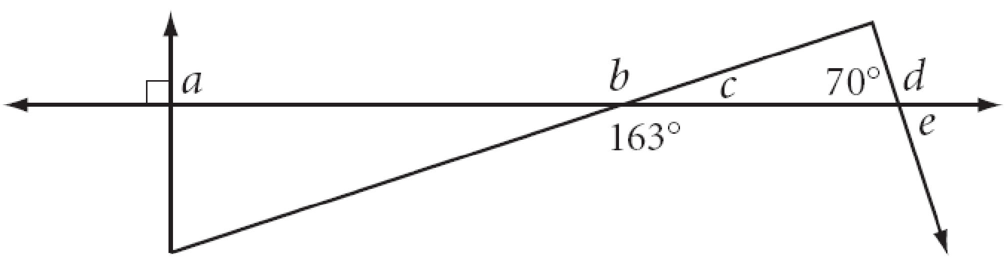


4.


5.


Linear Pair Conjecture:

If two ____________ form a

___________ ________, *then* the

measures of the angles add up

to _________.

Vertical Angles Conjecture:

If two angles are ___________

angles, *then* they are

____________.