5E Lesson Plan Template

*All companion materials such as power points, handouts and video clips must be included with the submitted lesson plan.

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Title:	Robots, Right Triangles, and Romance, Oh My!
Grade level(s):	10th-11th
Time Required:	Two 43-minute class periods (1.5 hours) *Note: Add extra time if students have never used Ozobots before.
Subject(s):	Algebra 1.5, Geometry
Standards:	G-SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. G-SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
Science and Engineering Practices, Cross-cutting Concepts and Standards for Mathematical Practice	**Science and Engineering Practices:** 1. Planning and carrying out investigations 2. Obtaining, evaluating, and communicating information **Cross-cutting Concepts:** 1. Scale, proportion, and quantity **Standards for Mathematical Practice:** 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Use appropriate tools strategically. 4. Attend to precision. 5. Look for and make use of structure.
Objectives:	1. I can decide whether or not two

	triangles are similar.
	2. I can construct a special right triangle.
Materials List:	- Ozobots (fully charged) - Large sheets of paper - Markers - Calculators - Rulers - iPad OR Laptop (whichever is available) - OzoCodes sheet - Paper for Evaluation *Students may use timer on their phones for elaboration activity
Safety Concerns:	Safety concerns could arise due to the amount of moving that will be happening in this activity. Students will need to move desks around to make room on the floor for their sheets of paper. Students might need to move into the hallway due to space constraints in the classroom.
Accommodations for Learners with Special Needs (ELL, Special Ed, 504, GT, etc.):	- Adjust the number of triangles students are given during the Elaboration - For gifted and talented students, include some triangles that are not classified as special right triangles in the Elaboration activity - Scaffold instruction as needed - Students who struggle with the concept of measuring time for side lengths in the Elaboration may be given a ruler if it is determined that it is unlikely for them to succeed without one.
References:	*Passengers* movie

ENGAGEMENT		Time: 5 Minutes
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will show students a video clip from the movie *Passengers* and relate the ship to geometric shapes.	1. If I told you the rooms in the ship were formed by right triangles, what would you know about these rooms? 2. If you were the engineer on this ship and you were asked to design rooms that were "similar," what would you be doing?	1. Students should mention that the triangle contains a 90 degree angle and could possibly be a 45-45-90 or a 30-60-90 triangle. 2. Students may take the word "similar" literally and think triangles should look alike. The desired answer is "Angles are the same and sides are proportional."
Evaluation/Decision Point Assessment	**Assessment**	**Student Outcomes**
1 (Recall, Tell)	Students will be formatively assessed on their responses to the open-ended questions above.	Students will identify misconceptions in their understandings of special right triangles and the meaning of the term *similarity*.

EXPLORATION		Time: 15 Minutes
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**

The teacher will introduce students to their new mission: *Program the Ozobot to leave Chris Pratt, pick a flower, deliver the flower and the message to Jennifer Lawrence, and return home. The path of this robot will form a special right triangle.* The teacher will place students into pre-determined groups of 2-3. As students work, the teacher will listen to their conversations and question students about their thought processes.		
	1. Are you designing a 30-60-90 triangular path or a 45-45-90 path? Can you prove this to me?	1. Students may at first question how they know what the measures of the angles are without a protractor. Students should reference the ratio of side lengths.
	2. Is this triangle exactly the same as the special triangles that you memorized earlier on in the unit? If not, how did you know it would still have the same angle measurements.	2. Students should reference the term "similar triangles." However, some students may attempt to only use the triangle they have memorized.
	3. If you were going to design a path to model the other special right triangle that you did not use, what would need to change about	3. Students should reference the fact that the side length ratios would change.

your path?		
As groups finish working, the teacher will instruct them to take a picture of their design and work using the Google Chrome extension Seesaw on their ipads or laptops.		

Evaluation/Decision Point Assessment	Assessment	Student Outcomes
3 (Construct, Model, Plan)	Students will be assessed formatively in their discussions with each other and with the teacher during group work. Student work will also be observed.	The goal of this exploration is for students to form connections between the overlapping concepts found in the topics of special right triangles and similarity.

EXPLANATION		Time: 20 Minutes
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will display student work on the SmartBoard using the SeeSaw extension on his or her laptop. The teacher will then guide students in a classroom discussion of their work. Throughout the discussion, the teacher will ask students to submit feedback and questions on their ipad or laptop.	1. Group 1, which type of special triangle did you choose for your path? How do you know the size of the angles without actually measuring them? 2. Group 2, I believe you	1. Answers may vary. Students should refer to the ratio of side lengths for the type of special triangle they chose. They should also reference the scale factor they chose for their specific robot path. 2. Answers may vary. Students should refer

	chose to model the other type of special triangle. What was your thought process? What was your scale factor for each side of the triangle?	to side length ratios and scale factors. In the case of both special triangles, students may be tripped up by the side lengths involving square roots.
	3. If you want to draw triangles, that are similar to your special right triangles, what things do you need to know?	3. Students should state that they need to memorize or be able to find the side lengths of the basic form of the special right triangles. They should then multiply each side length by whichever scale factor they have chosen for their triangle.
	*Note: After each discussion of student work, the teacher will ask students to leave feedback on the picture. This feedback can be either a question that they have or something they have learned. Adjust the amount of student feedback to fit time constraints.	
Evaluation/Decision Point Assessment	**Assessment**	**Student Outcomes**

| 2 (Explain, Compare) | The teacher will formatively assess student work as she views the pictures students have posted. Student answers and explanation of work during the class discussion will also be assessed. Finally, student feedback via SeeSaw will be reviewed before the next class period to determine what questions students are still grappling with. | The goal of this explanation is for students to gain a deeper understanding of special right triangles and similarity by articulating the patterns and thought processes they used to make decisions during the exploration. In addition, students will be allowed to seek assistance or correct their own misconceptions by listening to their classmates and responding via SeeSaw. |

*END OF CLASS PERIOD 1

ELABORATION		Time: 30-35 Minutes
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will address any student questions from the day before. The teacher will introduce students to a new scenario: *Chris and Jennifer have survived the fiery trials of deception and a ship explosion. Their love will last forever! However… the ship will not. Your task is to send your Ozobot into the heat-damaged rooms and determine which one must be fixed first to save*		

the ship. Rooms with angles 45-45-90 are food service rooms, and rooms with angles 30-60-90 angles are mechanical rooms. No rulers will be used as the rooms are currently too hot to enter- only your Ozobot may be sent into the room to measure the walls. The teacher will explain to students that using the SeeSaw extension on the ipads or laptops, they must then film themselves giving a scaled drawing of the room (A or B) that needs to be fixed first on a separate piece of paper using the Ozobot. They must explain their thought process for why they believe this room is a 30-60-90 triangle and label each angle. Each person in the group must talk in the video. The Ozobot must perform a move along on each wall to represent "fixing" the wall.		
As students work, the teacher will observe their conversations and ask questions to draw out their private speech.	1. What is your plan for determining what type of triangle you are dealing with?	1. Students may at first be confused by the lack of the ruler. It is expected they will either use logic and determine that the 45-45-90 triangle has two legs that are the same length, or they will time the Ozobot as it travels down the side lengths of the

		triangles to determine side ratios.
	2. How will you construct a precisely-scaled drawing using the Ozobot?	2. It is expected that students will time the Ozobot, find the appropriate percentage of time they need for a 30-60-90 triangle, and end each side length wherever the Ozobot stops in the allotted time. Students may struggle with finding the appropriate scaled time if they try to draw the long of the triangle before drawing the other two sides, since it involves a square root.

Evaluation/Decision Point Assessment	Assessment	Student Outcomes
5 (Defend, Interpret) 6 (Create, Design)	Student discussion with the teacher and one another will be used as a method of formative assessment. In addition, the teacher will watch student videos and listen to students' externalized private speech as they explain their scaled drawing of the room to the captain.	The goal of the elaboration is for students to deepen their understanding of scale factors by applying it to a new concept of measurement: time. Students should understand that right triangles share the same side length ratios, even when varying the unit of

		measurement.

EVALUATION		Time: 5-10 Minutes
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will post students' exit ticket for the day on the Smartboard. She will then give each student a blank piece of paper which they may use to answer the questions and show their work. She will collect it from students as they exit the room.	(As seen on PowerPoint slide) 1. Are these triangles similar? How do you know?	1. The triangles are similar since sides share a scale factor of 2.5. Students may assume the triangles are not similar because the scale factor is not a whole numbers.
	2. Construct a 45-45-90 triangle where no side equals one and label each side. Show all work.	2. Answers may vary, but both legs must be the same length. The hypotenuse should be the scale factor multiplied the the square root of 2. Students may struggle to scale the hypotenuse.
	3. What was your favorite part about using the robots on the spaceship?	3. Answers will vary.