**Lesson Title: Transformations - Reflections**

**Unit Title: Transformations in the Plane**

**Teacher Candidate: Nathan Stewart**

**Subject, Grade Level, and Date: High School**

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| **Placement of Lesson in Sequence** |

This is an introductory lesson to the concepts of Transformations. It focuses on using reflections, rotations, and translations so as to understand how objects and shapes can be moved in the Cartesian plane with real life applications. Being an introductory lesson as part of a learning progression of four days, it will be taught with an activity using a 5x5 grid problem about sheep and wolves to help discovery based learning to take place.

**Central Focus and Essential Questions**

To date the students’ exposure to Geometry has consisted of finding areas and angles of various shapes including right triangles and non-right triangles. This lesson is number one in a leaning progression on the topic of transformations. The focus of the lesson will be to see how reflections of objects and line of symmetry relate. In the wolves and sheep activity students will learn about reflections as they build up to the ultimate goal in the puzzle of 5 wolves and 2 sheep. They additionally will learn that since the problem only has one possible solution, that all other solutions are simply transformations of the original. For example, one such solution will simply be a reflection over the y= -x line of symmetry. Therefore terms line reflection over the x and y-axis will be important for the students to learn and understand their mathematical meaning given a situation. Then they will be divided up into groups of three to four to work together in and exchange of ideas on the various solutions that can come from the original solution to the wolves and sheet problem. After the entry task is complete there will be a fifteen minute lecture on lines of symmetry teaching the students the vocabulary for the lesson as well as providing examples of problems they will see on their worksheet. After the group lecture, students once again can return to small groups to help complete the assignment as I move around the room to analyze student progress and listen to conversations to gain insight into their reasoning skill, which is one of the mathematical practices important to this learning progression. Some of the questions that this first lesson will be answering are: What lines of symmetry/reflection points can be used with each shape? Can every line of symmetry/reflection point be used with every shape? Why are there some shapes that cannot be reflected with the y= x and y= -x? Then the lesson would end with an exit question slip for each student to explain again in his or her own words these characteristics using the mathematical terms learned during this lesson and previous.

**Content Standards**

[CCSS.Math.Content.HSG.CO.A.3](http://www.corestandards.org/Math/Content/HSG/CO/A/3/)  
Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

[CCSS.Math.Content.HSG.CO.A.4](http://www.corestandards.org/Math/Content/HSG/CO/A/4/)  
Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

[CCSS.Math.Content.HSG.CO.A.5](http://www.corestandards.org/Math/Content/HSG/CO/A/5/)  
Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

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| **Learning Outcomes (Objectives)** | **Assessment** |
| Students will be able to:   * Reflect a shape across the x-axis * Reflect a shape across the y-axis * Reflect a shape across the y= x * Reflect a shape across the y= -x * Explain why some transformations will not result in an orientation similar to the original | The formative assessment cycle will be, students will be put into groups and given a situation for an object to be reflected to a given position. Then the students will take turns explaining their findings or method for reflection. The teacher will discuss and review any misconceptions by use of leading questions and then have each group present their findings to the class. Then as an exit question students will again, in writing, explain their results of a transformation of an entirely new object, a trapezoid. |

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| **Learning Targets** | **Student Voice** |
| * I can visualize a transformation without doing any physical work * I can reflect and object over the various lines of symmetry * I can explain why some lines of symmetry do not work with various shapes | The students will be able to explain how to reflect an object from a given position to another given position and the steps taken to achieve this. The student will also be able to write in step by step format how to reorientation a shape given requirements to meet which will be the exit question of repositioning a trapezoid. Also during the exit slip students will have a chance to explain in writing what they found easy to accomplish and what they are still finding difficult to do. |

**Prior Content Knowledge and Pre-Assessment**

Students have experience working with geometric shapes like squares and triangle solving for various sides or areas. In previous classes as well as lessons students will have drawn diagrams on grid paper, graphing points and shapes. Additionally, they have had lessons on what it means for a triangle or another shape to be congruent. For example, a recent lesson was on congruent triangles and thus will relate very closely to this lesson which is all about keep shapes congruent as they get reflected across various lines of symmetry.

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| **Academic Language Demands** | | |
| **Vocabulary & Symbols** | **Language Functions** | **Mathematical Precision, Syntax, & Discourse** |
| * X-axis * Y-axis * Line of symmetry * Line: y= x * Line: y= -x * Reflected about the origin 90, 180, 270, 360o * Reflected about the center of the shape * Positive rotation * Negative rotation * Vertex * Reflect about a vertical line or horizontal line like x= 2 or y= 4 respectively | In this lesson student will use language to:   * Explain how to reflect an object about various lines of symmetry * Being precise with the descriptions and explanations of answers for reflected shapes * Justifying their answers | **Mathematical Precision:**  Students must be able to reflect an object over all lines of symmetry and know when some objects cannot be reflected with certain lines of symmetry.  **Syntax:**  Students must use the correct term when referring to a specific type of reflect.  **Discourse:**  Each student will be tasked with reflecting various objects/shapes; students will identify what which shapes cannot be reflected over certain lines of symmetry and why. Then through the class and group activities students must show they understand the meaning of each term and that some shapes will have more lines of symmetry than other. Lastly, each individual will answer in written form an exit question about the lines of symmetry for a trapezoid. |

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| **Language Target** | **Language Support** | **Assessment of Language Target** |
| I can identify the lines of symmetry for various shapes, including a trapezoid. I also can explain with details about why some objects cannot have certain lines of symmetry with logical/mathematical reasoning. I will use the correct vocabulary when discussing the material to help encourage preciseness. If I first reflect and object over the y-axis then over the x-axis, I understand that it is the same as reflecting it over the y= -x. | The vocabulary for this lesson will be taught as I go through the lecture and I will continue to use it and encourage the students to use it both in oral and written explanations. Also through modeling and explaining I will show how to explain and interpret details about a transformation/reflection so that the students will know precisely what I am referring to during the lecture and examples we discuss together | Students’ oral use of the mathematical language will be assessed as I listen to the students offer answers to my prompting questions and when each group presents their findings to the class. If they say something incorrect I will correct them and if they do not use the proper vocabulary I will offer corrections as well. I will be continuously monitoring the students while they work on the worksheet of reflecting various shapes over various lines of symmetry. I will also listen to the discussions taking place between groups to either encourage good ideas or help keep students on task. Throughout the entire lesson I will be asking leading questions so that students will gain the most form the lesson by themselves being the ones to come to the right interpretations. Written language will be assessed through their completion of the worksheet, wolves and sheep problem, and with the exit question which will be returned to them as feedback on how they did. |

**Lesson Rationale (Connection to previous instruction and Objective Standards)**

In previous lessons students were taught to find areas, missing sides, and similar triangles given various situations as well as graphed shapes on the Cartesian plane. In this lesson, the students will continue to find similar triangles given the added topic of reflecting the triangle or some of other shapes across different lines of symmetry, which is going to relate to the similar triangles because in order for the reflection to be correct all side lengths and angles must be congruent after the transformation. This lesson relies heavily on the previous ones and thus require the students to put more effort into remembering what it means to be congruent as well as how to graph objects on the Cartesian plane. Using what they previously know, like congruency and graphing, this lesson will continue to help them expand and see the connections to previous lessons as well as the remaining ones in this learning progression on the topic of transformations.

**Differentiation, Cultural Responsiveness and/or Accommodation for Individual Differences**

To accommodate for large differences in mathematics ability, the students will work together in groups to complete the worksheet as well as the Wolves/Sheep puzzle. Through a discovery lesson, students are lead with questions to understanding the importance of transformations, specifically reflections in this lesson and their use in the real world. I have many students who are distracted easily with anything, so to help keep them on task I will use questions posed to the class as well as making the puzzles fun and interesting by requiring students to talk to fellow students as well as with me. I will be requiring that a student who I feel is not paying attention or on task to answer a question about reflecting a bonus problem at the front of the room which will also help others who are getting stuck on various reflections. I will be mixing focused students with unfocused students by engaging those who are not focused and by preplanning who will be in each group. My lesson includes lots of hands on aspects that will get the students moving and help make up for the differences that each of my students have in learning styles.

**Materials – Instructional and Technological Needs (attach worksheets used)**

* Graph Paper
* Blank Paper
* Pencils
* Rulers

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| **Teaching & Instructional Activities** | | | |
| **Time** | **Teacher Activity** | **Student Activity** | **Purpose** |
| **before** | * This part I will simply hand out the wolves and sheep puzzle and walk through the directions and then through a scaffolder process of adding sheep and wolves stage by stage to increase the difficulty with the goal of having in the end 5 wolves and 3 sheep | * Students will be answering questions about my scaffolder examples providing for me answers in the form of diagrams on the worksheet.  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | W |  | W |  | |  |  |  |  | W | |  |  | S |  |  | |  |  |  |  |  | |  |  | S |  |  |   Sample answers may include: | This is to prepare the students for the lesson coming by getting them to think about patterns and reflections of answers, meaning many of the answers student will provide will be simply reflections or rotations of others. |
| **During part I** | * I will use the document camera to demonstrate and lecture on the new topic of transformations specifically reflections for day one. I will be asking many questions to help promote positive learning and gain insight into the understandings of my students. Example questions will be: what lines of symmetry can we use with this shape? To move a shape from the first quadrant to the fourth which line of symmetry would be the most efficient? Difference between each of the line of symmetry for a square and a triangle? | * Students will take notes on the provided worksheet to help get them started and to use as a later reference. * Students will be getting together in their groups and preparing themselves for how they are going to reflect various shapes or pick which answer best describes the reflection needed to answer the question * They will be providing answers to my questions as I monitor their learning. | The purpose of this part of the lesson is to provide examples they can reflect back on for solving new problems and to help them see that there is patterns in transformations. Students will be progressing through the thinking process about how to use knowledge they are gathering and decide what it means. In this case they will use their notes from lecture to mentally conclude what the needed reflection are for generating the new orientation given an old one. |
| **During part II** | * After students have finished with this worksheet on various reflections, they will move onto the next page which changes from a multiple choice to a fill in the blank. * I will continue to check on every students progress to help them stay focused and answer any questions they have about reflection an object | * The students will be answering fill in the blank questions * They will also be answering leading question that I have about properties of various shapes and why some cannot be reflected over certain lines of symmetry to produce an orientation like the original. | To again help students progress through the thinking process about how to use knowledge they already have to help them with new interesting situations. Also to help student bring to life the mathematics of reflections. Lastly, to know how to reflect any shape about various lines of symmetry. |
| **End** | * Asking questions about what was covered in the material that day * A final brief benchmark assessment exit question slip will be given to assess student understanding of the learning target | * Answering the teachers questions * Fill out the exit slip drawing by hand a transformation of a trapezoid given in words as well as providing their answer with a step by step scheme on how they solved it | To review and help the students better remember the key points of the lesson preparing them for the next day’s activities.  The exit question will assess how much of the information the students understood and how much they remembered. |