Let's Reflect On This...

Resource ID#: 71794 Primary Type: Lesson Plan

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Students will use parallel and intersecting lines on the coordinate plane to transform reflections into translations and rotations.

Subject(s): Mathematics

Grade Level(s): 9, 10, 11, 12

Intended Audience: Educators

Suggested Technology: Computer for Presenter, Internet Connection, Interactive Whiteboard, GeoGebra Free Software (Download the Free GeoGebra Software)

Instructional Time: 1 Hour(s) 30 Minute(s)

Freely Available: Yes

Keywords: reflection line, line of symmetry, reflection, translation, rotation, coordinate plane, transformations, pre-image, image

Instructional Component Type(s): Lesson Plan

Instructional Design Framework(s): Direct Instruction, Confirmation Inquiry (Level 1)

Resource Collection: USA Geometry

ATTACHMENTS

Whats My Line reflection lines cutouts.docx
Whats My Line reflections cutouts.docx
Whats My Line reflection lines equations cutouts.docx
Whats My Line cutouts teacher copy.docx
FlipFlop student copy.docx
FlipFlop teacher copy.docx
Lets Reflect... student copy.docx
Lets Reflect...teacher copy.docx

LESSON CONTENT

Lesson Plan Template: General Lesson Plan

Formative Assessment

- For the accessing prior knowledge aspect of the lesson, the teacher will have students hold up white boards with the correct lines graphed and identified and check for understanding. These whiteboards should be preserved so that students may refer back to them when needed.
- During the guided practice entitled "What's your line?", the teacher will travel about the room, offering guiding questions as needed to help students connect to the activity. They should be careful not to instruct the students on the directions of the this activity, but rather allow students to decide, based on what they are given, what their goal might be.
- During the independent practice entitled "Flip-Flop", the teacher should circulate around the room, taking note of the progress of the students, and being available to issue guided questions to facilitate learning. The teacher should also ask several students to share their posters with the class during the closure portion of the lesson.

Feedback to Students

- During the accessing prior knowledge part of the lesson, students will hold up their whiteboards so that the teacher can check the progress of their students. At this time, a whole group discussion can be held to correct any misconceptions before beginning the lesson.
- During the guided practice portion of the lesson, the teacher will circulate around the room, using guiding questions to spur students' thought processes, and to make sure students are actively engaged in the activities.
- During the independent practice portion, the teacher will circulate the classroom, monitoring student progress, and using proper questioning techniques to help struggling

students. Some students will be selected to share their work so that a class discussion can be used to help get a full understanding of drawing transformations.

- The summative assessment will be graded for accuracy and returned for discussion.

Summative Assessment

A summative assessment consisting of 4 problems will be given to students to complete independently at the end of the lesson. These will be graded to measure mastery.

Learning Objectives: What should students know and be able to do as a result of this lesson?

Students will be able to:

- draw a reflection line for a given pre-image and its reflected image
- draw translations using a combination of reflections over a set of parallel lines on a coordinate plane
- draw rotations using a combination of reflections over a set of intersecting lines on a coordinate plane
- identify the appropriate transformation based on a constructed graph

Guiding Questions: What are the guiding questions for this lesson?

- What are some real-world examples of a reflection? a translation? a rotation?
- What are the characteristics of these different transformations?
- What are the similarities and differences of reflections, translations, and rotations?
- What determines whether your pre-image becomes a reflection, a translation, or a rotation?

Prior Knowledge: What prior knowledge should students have for this lesson?

Students should:

- know how to graph linear equations such as $y = x + 3$, $y = -2$, $x = 7$, $y = x$, and $y = -x$
- know how to plot and interpret ordered pairs on a coordinate plane
- recognize and understand the meaning of perpendicular bisector

Teaching Phase: How will the teacher present the concept or skill to students?

Accessing Prior Knowledge 10 min.

After assigning groups and distributing supplies for the warm-up task for accessing prior knowledge, the teacher should display "Graph Me!" and instruct the students to graph all the lines on the same coordinate plane on their whiteboards, making sure to label each line with its equation. Students should hold up their whiteboards as they finish so that the teacher can assess their work. The teacher should display "Graph Me!" answers so that students can verify that all lines are correct and labeled appropriately. Students should be instructed to keep all lines and their equations on the whiteboards for reference later in the lesson. At this point, a quick discussion should be held to clear up any misconceptions about linear equations. *For the purpose of this lesson, only vertical, horizontal, and lines with m = 1 or m = -1 will be needed.*

GeoGebra Demonstration 10 min

Using the Free downloadable GeoGebra Software, the teacher should spend a few minutes instructing the class on graphing reflections, making sure to use appropriate vocabulary. See the attached GeoGebra lesson entitled "Reflections".

The teacher should point out the pre-image and the image, and the notations for each, using the "prime" to indicate the image. Have the students make other conjectures about the reflection, including the equal distances between the images and the reflection line, and the fact that the reflection line is perpendicular to the vector that extends from the pre-image point to its image. The teacher should drag point D and then point E to move the reflection line to the equation $y = x$ and help students see how the characteristics of the reflection line are maintained. Move line DE to each of the lines that the students graphed in the warm-up to see the effects of the move on the pre-image and its image. If an interactive white board is being used, the teacher may select students to come up to move the lines, while other students make conjectures about what is happening.

Guided Practice: 20 min

The teacher will give each group a set of cards entitled "What's My Line?". The teacher will not give any directions for the activity, and the students must decide on the intent of the activity based on the information on the cards. As students sort the cards, they should discover that there are three types; some showing a pre-image and its reflected image on a coordinate plane, some showing a dashed line on a coordinate plane, and some showing linear equations. Students should then determine that the task is to match the reflections to their lines of reflection, and equations to their lines of reflection. Students should also discover that some of the lines of reflection can be associated with more than one reflection. As the teacher circulates, questions should be answered in a way that does not give the answer, but guides the students to come up with the answer on their own. 9 blank cards are provided for differentiated instruction. As students finish the matching activity, they can be instructed to make their own reflections and a matching line of reflection and its equation on the remaining 3 sets of blank cards while other students finish the immediate activity. For differentiation, the teacher could also specify certain criteria for these independent drawings. **Teacher note- the answer key for "What's My Line" shows one possible combination of answers. There are other scenarios that would also work, depending on how the line of reflection is interpreted.*

Independent Practice: 20 minutes

The teacher will give each student a worksheet entitled "Flip - Flop", a piece of construction paper, scissors, glue and two crayons. The teacher should post "Flip - Flop" instructions on the board for reference. On the worksheet are six coordinate planes with a pre-image and two reflection lines. Students should be instructed to draw a reflection over line l, and then to draw that image's reflection over line m. They should then color the pre-image one color, and the final image another color, using the same color combination for each problem. The first resulting image should be color free. When all six combination transformations have been completed, the student should cut out each coordinate plane, and sort them into categories, either translations or rotations. On the construction paper, they should use their crayons to make two groups, heading those as translations and rotations. They should then glue the coordinate planes into their correct category on the construction paper. Using the left-over paper from the worksheet, they should then write their observations about the characteristics that made each type of transformation and glue those observations to the poster in the correct category.

Closure: 15 min

Students who were pre-selected to show their posters will come up to the front of the classroom to display their poster. They should be prompted to discuss their reasoning for sorting their transformations. The class should come to consensus about what makes a translation and a rotation. The teacher should then open the GeoGebra attachment entitled "Drawing Translations". Using the *reflect about line* button, the teacher should create the reflection over the line $x = -5$, and then reflect that image over the line $x = 3$. A discussion about the type of transformation that was created and why should ensue. Next, the teacher should open "Drawing Rotations A" to discuss the features of a rotation, including the visual characteristics of a rotation, how to tell which line was the reflection line for each transformation, and what the notation for each transformation looks like. The teacher should grab each reflection line and move it to visualize how the image changes as the line moves. Finally, the teacher should open "Drawing Rotations B", and using the *reflect about line* button to show the compound transformation of reflecting the pre-image over the line $x = -2$ and then

reflecting that image over the x-axis. The teacher can then drag the vertical line to different positions to see how the transformations are affected. A class discussion about how the translation and rotation are alike and different, along with what causes each to occur is expected.

Summative Assessment: 15 min

The teacher will administer the summative assessment entitled "Let's Reflect...", which should be done independently.

Guided Practice: What activities or exercises will the students complete with teacher guidance?
Pairs of students will be given a set of cards entitled "What's My Line?". Their task is to work together to match reflections to their lines of reflection, and to match the equations to the lines of reflection. Students should use a variety of methods to discover the correct line of reflection, including measuring, counting, discovering a pattern, etc.

Independent Practice: What activities or exercises will students complete to reinforce the concepts and skills developed in the lesson?
Each student will be given a worksheet entitled "Flip-Flop", and the necessary materials to complete the exercise. They will draw a pair of reflections on a coordinate plane to create either a translation or a rotation. They will then sort the graphs into either translations or rotations and make conjectures about the characteristics of each. They will cut out their graphs and make a poster to display the two kinds of transformations.

Closure: How will the teacher assist students in organizing the knowledge gained in the lesson?
Selected students will share their posters with the class, indicating what they discovered about the transformations and how they were made. A whole class discussion can then occur as students share their observations. The teacher should then use "GeoGebra" to illustrate both a translation and a rotation using the attached GeoGebra files "Drawing Translations", "Drawing Rotations A" and "Drawing Rotations B".

ACCOMMODATIONS & RECOMMENDATIONS

Accommodations:

- Mini white boards are used and can be preserved for students who need help graphing lines
- Students are grouped homogeneously so that struggling students can have an opportunity to work at their own pace, completing as much of the puzzle pieces as possible in the time constraints, while gifted students have an extension exercise built in to the activities
- "What's My Line" is a puzzle to accommodate visual and tactile learners
- The GeoGebra software is incorporated to help visual learners

Extensions: Students can investigate the relationship between the coordinates of the pre-image and its reflection, translation, or rotation and come up with rules for each.

Suggested Technology: Computer for Presenter, Internet Connection, Interactive Whiteboard, GeoGebra Free Software

Special Materials Needed:

- The teacher will need a set of cards made from "What's My Line" Reflections, "What's My Line" Reflection Lines and "What's My Line Reflections Line Equations" for each group. The coordinate planes on these worksheet should be cut into individual cards and placed in a paper clip or an envelope for distribution.
- Mini whiteboards, pens and erasers for the warm-up (activating prior knowledge)
- One copy of "Flip-Flop" for each student
- One piece of construction paper, scissors, glue, and two crayons for each student
- One copy of "Reflect This..." summative assessment for each student

Further Recommendations:

- A list of groups would be helpful to have posted as students enter the classroom
- A list of needed materials for the warm-up activity would be helpful so that students are ready to begin at the beginning of class
- A large poster of the guiding questions would be good to display and refer to during the lesson
- The teacher should download and familiarize themselves with the GeoGebra software

Additional Information/Instructions

By Author/Submitter

This lesson addresses the following Standards for Mathematical Practice:

- MAFS.K12.MP.5.1 - Use appropriate tools strategically
- MAFS.K12.MP.7.1 - Look for and make use of structure

SOURCE AND ACCESS INFORMATION

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Related Standards

Name	Description
MAFS.912.G-CO.1.5:	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.