

Flips, Turns, and Slides

(Reflections, Rotations, and Translations)

Introduction

Dr. Linda Griffith and Belinda Robertson developed these materials after receiving several requests from elementary classroom teachers for professional development addressing the geometry strand of the *National Council of Teachers of Mathematics Principles and Standards* particularly in the area of transformational geometry. Many teachers admitted that they had no personal experiences, instructional strategies, or instructional materials to support the teaching of “Flips, Turns, and Slides” in their classrooms.

The design of this unit allows for the material to be taught in four class periods followed by a unit assessment that requires one class period. The students in the second or third grade are the targeted audience for these materials. However, if the children haven’t experienced any learning in transformational geometry prior to the fourth or fifth grade, this unit could be used. Without using the formal recording of the results of the motions, K-1 teachers could use these materials to introduce transformational geometry.

The teachers using these materials should keep in mind that the answers recorded in the teacher’s guide are only sample answers and that the students’ answers could be different and still be completely correct.

Flips, Turns, and Slides

(Reflections, Rotations, and Translations)

These transformational geometry lessons should be presented in four class periods with a fifth day set aside for assessment.

The objectives of these activities are to provide the student with the hands-on experience of moving an image in space, creating a visual model, and analyze the results of that move.

After completing these activities, the students should be able to recognize that:

1. Flips result in parts of the figure exchanging places. The top and bottom exchange places or the left and right exchange places.
2. Turns result in parts of the image changing to a new position. For example, the top moves to the right, the right moves to the bottom, the bottom moves to the left, and the left moves to the top in a quarter turn clock-wise. However, after a half-turn both the top and bottom and the left and right exchange places.
3. Slides result in no parts changing places, but that the image moves to another location on the plane (page).

Students will complete a resource book during their study of transformational geometry. Also students will complete a performance assessment at the close of the unit. This assessment will allow the teacher to:

1. Identify which students are at the Below Basic level- can't identify any of the transformations.
2. Identify which students are at the Basic level - can identify the transformations with the aid of a transparency of the image (prediction and actual do not match).
3. Identify which students are at the Proficient level – can identify the transformations without the aid of a transparency of the image (prediction and actual match).
4. Identify which students are at the Advanced level – can identify the transformations stating more than one movement that gives the same result without using the transparent image.

Lesson 1: *Flips*

Time: One class period

Materials: Blank "Flips, Turns, and Slides" book – one per child; turtle cutout – 4 per student (any asymmetrical cut out will work as long as the student can identify a term to refer to the top, bottom, left and right); glue sticks, transparencies of flips and record sheet, *extra cut outs mistakes will be made*

Definition: A *flip* is a motion over a line of reflection that results in a mirror image. (*This is for the teacher's use only.*)

Prerequisite: The students need to know the positional words: top, bottom, left, right, North, South, East and West.

Note: Flip, reflection, and mirror image are mathematical synonyms.

Review the positional words listed above.

Model a flip using the turtle cutout or any other two-dimensional asymmetrical figure.

Hand out the student booklets, turtle cutouts and glue sticks.

Have the students place their cutout on the turtle in their student book.

Have the students record the "start" positions by answering these questions.–

- *What is on top ?* Top (North) back or shell;
- *What is on bottom?* Bottom (South) Feet;
- *What is on the left?* Left (West) Tail;
- *What is on the right?* Right (East) Nose or head.

See the teacher's copy of "Flips, Turns, and Slides" Book.

Model the flip up and record the "end" result when the students answer the same questions above.

Talk about the following, "What parts of the figure changed places?" Make sure the students record their answers in complete sentences (answers may vary). *Students may say that the top and bottom exchanged places of changed places.*

Do the same for "What parts stayed the same?"

Repeat this for each flip. After the second flip, ask "How are a flip up and a flip down different?" "The same?" Note for the teacher: These are both vertical reflections. If the image and preimage were the same color you wouldn't be able to tell the flip up from the flip down unless the preimage was identified.

Before the third flip have the students make predictions about the changes before doing the motion.

Lesson 2: *Turns*

Time: Two class period

Materials: Blank “Flips, Turns, and Slides” book – one per child; horse mat with rotating horse; horse cut out – 4 per student; glue sticks, transparencies of the horse mat and record sheet, *extra horse cut outs mistakes will be made*

Definition: A *turn* is a directional motion of a figure around a point (center of rotation) related to an angle or part of a turn. A complete turn would end at the same position as the start. This gives a resulting image in which parts change position (not exchange places). (*This is for the teacher’s use only.*)

Prerequisite: The students need to know the positional words: North, South, East and West and the directional words clockwise (turn to the right) and counterclockwise (turn to the left).

Note: Turn and rotation are mathematical synonyms.

Review the positional words listed above. With a clock face ask the students where the minute hand would be if it moved one-fourth the way around the face clockwise from the twelve. Do this for two-fourths (one-half), three-fourths, and four-fourths (one complete turn). Repeat for counter clockwise.

Have the students stand and face the North wall of the classroom with their right hand extended in front of them. Have the students make $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and complete turns clockwise and counterclockwise noting what wall they are facing after each turn.

You may want to record this as you go along. See the examples below.

Turn Clock wise	Minute hand position	Start Facing wall	Turn Clockwise	End Facing wall	Turn Counter clockwise	End Facing wall
No	12	North	None	North	None	North
1/4	3	North	1/4	East	1/4	West
1/2	6	North	1/2	South	1/2	South
3/4	9	North	3/4	West	3/4	East
1	12	North	1	North	1	North

Hand out the student booklets, horse cutouts, horse mat, and glue sticks.

Have the students record the "start" positions by asking the same question as in the "flip" lesson – Top (North) Back; Bottom (South) Feet; Left (West) Tail; Right (East) chest. *See the teacher's copy of "Flips, Turns, and Slides" Book.*

Model the $\frac{1}{4}$ turn clockwise on the overhead horse mat and record the "end" result.

After the students have modeled the $\frac{1}{4}$ turn clockwise on their horse mat and recorded the "end" result on their record sheet, talk about "What parts changed?" Have the students record their answers in complete sentences (answers may vary).

Do the same for "What parts stayed the same?"

Repeat this process for each turn clockwise. Before the third turn have the students make predictions about the changes before the doing the motion.

Continue this for each turn counterclockwise. The students should notice that the $\frac{1}{4}$ turn counterclockwise gives the same result as the $\frac{3}{4}$ turn clockwise ($\frac{1}{2}$ clockwise and the $\frac{1}{2}$ turn counterclockwise, also the $\frac{3}{4}$ counterclockwise and the $\frac{1}{4}$ clockwise). *Note, some students may recognize that the $\frac{1}{2}$ turn and a flip right-left along with a north-south flip give the same result.*

Lesson 3: *Slides*

Time: One class period

Materials: Blank "Flips, Turns, and Slides" book – one per child; boot cut out – 4 per student; glue sticks, transparency of slide grid and record sheet

Definition: A *slide* is a motion with both direction and distance that results in a copy of the image at a different location on the plane (page). (*This is for the teacher's use only.*)

Prerequisite: The students need to know the positional words: top, bottom, left, right, North, South, East and West.

Note: Slides and translations are mathematical synonyms.

Review the positional words listed above.

Hand out the student booklets, angel cutouts and glue sticks.

Model a slide using the angel cutout and transparency of the grid.

Have the students record the action "slide north" *a certain number of spaces* (3) in the action section on the record sheet and record the "start" positions – Top (North) Back; Bottom (South) Feet; Left (West) Tail; Right (East) Nose. *See the teacher's copy of "Flips, Turns, and Slides" Book.*

Model the slide north 3 spaces and record the "end" result. Each student should record the result of the sliden.

Talk about "What parts changed?" and have the students record their answers in complete sentences on their record sheet (answers may vary).

Do the same for "What parts stayed the same?"

The students should repeat this for each slide (north, south, east, west). Before the third slide have the students make predictions about the changes before the doing the motion.

Extentions:

(1) Encourage the students to perform combinations of transformations. They will need 2 cut outs of the same object. Encourage them to record the transformations that they want to make and make predictions of the outcome.

For Example:

Flip up and flip left- The dog's head is on the right. Its back is on top. Its feet are on the bottom. Its tail is on the left.
Prediction: Feet on top, back on bottom, head on right and tail on the left.

Have them do their transformations and check their prediction.

Others to consider: Turn left $\frac{1}{2}$ turn and flip left
Flip left, flip up, flip right, flip down
Turn a $\frac{1}{4}$ turn flip down
Flip left, slide up, flip down, slide right

Any combinations of transformations are legal. However the student should write down their prediction and check.

(2) Each pair will need 3 copies of the cutout object (original, image and the 3rd to conduct the guessed transformations). Have one student represent an original (before the transformation) and an image (after the transformation) while the other is not looking. Have the other student guess what transformations or combinations of transformations would produce the image. Have the students check their guess by laying the 3rd figure on top of the original and performing the transformations to see if they can get the 3rd figure on top of the 2nd.

(3) Stump the Teacher Give groups 2 copies of cutout figures and have them try to make a transformation that you can't figure out. If you can't figure out the transformation, let someone else in the class try.

(4) Place a small figure on the grid at a cross position and another at a diagonal location on the grid. Ask the students to tell you how to slide the first figure to the second if "no cutting across the squares" is allowed. *Maybe slide 2 to the right and 3 down. Or slide 3 down and 2 to the right. Or slide 1 right, 1 down, 1 right and 2 down*

Assessment: Flips and Turns

Time: One class period

Materials: One assessment sheet and transparent figure per student, glue or tape.

Part I: Distribute the assessment sheet to each student. Instruct the students that they are to look at the “start” figure and the “end” figure and make a prediction as to what motion or motions occurred to give these results. Instruct the students to record their predictions on the lines for predictions.

Note: Teachers students’ predictions cannot be marked incorrect.

Part II: After the students have completed their predictions, instruct them to not change their predictions and distribute their transparent figure. Tell them to use this tool and record the actual motions (which may be the same as or different from their predictions). Their predictions are not to be marked incorrect unless the words recorded do not relate to this unit.

Note: *There are several motions or combinations of motions that will give the same results. Encourage your students to find as many correct motions as they can find.*

Part III: The final section of this assessment is an open-ended response item that addresses a higher level of learning, synthesis. This item requires the students to use their transparent figure, perform combinations of motions, and create an “end” figure that is different from the previous five figures.

Below is a sample rubric for items 1-5.

Advanced (4)	The student made predictions for all items and responded correctly to all items with more than one correct motion. Actual motions and predictions matched.
Proficient (3)	The student made predictions for all items and gave at least one correct answer for each actual motion.
Basic (2)	The student made a prediction for each item and recorded an actual motion for each item. A few of the actual motions are correct.
Below Basic (1)	The student made a prediction for all of the items and made no attempt to fill in the actual motion Or The student made some predictions and made an attempt to record actual motions for these but the actual were not correct.

Zero The student made no response or predictions and actual responses did not relate to the unit.

The following is a sample rubric for item six.

Advanced (4) The student created a different ending figure and correctly described the motion or motions that occurred to create the ending figure.

Proficient (3) The student created a different ending figure and incorrectly described the motions of motions that occurred to create the ending figure.

Basic (2) The student made a figure from one of the previous problems and correctly described the motion or motions that created the ending figure.

Below Basic (1) The student made a figure from one of the previous problems and incorrectly described the motion that created the ending figure.

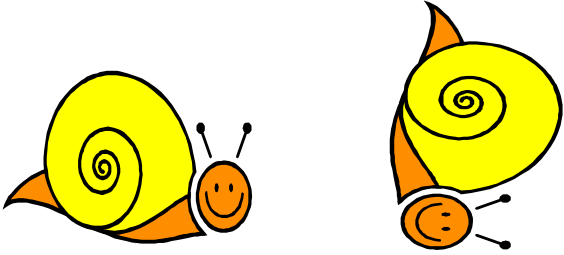
Zero No response.

Flips and Turns Assessment

Name _____ Date _____

Predict the motion that you think occurred to create the "end" figure for items 1-5. Record your predictions on the lines marked Predictions. After you have recorded your predictions, your teacher will give you a transparent copy of the figure. Use this figure to determine the actual motion or motions. Record the actual motion or motions on the lines marked Actual. Do not change your predictions.

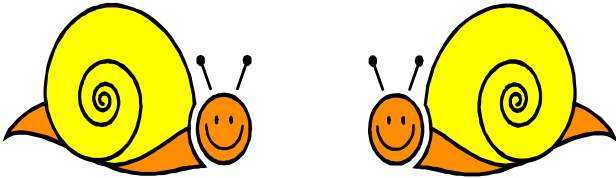
1.



Prediction _____

Actual _____

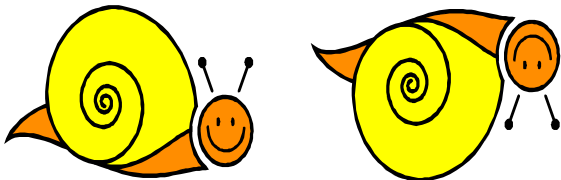
2.



Prediction _____

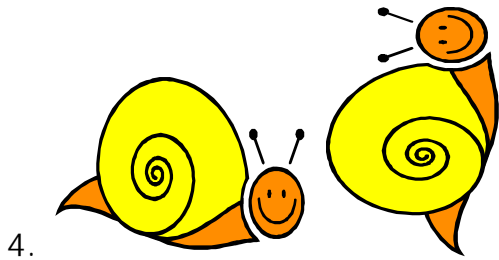
Actual _____

3.



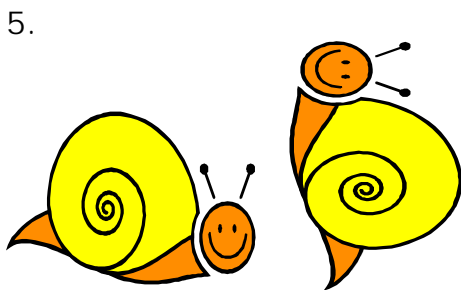
Prediction _____

Actual _____



Prediction _____

Actual _____



Prediction _____

Actual _____

6. Use your transparent figure and create a "end" figure different from items 1 – 5. Tape or glue this new "end" figure in the space provided. Record the motion or motions that occurred to create this new figure.

