WAMC Lab Template

Math Concept(s): Congruence Transformations
Source / Text: N/A
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Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

- This lab takes place after learning about transformations and how to complete them within a coordinate plane.

Lab Plan

Lab Title: Escher Drawing Lab

Prerequisite skills: Ability to complete transformations within a coordinate plane

Lab objective: To apply transformations to create an Escher-like tessellation.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- HSG-CO.A.5 – Given a geometric figure and a rotation, reflection, or translation, draw the transformed figures using e.g. graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
- HSG-CO.B.6 – Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

Standards for Mathematical Practice:

- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- Reading for Literacy in Science and Technical Subjects Grades 9 – 10.4 – Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9 – 10.

K-12 Science Standards

- CCC 1 – Patterns
- SEP 5 – Using Mathematical and Computational Thinking

- 3.a. – Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- 4.b – Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

Engineering

-

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)
☐ Global Awareness   ☐ Financial/Economic/Business/Entrepreneurial Literacy   ☐ Civic Literacy
☐ Health/Safety Literacy   ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER SKILLS	Productivity and Accountability
Creativity and Innovation	Information Literacy	Flexibility and Adaptability	☒ Manage Projects
☒ Think Creatively	☐ Access and Evaluate Information	☐ Adapt to Change	☒ Produce Results
☐ Work Creatively with Others	☐ Use and manage Information	☐ Be Flexible	Leadership and Responsibility
☐ Implement Innovations	Media Literacy	Initiative and Self-Direction	☐ Guide and Lead Others
Critical Thinking and Problem Solving	☐ Analyze Media	☒ Manage Goals and Time	☐ Be Responsible to Others
☐ Reason Effectively	☐ Create Media Products	☒ Work Independently	
☐ Use Systems Thinking	Information, Communications and Technology (ICT Literacy)	☒ Be Self-Directed Learners	
☐ Make Judgments and Decisions	☐ Apply Technology Effectively	Social and Cross-Cultural	
☐ Solve Problems		☐ Interact Effectively with Others	
Communication and Collaboration		☐ Work Effectively in Diverse Teams	
☐ Communicate Clearly			
☐ Collaborate with Others			

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- Student directions and tracking sheet
- Polygon Patterns printed on card stock paper
- 2 pieces of graph paper with coordinate plane on it for each student
- Tape
- Scissors

Set-Up Required:

- Have enough copies of each sheet for students

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students will have to show initiative, self-direction, productivity, and accountability to complete two tessellation drawings.

Cooperative Learning:

- N/A

Expectations:

- Students apply transformations to create an Escher-like tessellation.

Timeline:

- 1 – 2 class periods

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Tessellations are used in computer graphics, architecture, fashion, gaming

Career Applications

- Architects
- Graphic Design
- Computer gaming developers
- Fashion designers
- Artists

Optional or Extension Activities

- Challenge students to create a tessellation that is a recognizable figure (animal, person, etc.)
- Research activity where students find how the different careers use tessellations
- Have students use GeoGebra or Desmos to create a tessellation on the computer.

Escher Drawing Lab

MC Escher was a graphic artist in the early 1900s. One of his most famous themes was tiling a design over an entire page with no gaps or overlaps using geometric transformations. Escher created over 150 different types of this drawing (see example below).
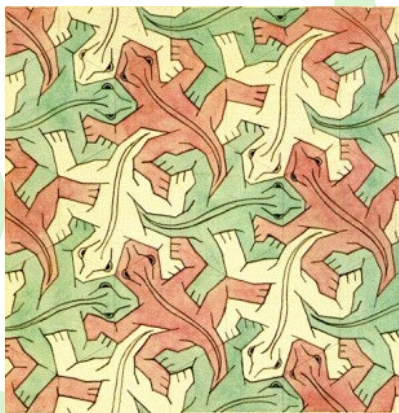
Objective: To apply transformations to create an Escher-like drawing.

Materials:
- Student directions and tracking sheet
- Polygon Patterns printed on card stock paper
- 2 pieces of graph paper for each student with coordinate plane on it
- Tape
- Scissors
- Optional – colored pencils

Part 1 – Introduction:
1. Look up information about MC Escher. What are the types of drawings he did called?

2. What shapes can be used to create the types of drawings Escher created?

3. What is special about the shapes from question 2 that allows them to be used to create the drawings?

Part 2 – Practice:

1. Choose a regular polygon from the provided sheet and cut it out.

2. Choose a vertex of the regular polygon and label it as A on the shape.

3. On a piece of graph paper, place the shape so that vertex A is at a coordinate point. Label this point A and trace the shape.

4. Perform a transformation (rotation, translation, reflection) to get the next placement. Trace it.

5. Record which transformation you did and the new coordinates of A on the table below.

6. Repeat steps 4 and 5 until the entire page is covered. You only need to record the first 10 transformations you complete.

7. Color/decorate your design as desired.

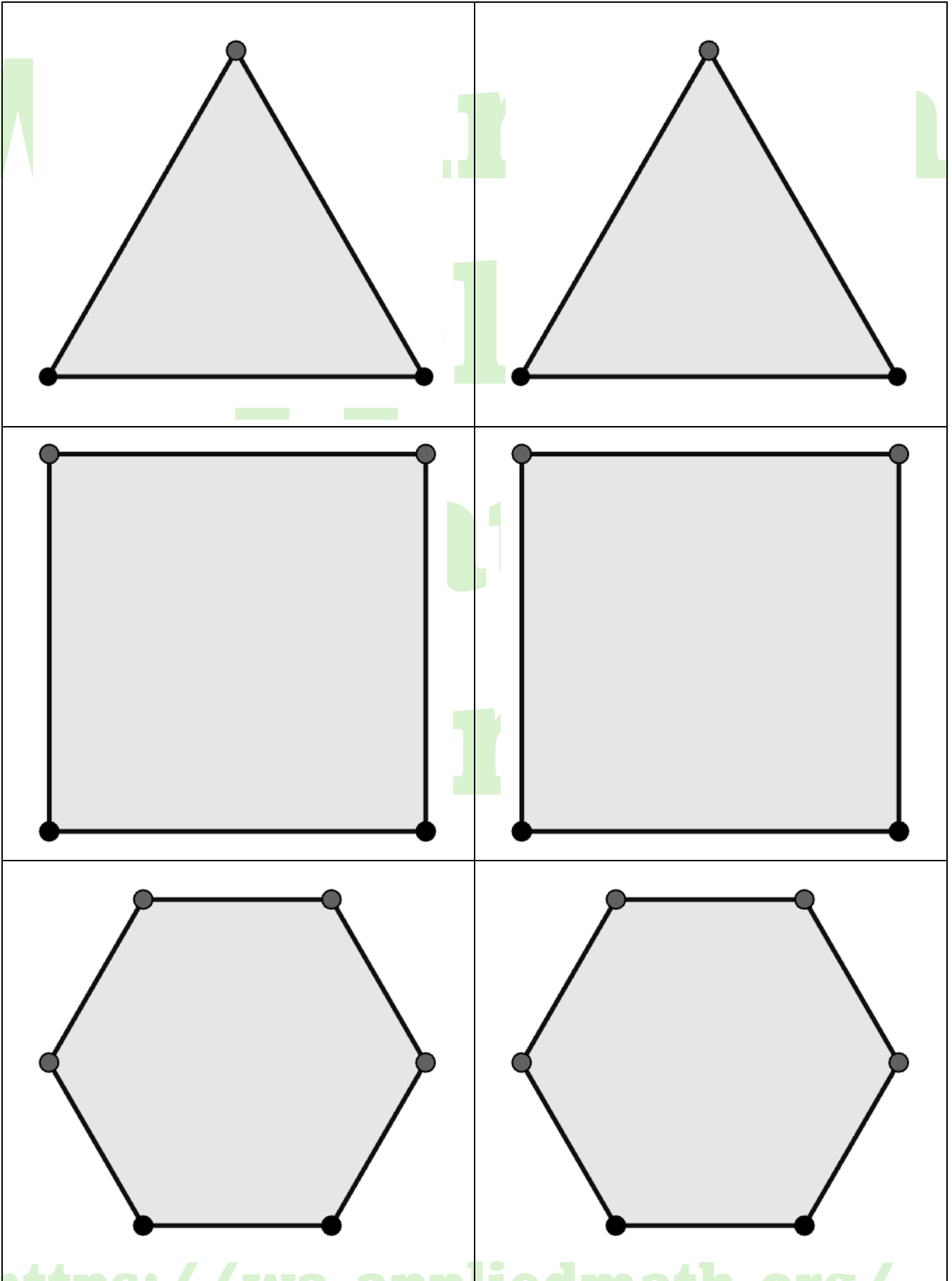| Step	Transformation	Coordinate of A	Step	Transformation	Coordinate of A
0	N/A		6		
1			7		
2			8		
3			9		
4			10		
5					

Part 3 – Create Your Own:

1. Choose a regular polygon from the provided sheet and cut it out.

2. Cut a portion of the figure on one side, slide it to the opposite side, and tape it. Repeat as many times as desired to get a new shape.
   Ex:
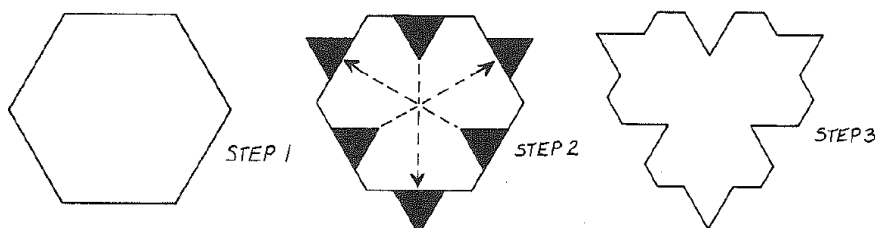
3. Choose a vertex of the regular polygon and label it as B on the shape.

4. On a piece of graph paper, place the shape so that vertex B is at a coordinate point. Label this point B and trace the shape.

5. Perform a transformation (rotation, translation, reflection) to get the next placement. Trace it.

6. Record which transformation you did and the new coordinates of A on the table below.

7. Repeat steps 5 and 6 until the entire page is covered. You only need to record the first 10 transformations you complete.

8. Color/decorate your design as desired.

Step	Transformation	Coordinate of B	Step	Transformation	Coordinate of B
0	N/A		6		
1			7		
2			8		
3			9		
4			10		
5					

Sample Escher Drawing Rubric

	4 pts	6 pts	8 pts	10 pts
Fulfills the definition of a tessellation (no gaps, no overlaps, fills the page)	Violates all 3 parts of the definition but tried to complete a drawing.	Violates 2 of the 3 parts of the definition.	Violates 1 of the 3 parts of the definition.	Completely fulfills the definition.
Used transformations to create the drawings	Used 1 of the 3 transformations.	Used 2 of the 3 transformations.	Used all three transformations at least once each.	Used all three transformations multiple times.
Completed the table for each drawing	Completed the table correctly through step 5.	Completed the table correctly through step 7.	Completed the table correctly through step 9.	Completed the table correctly for all 10 steps.