

Educator Guide



STEAM and  
Optical Illusions



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This STEAM curriculum is a complimentary resource for PCS Edventures subscribers. Its purpose is to showcase the potential for hands-on learning and spark students' interest in STEAM concepts through engaging activities.

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# A Quick Look into STEAM and Optical Illusions

Educators know time is an illusion. The learning begins and whoosh! The minutes either disappear or we're left with more than we expected. Sometimes, you only need a quick activity to capture learners' attention, while other times, it's about nurturing their curiosity and keeping the magic alive. Consider this resource as a trick up your sleeve for mastering the art of time management with STEAM.

These activities are perfect for:

- Brain breaks.
- Whole class activities.
- Small groups.
- Independent or small group centers.
- Anytime!

Each activity requires minimal materials and easily adapts to fit the needs of any grade level. Activities begin with an introductory, mind-bending optical illusion. Need more activities right away or for another day? Try out one (or all!) of the cross-curricular extensions that follow.

Directions for educators are in black. Discussion questions and example scripts are in blue for quick and simple implementation.

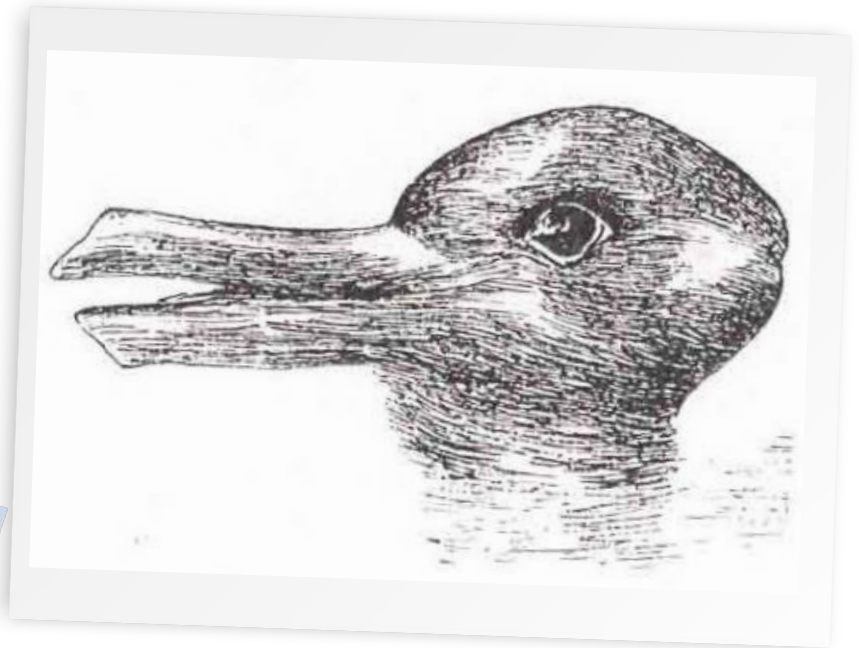
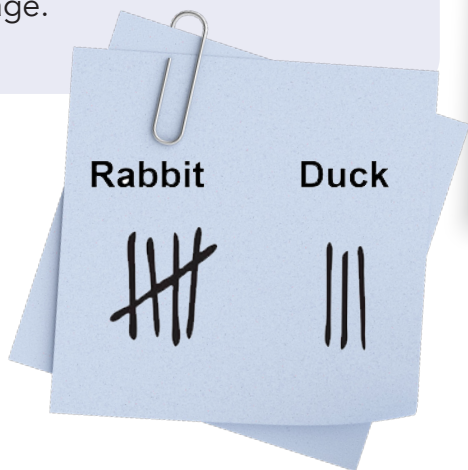
Prepare to amaze your learners and spark their curiosity with these optical illusion adventures!



PCS Edventures' STEAM Enrichment programs are designed to cultivate curiosity and creative thinking through hands-on activities. Optical illusions play with our perception, showing how what we see may not always align with reality. Challenge learners' perceptions by exploring the 'how' behind learners' favorite superhuman abilities (invisibility, flight or even web-slinging!) in *The Science of Superpowers*. For older learners, *Da Vinci Camp* is perfect for exploring more STEAM possibilities. Learners unravel the mysteries of perception and refine their observational skills through measurement, estimation and the exploration of patterns and fractals.

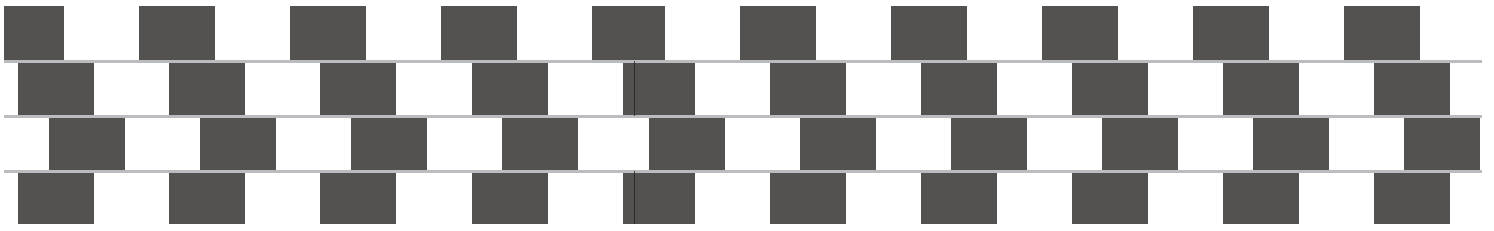
# Activity 1: Double-Pictures

Take a look at this picture.  
**What's the first thing you see?** Ask learners to place their hands on their heads when they're ready to share what they see. As they share, consider writing their ideas on a chart and adding tally marks beneath each to show how many of their peers saw the same or a different image.



What do scientists, engineers, artists and mathematicians have in common? They all share an ability to view things from unique perspectives. Their flexible thinking helps them solve problems and create incredible innovations! Sometimes, all it takes to uncover something amazing is to change how we view it.

Challenge learners to see the image they did not initially see. Ask: **Why do STEM professionals often work in teams?** Sample response: Scientists, mathematicians and engineers collaborate to solve problems. Since people can look at the same problem from different perspectives, each may see a unique solution they can share with their team.



## Short on Time?

### More Double-Pictures

Look at the images through mathematicians' eyes!

Observe the additional double-pictures provided in the student booklets.

Discussion Questions:

- Describe the features (attributes) of each character you identified.
- Are mathematical transformations, such as rotations or reflections, evident in the images?
- Can you identify any geometric shapes or symmetry within the double-picture illusion?
- How does the use of perspective and angles contribute to the illusion's effect?

**ELA Extension:** Write a story that includes both characters in one of the double-picture images. What brought them together? What resolution do they come to?

## Keep It Going!

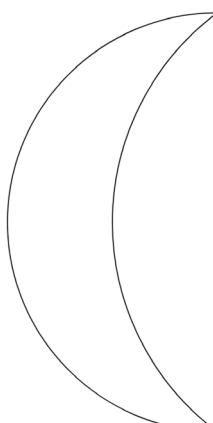
### This is NOT a Moon

Practice changing your perspective with a creative art activity!

Ask learners to finish the drawing provided in their student booklet. Challenge them to use creativity and critical thinking skills, knowing that the picture is certainly NOT a moon.

**This Is Not a Moon!**

**Directions:** This is not a moon! Add to the image below to create a new picture. What do you see?



You may see a moon, but I see a \_\_\_\_\_!

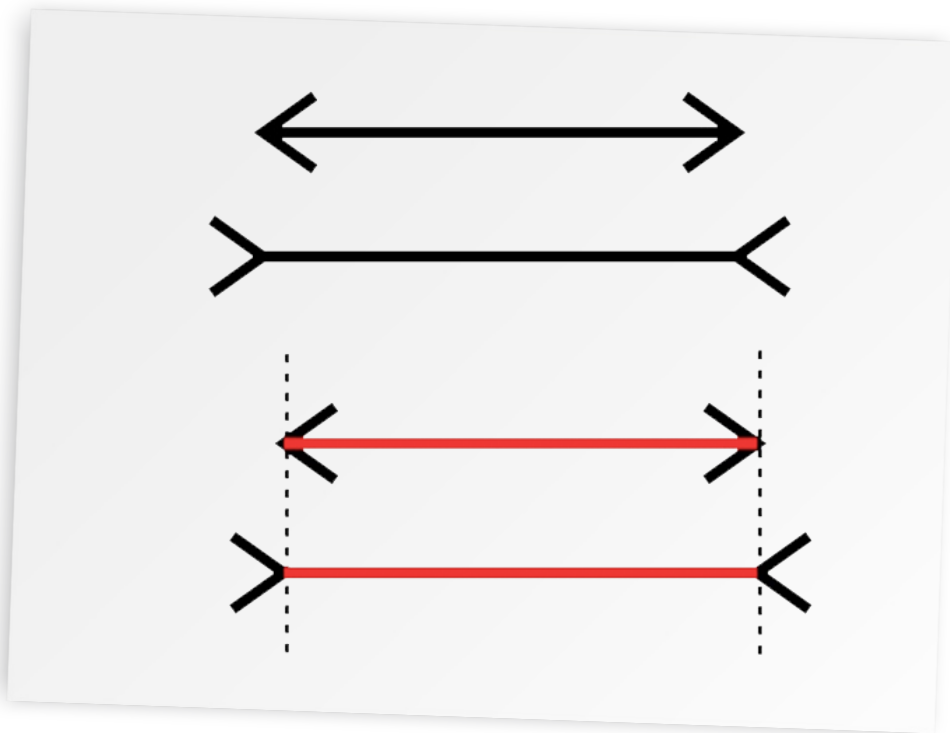
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**ELA Extension:** Begin this activity by exploring the picture book *NOT a Box* by Antoinette Portis. *Watch the Video.*

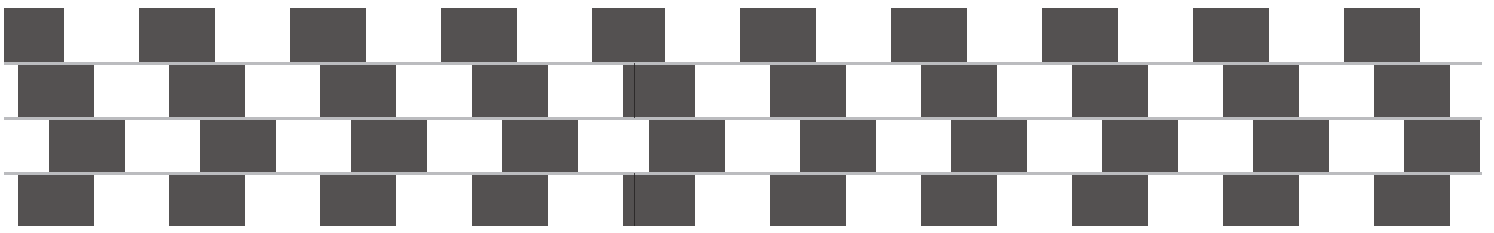
## Activity 2: Müller-Lyer Illusion

Without measuring, examine the two line segments in the student booklets. *These simple lines are more than they appear. Before we see how, let's quickly make an observation. Which line is longer?* Give learners a moment to observe before asking them to vote for the top or bottom line.



Use a ruler to measure both lines end-to-end as a class or in teams. *Wait a minute! Even though the line segments don't look the same, they are the same length. What do you think is affecting our perception?*

Let learners talk over their ideas with someone nearby for three minutes. Then, ask them to share their ideas with the class. *Sample response: The orientation of the arrowheads affects how our brain interprets the length of the line.*

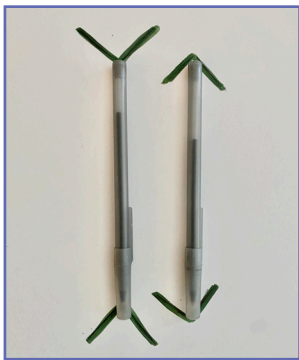


## Short on Time?

Experiment with items found in your learning environment, home or out in nature (e.g., sticks, pipe cleaners, uncooked spaghetti, etc.). Be sure they're the same length before adding inverse arrows to each object's ends.

Note: You may choose to provide the items or, if time allows, practice measuring skills and have learners go on a mini scavenger hunt to collect their own.

### EXAMPLES:



Pens



Pretzel Sticks

As learners explore, consider asking the following to push their thinking:

### Discussion Questions:

- *What do you notice?*
- *Are the pair of items still the same length?*
- *How might understanding this illusion be useful in STEAM fields? (e.g., design, architecture.)*

## Keep It Going!

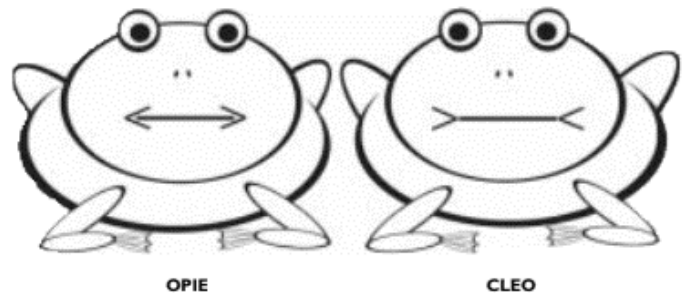
### My Müller-Lyer Illusion Illustration

#### Supplies:

- Paper
- Rulers
- Pencils
- Colored writing utensils

Create your own Müller-Lyer illusion drawings! Experiment with various shapes, sizes and angles to see how they affect the perception of line length.

**Art Extension:** Challenge learners to see how many creative ways they can incorporate the illusion in a detailed illustration.



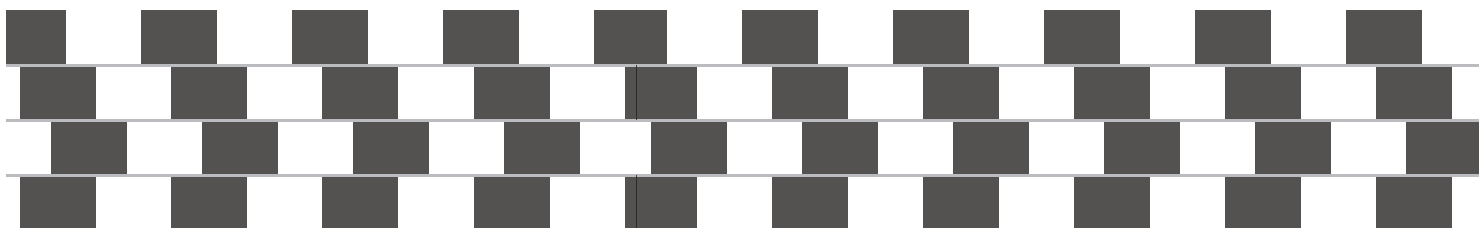
## Activity 3: A Mind-Bending Illusion

This illusion is truly mind-bending. This experiment requires a transparent cup with water and a pencil. Show learners the pencil. *Let's put on our scientist hats and practice our observation skills. Here is an ordinary pencil. What are its characteristics?*

Show learners the cup of water. *It's time for another observation.* Place the pencil in the cup of water, resting half of it beneath the surface with the other half above the water. *How would you describe the pencil now? Sketch your observations in your student booklet.*



*When light passes through water or air, it bends or changes direction. This is because the speed of light changes as it passes through different materials. This phenomenon is known as refraction, and it tricks our brains into thinking the pencil breaks when placed in a cup of water.*



## Short on Time?

### Magic Coin

Amaze learners with this disappearing coin trick!

Supplies per group:

- Transparent cups
- One coin
- Water

Directions:

- Place a coin at the bottom of a transparent cup.
- Slowly fill the cup with water.
- Look at the cup from the side.

Discussion Questions:

- *Why does the coin seem to disappear?*
- *What do you see when you look down from above the cup?* One coin.
- *What do you see when you look down from the side of the cup?* Two coins. This is known as refraction.

## Keep It Going!

### Refraction In Action

Supplies:

- Transparent cups
- Notecards or paper
- Colored pencils, markers or crayons
- Water
- Containers of varying shapes/sizes (optional)

Get learners to unleash their creativity. Have each draw their own image, preferably one that faces one direction. It could be an animal, an arrow, a flashlight or anything they like!

Next, have them place their artwork behind an empty transparent cup. As they slowly fill the cup with water, watch in wonder as their image undergoes a magical transformation right before their eyes!

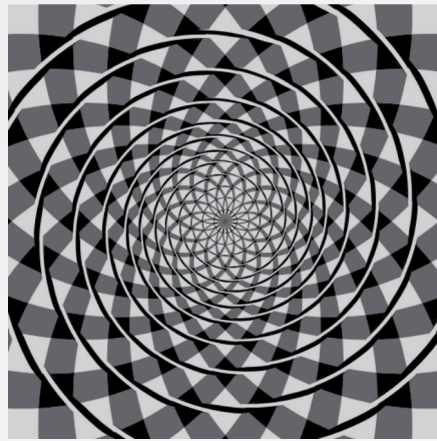


**Science Extension:** Give learners a chance to experiment with different variables for more refraction fun. For example:

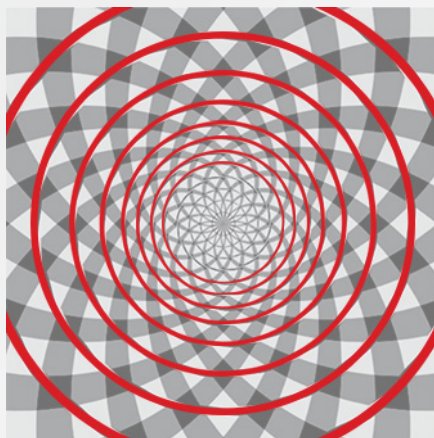
- Varying-sized or shaped containers
- Different liquids (e.g.: bubble solution, juice, oil)

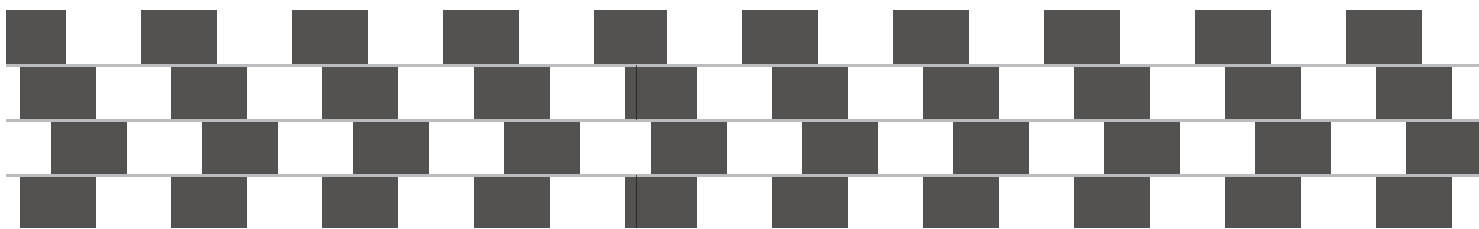
## Activity 4: A Twisted Illusion

Take a look at this wacky work of art. *How would you describe this image? Try sketching what you see in your student notebook.* Did learners draw one giant spiral?



Don't get it twisted! *While this looks like an infinite spiral, this image, known as the Fraser spiral illusion, is just a bunch of concentric circles! Concentric circles are two or more circles with a common center.*





## Short on Time?

### Concentric Circles Game

Directions:

1. Split the class in half and form two concentric circles, an inner circle of learners facing a larger, outer circle of learners.
2. First, have learners walk in a circle, following the person beside them. *Discuss: What do you notice about our two circles?*
  - The circles have the same center.
  - The circles will never cross no matter which direction they rotate.

#### Keep the Fun Going!

If time allows, use this as an opportunity for learners to practice their discussion skills.

Show the class more examples of optical art. Learners can discuss each illusion, rotating the inner circle every few minutes to spark conversations among different learners.

## Keep It Going!

### Optical Art

Supplies:

- 100-square grid
- A ruler
- Black marker

Combining black and white geometric shapes or patterns can create optical illusions that give the impression of movement, vibration, pulsation or warping.

Experiment with different designs on a 100-square grid to create your own optical art illusions. You can try breaking the squares in the grid into triangles, rectangles or other shapes to experiment and explore different possibilities.

**Math Extension:** Challenge learners to think like mathematicians with these discussion questions:

1. *Can you see any patterns, fractions or decimals in your design? Where are they?*
2. *Can you identify any different quadrilaterals?*

## Activity 5: The Impossible Triangle

Sure, you can see the Penrose triangle here as a 2D image, but it's impossible to construct a 3D model of it. Don't believe us? Give it a try using building bricks.

Have learners team up into groups of 3 to 5. *Take a look at the image in your student booklets.* **Can you construct a model of it using building bricks?**



Stumped? Here is a step-by-step guide to creating a 3D model. It's all about perspective!

Provide each group with the following building bricks of the same color, if possible:

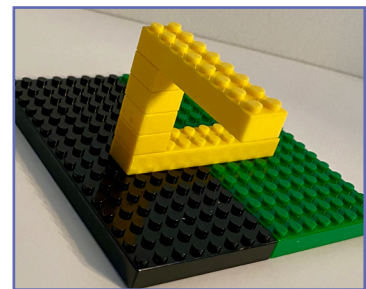
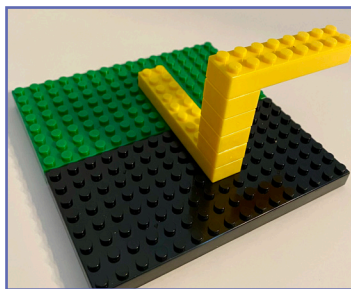
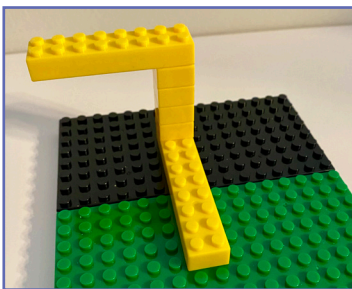
- one 2×10-stud brick
- one 2×8-stud brick
- four 2×2-stud bricks
- one 16×16-stud or 32×32-stud brick base

**Short on time?  
Build a model  
before the  
activity begins.**

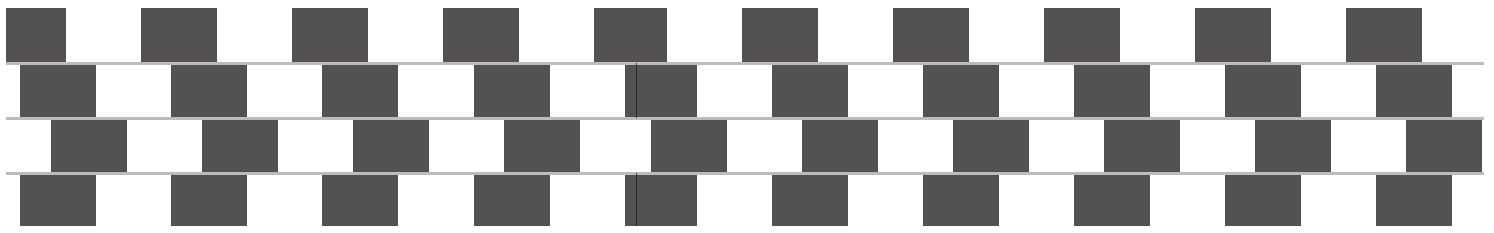
**Step 1:** Place the 2×10-stud brick on the base.

**Step 2:** Stack the four 2×2-stud bricks and place them at one end of the 2×10-stud brick.

**Step 3:** Place the 2×8-stud building block at the top of the 2×2-stud brick stack, facing away from the bottom brick.



**Step 4:** Trick your brain! Have learners view the model from different angles and distances until they're able to see a fully closed triangle. If it helps, try closing one eye, as this affects our depth perception.



## Short on Time?

### Target Practice!

#### Supplies:

- 1 target (student booklet) per group
- 2 colored markers

Depth perception plays a large role in our ability to see things as they are. In this activity, learners try to drop their marker as close to the center of a target as possible.

#### Directions:

1. Place the target found in the student booklet on the floor.
2. Close one eye before raising an open marker above the target.
3. Drop the marker, aiming for the center of the target. Repeat five times.
4. Using a different colored marker, keep both eyes open and aim for the target's center. Repeat this another five times.

#### Discussion Questions:

- *Compare your accuracy between the different trials. Were you more successful with one eye or both eyes open?*
- *How did your results compare to others?*
- *How is depth perception important to humans?*
- *What are some ways to improve this experiment or further things to test?*

## Keep It Going!

### Draw your own Penrose polygons.

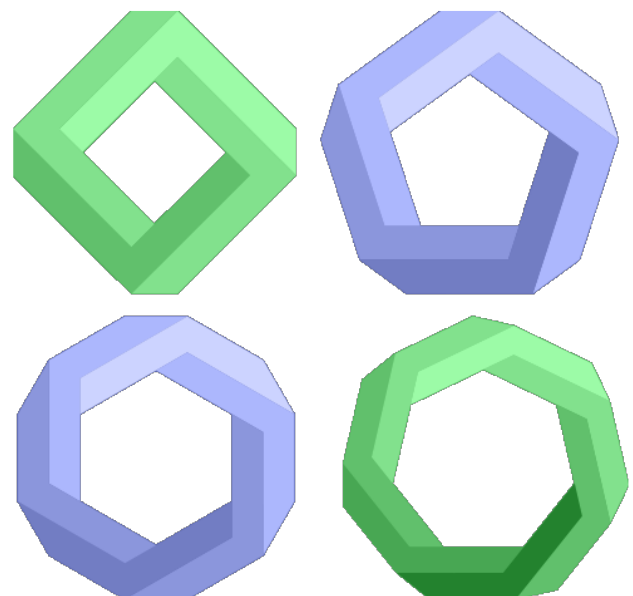
#### Supplies:

- Pencil
- Paper
- Colored writing implements (optional)

You've seen how the Penrose Triangle looks as a 2-D and 3-D model. Challenge yourself to draw other Penrose polygons such as a:

- Square
- Pentagon
- Hexagon
- Heptagon
- Octagon

#### Examples:



# Keep the Magic Going!

Be sure to check out our [BrickLAB Collection](#) for more hands-on build challenges educators and learners love!

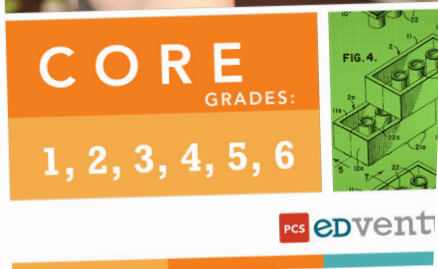
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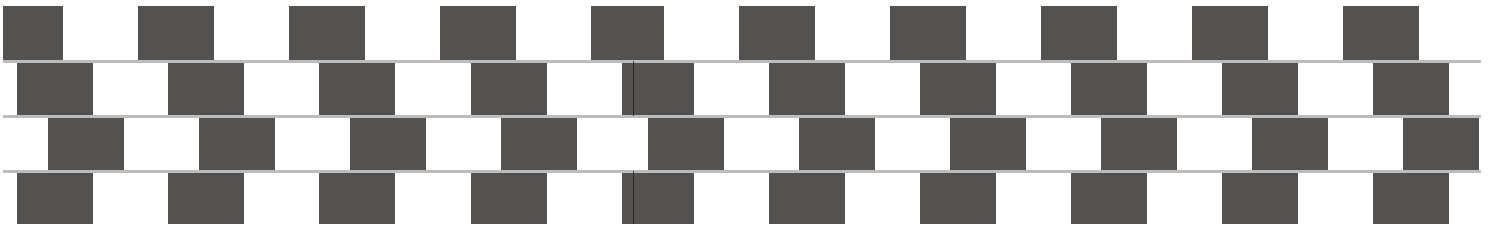
Judy B.

BrickLAB



*We all loved having the resources to build with. As a teacher, the lesson plans are amazing, and I love all of the cross-curricular connections. We can use the bricks to enhance almost any lesson. The students are so much more engaged when we do hands-on activities while we are learning.*





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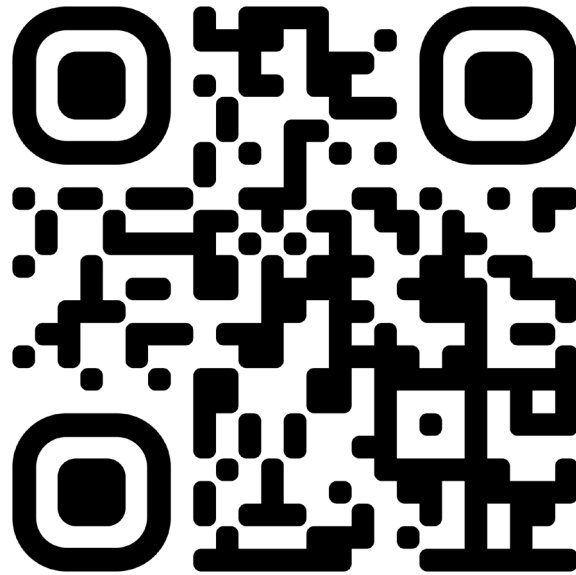
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