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TEACHER LESSON PLAN

Geometry of Perspective

Math Behind Optical Illusions · Grades 5–8 · Math · 30 minutes

Students discover how mathematical principles—angles, ratios, and perspective—create optical illusions, and use measurement to prove that their eyes can deceive them.

THE 30 MINUTES

5 min
HOOK

10 min
DIRECT INSTRUCTION

12 min
ACTIVITY

3 min
CLOSING

LEARNING OBJECTIVE

Students will understand how mathematical principles including angles, ratios, and linear perspective create optical illusions, use measurement tools to prove visual deceptions, and apply one-point perspective to create their own mathematically-based illusion.

STANDARDS ALIGNMENT

- **CCSS.MATH.CONTENT.7.G.A.1:** Solve problems involving scale drawings of geometric figures.
- **CCSS.MATH.CONTENT.7.G.B.5:** Use facts about supplementary, complementary, vertical, and adjacent angles.
- **CCSS.MATH.PRACTICE.MP3:** Construct viable arguments and critique the reasoning of others.

MATERIALS NEEDED

- Rulers (one per student) and protractors (one per pair)
- Graph paper for perspective drawing; pencils and erasers
- Mini Museum Perception Lab: minimuseumproject.org/exhibitions/seeing-is-deceiving/illusions
- Recommended from Perception Lab: Müller-Lyer (#12), Ponzo Corridor (#10), Ponzo Railroad (#11), Sander Parallelogram (#17), Ebbinghaus Circles (#14)

HOOK · 5 MINUTES

Your eyes vs. math

Display the Müller-Lyer illusion (two horizontal lines of equal length—one with fins flaring outward at both ends, $>-<$, and one with arrowheads, $<->$).

“Which line is longer—the top one or the bottom one?” Take a class vote. Most students will say the one with outward fins ($>-<$) looks longer. *“Now let’s check with math.”* Have a student measure both lines with a ruler.

Reveal: *“They’re exactly the same length! Your eyes told you one thing, but mathematics tells you another. Today we’re going to explore WHY these illusions work—and the answer is geometry.”*

The math behind illusions

01

Müller-Lyer (angles)

"The arrows at the ends create angles. Your brain interprets these as depth cues:"

- Outward fins ($>-<$) look like the inside corner of a room — farther away
- Inward arrowheads ($<->$) look like the outside corner of a building — closer
- Brain "adjusts" length based on perceived distance: the line that seems farther away looks longer

Math: Arrow angles (45° or 30°) determine illusion strength.

02

Ponzo (converging lines)

Display the Ponzo illusion (the Perception Lab's Ponzo Corridor: two identical balls in a corridor whose walls converge into the distance).

- Converging lines signal "distance" to your brain
- Objects "farther away" must be larger
- Brain scales up the top line

Math: Ratio of line to track width changes.

03

One-point perspective (vanishing points)

Artists use mathematical perspective: all parallel lines converge to a single vanishing point, objects get proportionally smaller, and the rate of shrinking follows mathematical ratios.

ACTIVITY · 12 MINUTES

Prove it with math

Part 1: Measurement challenge (5 minutes)

Distribute printed illusions. Students work in pairs to:

1. Predict which line/shape is larger
2. Measure with ruler/protractor to find actual values
3. Calculate the difference between perception and reality
4. Record findings in a data table

Part 2: Create a one-point perspective drawing (7 minutes)

Using graph paper:

1. Draw a horizon line across the middle of the page
2. Mark a vanishing point on the horizon
3. Draw a rectangle (front of a box or building) below the horizon
4. Connect corners to the vanishing point with light lines
5. Draw back edge of box parallel to front edge; erase construction lines

"You've just used geometry to trick someone's eye into seeing depth on a flat page!"

CLOSING · 3 MINUTES

Math as a tool for truth

"Today you learned that your eyes can be fooled, but math doesn't lie. When perception and measurement disagree, measurement wins. This is why scientists, engineers, and artists all rely on mathematical tools."

Discussion: "Can you think of real-world situations where measuring is more reliable than just looking?" (Construction, medicine, sports photo finishes, cooking, etc.)

MINI MUSEUM CONNECTION

Option 1 — Visit the Mini Museum: The stereoscope creates 3D illusions using geometry—each eye sees a slightly different angle (about 6 cm apart), and your brain calculates depth from the difference.

Option 2 — Virtual Visit: Explore at minimuseumproject.org/exhibitions/seeing-is-deceiving or view artifacts at minimuseumproject.org/exhibitions/seeing-is-deceiving/artifacts

ASSESSMENT

- **Formative:** Check measurement accuracy and ability to explain why the illusion works mathematically.
- **Completed work:** Assess one-point perspective drawing for correct use of vanishing point and converging lines.
- **Exit ticket:** *“Explain in one sentence why the Müller-Lyer illusion works, using the word ‘angles’ in your answer.”*

DIFFERENTIATED STUDENT HANDOUTS

Three levels of student handouts are provided as separate files:

GREEN LEVEL MORE SUPPORT

“More support” — Guided measurement with templates, simple perspective exercise

YELLOW LEVEL GRADE LEVEL

“Ready for a challenge” — Independent measurement, calculate differences, perspective drawing

RED LEVEL GO DEEPER

“Go deeper” — Design forced perspective illusion, explain mathematical principles