Space Justification Jam

Intro to Proofs Using Spatial Reasoning

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Grade Level	9th – 10th Grade	**Time Frame**	2 class periods
Subject	Mathematics	**Duration**	90 minutes
Course	Geometry		

Essential Question

How does spatial awareness help us to be confident in our geometric knowledge?

Summary

Proofs can be difficult and require a certain mindset. Spatial reasoning and awareness is a skill that can be developed no matter the age of the student. In this lesson, spatial reasoning is refined using drawing techniques and prior knowledge of shapes, lines, and the coordinate plane. This lesson is a great culmination activity for algebraic reasoning and proofs leading into geometric and figure proofs in a Geometry class. Required knowledge for this lesson includes: the ability to calculate midpoint, slope, distance, angle measure.

Snapshot

Engage

Students attempt a Quick Draw of a coordinate image and reflect on what they looked for first.

Explore

Students use calculations to refine their Quick Draw to be exact.

Explain

Students take notes over academic language related to proofs.

Extend

Students look at sample problems to determine what is given and what else they can figure out from the given.

Evaluate

Students reflect on what they 'look' for first and make a plan for tackling proofs in the future.

Standards

Oklahoma Academic Standards Mathematics (Geometry)

G.RL.1.1: Use undefined terms, definitions, postulates, and theorems in logical arguments/proofs.

Attachments

- Evaluating Proofs—Space Justification Jam - Spanish.docx
- Evaluating Proofs—Space Justification Jam.docx
- Evaluating-Proofs-Space-Justification-Jam - Spanish.pdf
- Evaluating-Proofs-Space-Justification-Jam.pdf
- How I Know It—Space Justification Jam - Spanish.docx
- How I Know It—Space Justification Jam.docx
- How-I-Know-It-Space-Justification-Jam - Spanish.pdf
- How-I-Know-It-Space-Justification-Jam.pdf
- Lesson-Slides-Space-Justification-Jam.pptx
- Metacognitive Geometry Plan—Space Justification Jam - Spanish.docx
- Metacognitive Geometry Plan—Space Justification Jam.docx
- Metacognitive-Geometry-Plan-Space-Justification-Jam - Spanish.pdf
- Metacognitive-Geometry-Plan-Space-Justification-Jam.pdf

Materials

- Lesson Slides (attached)
- Evaluating Proofs handout (attached, 1 per student)
- Metacognitive Geometry Plan handout (attached, 1 per student)
- How I Know It handout (attached, 1 per student)
- Students' interactive notebooks
- Basic math tools (rulers, protractors, compass, etc.)

Engage

Begin the lesson by introducing the essential question and objective with students using **slides 2 and 3** of the attached **Lesson Slides.**

Display **slide 4.** This slide has the directions for the Quick Draw Activity. While students are reading the directions, pass out a copy of the **How I Know It handout**, which contains a coordinate grid and a How I Know It circle, to each student.

Teacher's Note: Interactive Notebook

If you use interactive notebooks that have graph paper, the first page of the How I Know It handout is not needed. Graph paper notebooks are recommended for a geometry class, but the coordinate grid can be glued into the notebooks if you use lined notebooks.

Remind students that the image will be quick, so look carefully. Progress to **slide 5**—click once to trigger the image to appear. The image will appear and automatically disappear after three seconds. Once the image disappears, tell students to replicate as much as they can on their grid paper.

Teacher's Note: Difficulty Ranking—Formative Assessment Opportunity

Depending on how many spatial specific tasks students have had before this, replicating the image may be difficult for students and result in frustration. Use this as a guide to determine how much scaffolding is needed to get students from where they are to be able to look for specific characteristics to 'orient' themselves within the image.

Go to **slide 6.** Invite students to use the second page of the How I Know It handout to answer two questions: 'What did I look for to help me?' (inside the circle) and 'How do I know this is something I should look for?' (outside the circle with a line connecting to what they looked for). Have students think back, using their drawing as inspiration, to identify what 'jumped out' in the image that was easiest to replicate and how they knew they could rely on that piece of the image.

Teacher's Note: The Lead In

The step of students reflecting on what they looked for and how they know they can rely on it is the big moment of the Engage. This is the precursor to the concept of proofs, so put emphasis on this step rather than the drawing part.

Potential Answers

Maybe what students will say is that they saw two triangles and one rectangle, with the reason being that triangles have three sides and rectangles have four sides.

Let students know that they are going to see the image again, so they should make a plan of what to look for to help replicate the image perfectly. Go to **slide 7** to display the image. Click once to trigger the image to appear. The image will appear and automatically disappear after three seconds once again.

Go to **slide 8.** Again, have students replicate the image from memory and reflect on what they looked for and how they knew to look for that.

Explore

Pass out rulers, protractors, and calculators. Progress to **slide 9** to give students a few vital clues to create an exact replica of the image. Remind students that they can use any of their knowledge or formulas if they think it applies.

Give students about 10 minutes to make their calculations and finish their quick draw.

Have students look back on their How I Know It answers and denote which one they measured, calculated, or used a formula for.

Teacher's Note: Liberating Helpless Handraisers

This is a great chance to enable students to look back at their own notes and figure out how to remember things they've done in the past. Sometimes it is difficult for teachers to watch students struggle, but using their own notes and ways of figuring things out is a big skill for students to gain.

Explain

Have students set their drawing aside and set up the next page in their notebook for the notes.

Progress to **slide 10.** Remind students that they will take notes over the information.

Explain that looking at an image and seeing it mathematically is sometimes believed to be a talent that "you either have or don't", but in reality, it's a skill that can be improved with practice. One of the ways to improve looking at things mathematically is to know what to look for, and understanding why.

Progress to **slide 11.** It lists the following terms with their definitions: undefined, defined, postulate, theorem, given.

Go to **slide 12.** Direct students to look back on the How I Know It answers. Using the information they just took notes over, tell students to classify all the things they looked for as either undefined, defined, postulate, or theorem.

Potential Answer

From the Engage section, the example was that triangles have three sides and rectangles have four. Both of these are examples of using part of the *definition* of triangles and rectangles.

Teacher's Note: The Year-Long Tone

This is a great chance to remind your students that this skill is being introduced right now but that they'll be working on improving the skill throughout the entire year as a Geometry student. Also, anytime you as the teacher feel like they need a reminder, you can repeat this lesson with whatever content they are working on at the moment.

Extend

Go to **slide 13.** Pass out an **Evaluating Proofs handout** to each student.

Tell students that they will not solve the problems, but they will use their new skills to observe what is there and what they think is the most important information they will use for the problem. Also, they need to think about what is given as well as what they would need to figure out.

Potential Answers

For example, the given in the first question is that certain line segments are congruent, which means that other line segments are also congruent and that, based on the given, there are three line segments and all three are mentioned once. This indicates they're all connected somehow. (Notice how this is not solving the problem but more about the thought process needed for effectively solving it).

Teacher's Note: Different Take On Math

Students may not used to be 'solving' problems, so be ready to scaffold that. Math is just as much—maybe more—about the process than just the solution. This lesson tries to tap into that to help students with a very difficult subject.

Evaluate

Go to **slide 14.** Pass out the **Metacognitive Geometry Plan handout.** Explain to students that they are going to reflect on their learning during the lesson and make a 'plan' for how they are going to look at geometric figures throughout the school year.

Teacher's Note: Groups Of One

Collaboration is vital, but individual reflection is also just as important. Since this is students' plans based on their thought processes, this task is best done alone.

When students are done with the handout, have them glue or attach their plan in their notebook for use later.

Teacher's Note: Bookmarking It

Consider having students bookmark or tab this page for future use. Looking back on their reflections and plans is a big part of having a growth mindset classroom.

Resources

- K20 Center. (n.d.). How I know it. Strategies. https://learn.k20center.ou.edu/strategy/144
- K20 Center. (n.d.). Quick draw. Strategies. https://learn.k20center.ou.edu/strategy/51