Lesson 01: Which One Doesn't Belong (High-Inquiry Version)

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Lesson Title: Which One Doesn't Belong - Generating Multiple Valid Justifications
Intended Grade Level(s): Grades 6-12 (adaptable)
Content Area: Content-Agnostic Visual Reasoning

I. Planning

Lesson Focus / Goals

State the big idea(s) of the lesson. Focus on conceptual understanding. Avoid vague objectives. Specify the knowledge and skills students should demonstrate.

The lesson aims to provide the following for students: - Discover that ALL items can validly "not belong" for different reasons - Generate multiple justified hypotheses rather than finding "the answer" - Understand that strong reasoning matters more than convergent "correctness" - Experience genuine mathematical/scientific argumentation

Learning Objectives

Write clear, measurable objectives. Include both procedural and conceptual goals. Consider potential misconceptions students might have.

By the end of the lesson, students will be able to: - Generate at least 2-3 different valid justifications for different items in the same set - Evaluate which justifications are stronger based on specificity and evidence - Defend their reasoning when classmates challenge or question it - Recognize that divergent thinking (multiple answers) is valuable in inquiry

Potential Misconceptions: - Students might think there's ONE right answer they need to find - Students might think the teacher knows "the best" answer - Students might accept weak justifications without pushing for specificity - Students might think "any answer" is okay without requiring evidence

Standards Alignment

Note: This is a content-agnostic lesson that places math and science students on equal footing. However, the reasoning processes naturally align to core practices in both disciplines.

Standards for Mathematical Practice (Common Core): - **MP3** – Construct viable arguments and critique the reasoning of others.
Students explain why an object doesn't belong using specific criteria. - **MP6** –

Attend to precision.
Students use precise vocabulary when describing properties.

Teacher Note on Precision: When pressing students for specificity (MP6), focus on clarity of reasoning rather than technical correctness of vocabulary. The goal is for students to articulate properties clearly enough that others can understand and evaluate their reasoning—not to police terminology or demand formal mathematical language prematurely.

NGSS Science and Engineering Practices: - Analyzing and Interpreting Data – Students identify patterns and relationships among visual elements. - **Engaging in Argument from Evidence** – Students justify claims about similarities and differences using observable properties.

II. Implementation

Materials Needed

List all physical and digital resources, manipulatives, and technology needed. For each item listed, provide a brief justification/explanation for its inclusion.

The following materials are used in the lesson: - **Projector/screen** to display the four images - **Student recording sheets** with space for multiple justifications per set - **Chart paper or whiteboards** for small groups to post their thinking publicly - **Sticky dots or markers** for voting/prioritizing strongest justifications - **Gallery walk protocol handout** for structured peer feedback

Preparation: Teacher prepares 3-4 different "Which One Doesn't Belong" slides (fewer than LOW version because more time spent on each). Teacher has identified 3-4 possible justifications per set but does NOT share them—uses them to validate student thinking and push for more.

Lesson Flow

(Before-During-After)

Organize your plan using the Before–During–After framework: - Before – Connect to prior knowledge, spark interest (Launch) - During – Students work on task, teacher facilitates (Explore) - After – Students share strategies, connect ideas, consolidate learning (Summarize)

Include approximate timing, key questions, and anticipated student responses.

Note for instructors: Not every discussion prompt or teacher move needs to be used in every lesson. Select the moves that best fit your context, time constraints, and students' needs. The key epistemic priority is ensuring students generate multiple justifications and evaluate their strength—the specific prompts are tools for that goal, not requirements.

Before: (Launch – 5 min)

1. Show **Slide 1** with four shapes (no context, no explanation)
2. Ask: "Which one doesn't belong?"
3. Give 1 minute silent think time
4. Ask: "Turn to your neighbor. Do you agree? Why or why not?"
5. Take 3-4 different answers publicly. For EACH answer, ask: "Can you say more? What property makes it different?"
6. Reveal the key insight: "I'm hearing different answers. Is someone wrong?" → Lead students to discover that MULTIPLE items can legitimately "not belong"
7. Frame the challenge: "Today you'll work in groups to find as many valid justifications as possible. The goal isn't THE answer—it's STRONG REASONING."

During: (Explore – 15 min)

- Students work in groups of 3-4
- Show **Slide 2** (new WODB set)
- Challenge: "Find at least 3 different ways that different items don't belong. For each, write: (1) Which item, (2) What property, (3) Why that matters"
- Groups work on chart paper, generating multiple justifications (8 min)
- Teacher circulates with moves:
  - If group has weak justification: "Can you be more specific about that property?"
  - If group has only 1-2 justifications: "You found great ones! Can you find a different type of property? Visual? Functional? Categorical?"
  - If group says "we can't find any more": "What if you started with a different item?"
- Gallery walk (4 min): Groups post charts, do silent walk to see other groups' thinking
- Quick debrief (3 min): "Which justification did you see that surprised you?" "Which was strongest? Why?"
  - **Important framing:** When discussing "strongest," help students recognize that strength depends on criteria (specificity? novelty? applies to multiple contexts?). Different criteria can lead to different evaluations—there's no single "best" justification, but we can compare them using clear standards.

After: (Discuss – 5 min)

- Whole class discussion: "What did we discover about WODB today?"
- Guide toward big ideas:
  - Multiple valid answers can coexist
  - The reasoning/justification is what matters, not finding "the right one"

  - Being specific strengthens arguments
- Meta-cognitive question: "When you were stuck finding a new justification, what helped you unstick?"
- Connection: "Where else in math/science do we need to consider multiple explanations for the same phenomenon?"
- Preview: "Next time we'll tackle a harder set where the differences are more subtle."

III. Assessment

Formative Assessment

Describe how you will check for understanding during and after the lesson. Include formative (observations, questions, student work) and self-assessment opportunities.

During Exploration: - Monitor group chart papers for number and quality of justifications - Listen for specificity in student language (vague vs. precise property descriptions) - Watch for argumentation: Are students defending ideas or just listing them? - Note which groups struggle to generate beyond 1-2 justifications

During Gallery Walk: - Observe which justifications students pause at or discuss - Listen for comparative language ("this one is stronger because…") - Note students' criteria for what makes justifications compelling

Exit Ticket: Students complete one final "Which One Doesn't Belong" independently, providing at least two justifications and evaluating which is stronger.

Self-Assessment: Students reflect on their group's strongest justification and explain their criteria.

IV. Reflection & Next Steps

After teaching: Note what worked well and what didn't. Identify topics or skills to revisit. Record surprising student thinking. Suggest changes for next time.

I will aim to answer the following questions after the lesson has been taught: - Did students genuinely discover that multiple answers are valid, or did they still seek "my answer"? - How many justifications per set did groups typically generate? - What teacher moves helped students push beyond their first idea? - Did students engage in authentic argumentation, or just list ideas? - Which groups struggled? What support scaffolds are needed? - Were students surprised by the divergent nature of the task?

Note: Please attach student handouts and any other printed materials (e.g., readings) that students will need to complete the lesson.

Student Recording Sheet

Group Members: _____ **Date:** _____

Which One Doesn't Belong - Multiple Justifications

For each WODB set, find at least 3 different valid justifications. For each one, explain WHY that property matters.

WODB Set #2

Justification 1:
Which item: _____
What property: _____
Why this matters: _____

Justification 2:
Which item: _____
What property: _____
Why this matters: _____

Justification 3:
Which item: _____
What property: _____
Why this matters: _____

Challenge: Can you find a 4th?
Which item: _____
What property: _____

_____

Group Reflection

Circle one: Our **strongest** justification was #: _____ because:

_____

_____

Exit Ticket (Individual)

WODB Set #3: [Four new items shown]

Provide justifications for at least TWO different items:

Item 1: _____
Justification: _____

Item 2: _____
Justification: _____

Which justification is stronger? Why? _____
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V. Further Revision Ideas

These are additional inquiry-enhancing moves suggested through analysis of the lesson's revision capacity. While not included in this version, they represent growth opportunities for continued development.

Add Context-Rich Constraints (Dimension 4)

- Frame WODB sets with disciplinary lenses: "Which one doesn't belong *if we care about symmetry*?" or "...if we're thinking about function vs. form?"
- Anchor properties to real-world contexts where those distinctions matter
- This deepens engagement but requires more content-specific framing

Strengthen Integration of Big Ideas (Dimension 9)

- Add explicit closing question: "Where else in [your discipline] do multiple valid explanations coexist?"
- Connect divergent reasoning to scientific modeling or mathematical proof strategies
- Make transfer more visible: "How does this prepare you for analyzing data? Evaluating arguments?"

Expand Connection-Making Across Cases (Dimension 10)

- Add structured comparison: "Look at your justifications for Sets 1 and 2. What *kinds* of reasoning did you use in both?"
- Name categories of reasoning (visual, functional, categorical, relational)
- Help students build meta-cognitive awareness of their reasoning patterns

Extend the Ceiling Further (Dimension 2)

- Challenge: "Create your own WODB set where all four items have equally strong justifications"
- Reverse task: "What's the weakest possible WODB set? Why?"
- Design challenge requires deeper understanding of what makes reasoning compelling

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Capacity Analysis Summary

Why This Lesson Has High Revision Capacity:

This lesson is **structurally stable but epistemically constrained** in its LOW version. That makes it ideal for novice revision because: - The task shell doesn't need rebuilding - Inquiry can be added by loosening specific pedagogical moves, not rewriting the lesson - Revisions are **visible** in teacher moves, not materials - Candidates can succeed incrementally (strengthening 2-3 dimensions produces noticeable change)

Key Insight: This lesson doesn't *teach* inquiry. It **reveals what inquiry requires**.

High-Capacity Dimensions for Novice Revision: 1. **Openness & Multiple Pathways** (HIGH) – Task already affords multiple answers; revision removes teacher suppression 2. **Low Floor / High Ceiling** (HIGH) – Ceiling is artificially capped; novices can release it 3. **Student Agency** (HIGH) – Agency is missing only because of teacher moves; clean lever for novices 4. **Curiosity** (HIGH but fragile) – Curiosity is actively shut down in LOW, not absent; revision is subtractive

Medium-Capacity Dimensions: 5. **Problem Before Method** (MEDIUM-HIGH) – Mostly temporal revisions: delay explanation, insert struggle 6. **Causal Explanation** (MEDIUM-HIGH) – "Why" language exists; novices can make it student-enacted 7. **Collaboration & Discourse** (MEDIUM-HIGH) – Talk exists; structures are minimal and easily added 8. **Context-Rich** (MEDIUM) – Visual reasoning is abstract; context can be added but stretches some candidates 9. **Integration of Big Ideas** (MEDIUM) – Requires meta-cognitive framing 10. **Connection-Making** (MEDIUM) – Pattern recognition across cases needs explicit structure