Lesson 03: Headbandz - Exploring the Space of Possibilities (High-Inquiry Version)

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Lesson Title: Headbandz: Designing and Comparing Questioning Strategies
Intended Grade Level(s): Grades 3-12 (adaptable)
Content Area: Content-Agnostic Logical Questioning

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: - Develop and test their own questioning strategies through experimentation - Compare different approaches and evaluate trade-offs (efficiency vs. creativity vs. risk) - Understand that questions have different information value - Experience inquiry as exploration of possibility space, not optimization for speed - Recognize that multiple strategic approaches can be valid for different reasons

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: - Design and articulate their own questioning strategy - Explain why certain questions provide more information than others - Compare different questioning approaches and identify trade-offs - Reflect on how their strategy evolved through experimentation - Distinguish between "finding the answer quickly" and "understanding the possibility space"

Potential Misconceptions: - Students might think there's ONE best strategy that always works - Students might equate "good questioning" with "fastest solution" - Students might not recognize that different strategies serve different purposes - Students might think lucky guesses demonstrate good strategy - Students might not see the value in "inefficient" but informative questions

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): - **MP7** – Look for and make use of structure.
Students analyze and exploit the structure of the possibility space when designing questions. - **MP8** – Look for and express regularity in repeated reasoning.
Students recognize that the same questioning pattern works for different items.

NGSS Science and Engineering Practices: - **Asking Questions and Defining Problems** – Students formulate yes/no questions to gather information systematically. - **Analyzing and Interpreting Data** – Students use responses to narrow down possibilities through logical elimination.

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: - **Headbands** (one per student) - can be made from cardstock strips with elastic or paper bands - **Pre-made cards** (40-50 cards total) with varying complexity across multiple categories: Animals, Food, Objects, Jobs, Places, Activities - **Strategy development sheets** with space to articulate approach and rationale - **Question tracking sheets** to record questions, eliminations, and reflections - **Chart paper** for pairs to post their questioning strategies - **"Information value" anchor chart** (posted after initial exploration, not before) - **Teacher list** of all possible cards for reference

Preparation: Make headbands. Create cards with varying specificity (e.g., "animal" category includes both common like "dog" and less common like "platypus"). Prepare strategy sheets and tracking tools. Do NOT post any prescribed questioning sequence.

Lesson Flow

(Before-During-After)

Organize your plan using the Before–During–After framework. Include approximate timing, key questions, and anticipated student responses.

Note for instructors: Not every discussion or reflection prompt must be used; instructors should select moves that best fit their context and time. The key epistemic priority is ensuring students develop, test, and compare their own questioning strategies—the specific prompts are tools for that goal, not requirements.

Before: (Launch – 7 min)

1. Show a headband with a card (e.g., "dog") facing outward
2. Explain: "You can't see your own card, but everyone else can see it. Your job is to figure out what you are by asking yes/no questions."
3. Demonstrate the basic mechanic with volunteer:
   - Student asks: "Am I red?" → "No"
   - Student asks: "Am I a dog?" → "Yes!"
4. Pose the challenge: "That was only 2 questions! But was that luck, or a strategy that would work reliably? Today you're going to experiment with different questioning approaches."
5. Frame the inquiry: "There are lots of ways to ask questions in this game. Some people like to narrow systematically. Others prefer creative guesses. Some go fast. Some learn more along the way."
6. Key question: "Your job isn't to find THE best strategy—it's to figure out what makes a question informative, and what trade-offs different approaches have."
7. Set expectation: "You'll play several rounds. After each round, you'll reflect on what you learned about questioning. Your strategy will probably evolve—that's inquiry!"

During: (Explore – 20 min) Round 1: Experimental Phase (7 min) - Distribute headbands and place one card on each student's headband (without them seeing it) - Students work in pairs, taking turns asking questions - NO strategy prescribed—students develop their own approach - Students use tracking sheets to record questions, answers, and eliminations - Teacher circulates with observational questions only: - "What's your questioning approach so far?" - "How did that question help you?" - "Are you learning about what you might be, or eliminating what you're not?" - After first card is guessed: Brief reflection (2 min) - "What worked? What would you change?" - Pairs share one insight with class

Round 2: Refinement Phase (8 min) - New cards distributed - Encourage: "Try a different approach this time, or refine what you did" - Teacher notes which pairs: - Use binary elimination (category-level questions) - Use specific guesses - Use trait-based narrowing - Use creative/risk-taking questions - After second card: Pairs write on chart paper: - "Our strategy: [brief description]" - "Why we chose this approach: [rationale]"

Strategy Gallery Walk (5 min) - Pairs post their strategies - Silent walk to observe different approaches - Notice similarities and differences

After: (Meta-Discourse – 10 min) Compare Strategies (5 min) - Collect 2-3 different approaches from gallery walk - Example contrasts: - "This pair asked category questions first. This pair made creative guesses. What are the trade-offs?" - "This pair got lucky with 3 questions. This pair took 12 but learned a lot about the card space. What did each approach value?" - Push for comparative reasoning: "Which strategy is 'better'? Does it depend on your

goal?"

Surface Big Ideas (3 min) - Post "Information Value" anchor chart (now, not before): - "Some questions eliminate many possibilities (high information)" - "Some questions are specific tests (low information but high payoff if right)" - "Different strategies optimize for different things: speed, learning, certainty, fun" - Ask: "When might you want high information questions? When might you take a risk?"

Transfer to Inquiry (2 min) - "How is this like what scientists or mathematicians do?" - Guide toward: Inquiry isn't about finding answers fast—it's about understanding the space of possibilities - "When you design an experiment or solve a problem, do you always need the most 'efficient' approach? What else might matter?" - Close with: "Sometimes the 'inefficient' question teaches you more than the 'smart' one. That's inquiry."

III. Assessment

Formative Assessment

Describe how you will check for understanding during and after the lesson.

During Round 1: - Observe whether students ask any questions at all (engagement) - Listen for whether students track eliminations or just guess randomly - Note whether students reflect on what questions teach them

During Round 2: - Monitor whether strategies evolved from Round 1 - Listen for meta-commentary: "That question wasn't helpful because…" - Check if students articulate WHY they chose their approach

During Gallery Walk & Discussion: - Listen for comparative reasoning about strategies - Check if students identify trade-offs rather than ranking "best" - Note whether students connect information value to question type - Observe whether students distinguish efficiency from understanding

Exit Ticket: Students complete: 1. "Describe your questioning strategy and why you chose it" 2. "Compare your approach to one other pair's. What are the trade-offs?" 3. "When might a 'slow' question be better than a 'fast' one?"

Self-Assessment: "How did your strategy change from Round 1 to Round 2? What did you learn about questioning?"

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 develop their own strategies, or did they seek teacher validation for "correct" approach? - How did strategies evolve from Round 1 to Round 2? What prompted changes? - During meta-discourse, did students compare trade-offs or rank strategies as "better/worse"? - Did students recognize that efficiency isn't the only (or best) goal? - Which pairs struggled with strategy articulation? What support would help? - Did the gallery walk surface genuinely different approaches, or did strategies converge?

Note: Please attach student handouts and any other printed materials that students will need to complete the lesson.

Student Strategy Development & Tracking Sheet

Names (Pair): _____ **Date:** _____

Headbandz - Developing Your Questioning Strategy

Round 1: Experimental Phase

My card was: _____

Question #	My Question	Answer (Y/N)	What This Told Me
1			
2			
3			
4			
5			
6			
7			
8			

Number of questions it took: _____

Reflection: What worked about your approach? What would you change?

Round 2: Refinement Phase

My card was: _____

Question #	My Question	Answer (Y/N)	What This Told Me
1			
2			
3			
4			
5			
6			
7			
8			

Number of questions it took: _____

_____

Strategy Chart (Post This!)

Our questioning strategy:

_____

_____

Why we chose this approach:

_____

_____

_____

Exit Ticket

1. Describe your questioning strategy and what you were trying to optimize for (e.g., speed, learning, certainty, exploration):

_____

_____

2. Compare your approach to one other pair's strategy you saw during the gallery walk. What are the trade-offs?

Our Approach	Their Approach	Trade-offs

3. When might a "slow" or "inefficient" question actually be better than a "fast" one?

_____

_____

4. How did your strategy change from Round 1 to Round 2? What did you learn about questioning?

_____

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.

Remove Question Limits Entirely (Dimension 2)

- Allow students to take as many questions as they want
- Value "thorough exploration" alongside "efficient solution"
- After the game, ask: "What did you learn by taking more time that a quick guesser might miss?"
- This further de-emphasizes speed and creates space for genuine curiosity

Add Cross-Round Transfer Reflection (Dimension 10)

- After 3-4 rounds, ask: "How did your thinking about questioning change across rounds?"
- Create a timeline: "Round 1 strategy → Round 2 strategy → Round 3 strategy"
- Surface meta-learning: "I used to think good questions were ***, but now I think*** "
- Makes learning about inquiry visible and explicit

Allow Students to Design the Card Space (Dimension 6)

- Give pairs the task: "Create a set of 12 cards that would be interesting to guess"
- Students must consider: What makes the space challenging? Easy? Interesting?
- Shifts agency from "player within system" to "designer of system"
- Deepens understanding of information structure

Introduce "Most Informative Question" Challenge (Dimension 5)

- After experiencing multiple rounds, pose: "Can you design the single MOST informative first question for this card set?"
- Students must analyze the structure of the card space
- Connect to information theory: "What makes a question high-value?"
- Bridges to mathematics (combinatorics, sets) and science (experimental design)

Add Constraint Variations (Dimension 1)

- Play a round where you can only ask trait questions (no categories)
- Play a round where your first 3 questions must be guesses (no elimination)
- After each constraint, debrief: "How did this change your approach? What did you learn?"
- Makes invisible strategic assumptions visible

Create "Question Autopsy" Protocol (Dimension 5 & 9)

- After each round, pick one question and analyze deeply:
  - "How many possibilities did this eliminate?"
  - "What information did it give us?"
  - "Could a different question have been more informative? Less?"
- Builds explicit understanding of question power
- Connects to scientific reasoning about experimental design

Capacity Analysis Summary

Why This Lesson Has Very High Revision Capacity:

This lesson is **structurally engaging but epistemically algorithmic** in its LOW version. Revision capacity stems from a distinctive tension: - **Lesson 01 (WODB):** authority & closure constrain inquiry - **Lesson 02 (Mystery Graphs):** interpretation vs. explanation constrains inquiry
- **Lesson 03 (Headbandz): efficiency vs. epistemic agency** constrains inquiry

Key Insight: This lesson exposes "inquiry-as-efficiency" thinking. Candidates often equate inquiry with clever strategies. This lesson lets that belief surface—and be challenged.

Core Message: Inquiry isn't about finding the answer faster—it's about **understanding the space of possibilities**.

Very High/High-Capacity Dimensions for Novice Revision:

1. **Low Floor / High Ceiling** (HIGH) - Entry immediate; ceiling artificially capped by efficiency metrics and fixed categories; releasing constraints is very accessible
2. **Curiosity & Genuine Puzzlement** (HIGH) - Game format is inherently motivating; curiosity suppressed by overemphasis on speed; revision is largely subtractive (slow down, value exploration)
3. **Collaboration & Discourse** (HIGH) - Task is inherently social; pairs negotiate meaning; adding meta-discourse about strategy is high payoff, low cost
4. **Causal Explanation** (MEDIUM-HIGH) - Elimination logic explicit; cause-and-effect reasoning exists (questions→eliminations); asking students to justify WHY questions are powerful bridges to information theory
5. **Integration of Big Ideas** (MEDIUM-HIGH) - Structure, elimination, and efficiency are big ideas; lesson already gestures to inquiry; surfacing these explicitly is accessible
6. **Openness & Multiple Pathways** (MEDIUM-HIGH) - Task could support many strategies; one canonical path is enforced; allowing alternatives is visible and intelligible

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Medium Capacity Dimensions:

7. **Problem Before Method** (MEDIUM) - Problem (figure out card) is immediate, but method is front-loaded; candidates must resist urge to teach "best way" first—cognitively harder but powerful
8. **Student Agency** (MEDIUM) - Students ask questions but within strict rails; teacher defines sequence, success criteria, optimal strategy; revision requires pedagogical courage but is accessible
9. **Connection-Making** (MEDIUM) - Each round treated independently; adding reflection on strategy evolution is manageable with intentional framing

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Lower Capacity Dimensions (Still Valid):

10. **Context-Rich / Phenomena-Based** (LOW-MEDIUM) - Context intentionally generic; phenomena categorical not causal; can tie to disciplinary domains but less central to this lesson's power

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Why This Is a Particularly Revealing Low Anchor:

Three key teaching virtues:

1. **Exposes "inquiry-as-efficiency" thinking** - Candidates often conflate inquiry with clever shortcuts; this lesson surfaces that assumption so it can be examined
2. **Foregrounds epistemic rules** - Who decides what a "good" question is? The game makes this unavoidable; shifts from teacher authority to evidence-based reasoning
3. **Revisions shift values, not materials** - Inquiry emerges by changing what's valued (sense-making vs. speed), not what's used; highly visible for novices

Pedagogical Leverage: This lesson helps candidates see that teaching "smart strategies" promoting inquiry. Inquiry requires epistemic agency, not just efficient algorithms.