Teaching Science as Inquiry: Inquiry Questioning Strategies Guide

The exchange of teacher questions and student responses is at the heart of inquiry-based science education. In Teaching Science as Inquiry (TSI), the teacher acts as the research director of the classroom. This role highlights the teacher's importance in guiding student inquiry–both through direct instruction and questioning.

The more time that teachers ask the appropriate questions at the appropriate levels at the appropriate time, the better the inquiry. While teacher quality is of course marked by more than just the use of questioning strategies, inquiry-based science will not succeed without knowledge of and appropriate use of questioning strategies. This is because questions are inquiry, and inquiry drives science.

Questioning can be used in inquiry classrooms in a variety of ways. This guide highlights different inquiry questioning strategies and is organized around three focus activities in the *Exploring Our Fluid Earth* Biological Module. This guide is designed to elicit the question: How can we use these questioning strategies effectively in the classroom?

Although the focus of questions will vary based on lesson characteristics, there is an underlying general questioning approach that should remain constant. The teacher's role is to listening to students carefully; accept what is heard, and then tie student responses to initiating questions. Good questioning strategies support student engagement and learning and include the following characteristics:

- asking clear and unambiguous questions at the appropriate opportunities for the purposes of initiating discussions and encouraging student curiosity.
- asking students to reflect on possible answers to their own questions, for example, "What do you think?"
- asking questions that gain insight into student thought processes, for example, "What might happen if you did ____?"
- asking questions that elicit comparisons or contrasts, for example, "How do these results compare with our previous results?" and "How are they different?"
- asking questions about the sufficiency of evidence, for example, "What is the evidence for that, and what is the quality of that evidence?"
- asking questions that connect findings to everyday life.

Inquiry Questioning Strategies: Organizing and Critical Thinking

Focus Activity: Is it Alive?

Question Type	Purpose	Examples
Clarifying	Elicit the meaning of unfamiliar terms or rephrase unclear statements	• What do you mean by "alive"? • Can you be more specific?
Extending	Push for elaboration-probe for additions analogies, alternatives, or explanations	• Is there anything else you would like to add? • Do cells have properties that are similar to anything else you know about?
Focusing	Initiate discussion, shift direction, or bring discussion back on track	• Let's go back to our chart. What else did moving objects have in common? • How does that relate back to being alive?
Lifting	Lift level of discussion, bring from narrow to broad	• What role might DNA play in being alive? • Accepting that a virus is considered a living thing but does not have a cell, what role might its hosts play in helping the virus reproduce?
Summarizing	Restating or summarizing an elaborate answer	• Can you give us the main idea of what you are saying? • How could we write that in a short sentence?

Strategies to use with Caution	Rationale	Examples
Verbal Rewards	Tone is crucial. Over-rewarding can impede discussion by making some students reluctant to respond. The most effective reward is implied acceptance.	• You knew just what I was thinking! • You are so smart!
Verbal Repetition	Can restrict interaction if it forces all responses to go through the facilitator. Ask students to repeat or add on.	• What did you see? ○ *It was moving.* • It was moving. Did you see anything else?
Multiple Questions	Can switch the focus from the intended question and confuse students	• What was the thing that was moving but wasn't alive? Which non-living thing could still move?

Inquiry Questioning Strategies: Data Management

Focus Activity: Elodea, Light and Photosynthesis

Question Role	Examples
Identifying a Problem	• What is puzzling about this phenomenon? • Have you seen something like this before?
Formulating a hypothesis	• What are some possible solutions to this anomaly? • How might you separate this problem into simpler parts?
Designing an Experiment	• What are the variables? How could we control the variables? • What data do you need? • What controls are necessary?
Analyzing Results	• Which data are relevant? Which are unnecessary? • What are the possible sources of error? • How might you explain data that seem to contradict your conclusions?

Strategies to use with Caution	Rationale	Examples
Restricting Words	Some words may inadvertently restrict conversation or make students feel they have to guess what is important to the teacher.	• What important things did you observe?
Leading Questions	These suggest the answer the teacher wants. They can be used occasionally to direct discussion or to force students to think, by feeding an incorrect answer.	• It would be a good idea to add extra salt, wouldn't it?
Loaded Questions	Loaded questions trap students	• Why didn't you check the temperature of the water?

Inquiry Questioning Strategies: Connecting Self and Scientific Investigation

Focus Activity: Microevolution

Question Strategy	Purpose	Examples
Accepting and Clarifying	Accept all responses and ideas, relate ideas, ask for further development*	• If I understand correctly, your idea adds to Ann's by… • Karen, do you have something you would like to add?
Focusing discussion	Point out when discussion is drifting and bring back to point. Bring out an important point that has been missed.	• My understanding is that we were discussing_____. • Is there anything else that should be considered?
Summarizing /Clarifying	Call attention to unanswered questions	• What should our next step be?
Withholding Judgment	Both positive and negative judgment can suppress participation. Nonjudgmental responses foster an accepting social climate.	• When was the last time that happened? • In other words, do you think the data are questionable?
Accepting Feelings	Clarify feelings, separate feelings from content.	• Could you explain how you feel about that? • What is it about this *idea* you disagree with?

*Accepting all responses does not mean validating all opinions. A balance of opinions does not equal a balance of evidence. Addressing student opinions, but bringing the discussion back to scientific evidence, is a skill that takes time and practice.

When the right questioning strategy…is a statement

Statements can be just as effective as questions, and may be a more appropriate option depending on the circumstance. For example, you make want to motivate a student (e.g. "You're on the right track" or "good effort so far") or prevent an unwanted or inappropriate discussion (e.g. "that is not an appropriate topic for science class").

Question Prompts	*Ask Yourself*
What do you mean by _____? Can you give us an example? Can you think of any other ____? How does that relate to _____? What hypothesis might explain _____? What is the main idea of what was just said? What did you observe? What do you know about _____? Could you separate the problem into smaller parts? What are variables and controls are necessary? What kind of data would you need? Which data were relevant? Did you take all possible variables into account? What are possible sources of error? What are other possible interpretations? What could we add to that explanation? How does your idea relate to _____? What is it about this *idea* you disagree with? Are there any other questions? Could you please repeat what you just said?	*Are my questions simple and direct?* *Am I avoiding compound or multiple questions?* *Am I using an adequate mix of recall, processing, and applying questions?* *Are my questions extending and lifting the discussion?* *Are my questions clarifying specific aspects of the investigation?* *Do some of my questions build cognitive conflict?* *Am I asking some comparative questions?* *Am I calling on a student after, rather than before, I pose a question?* *Am I allowing at least 3 seconds for a student's response?* *Am I accepting students' responses without prejudging or editing them?*

AVOID	
That's a great idea!	Wouldn't it be better to ____?
That's doesn't make sense.	Why didn't you _____?
You knew just what I was thinking!	*Over-repetition*
What *important* things did you observe?	*Multiple Questions*