Another Way to Consider Inquiry

Use this chart to help recognize if you are providing sufficient opportunity for student inquiry learning in your classroom activities.

Essential Feature	Variations in Learning Process			
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source
2. Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3. Learner formulates explanations from evidence	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence and how to use evidence to formulate explanation
4. Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use sharpen communication	Learner given steps and procedures for communication
	More ← Amount of Learner Self-Direction → Less **Less ← Amount of Direction from Teacher or Material → More**			

Information and diagram from the Iowa CORE Curriculum website: http://www.corecurriculum.iowa.gov.

The Inquiry-Based Investigative Process

Remember: All hands-on is not inquiry; not all inquiry is hands-on.

	Inquiry Process Skills
Observing	• The first step of the Inquiry process, and one that continues throughout the whole process. • Observation skills can include: watching carefully, taking notes, gathering evidence, identifying similarities and differences, comparing and contrasting, identifying patterns and order of events, and differentiating between observation and inference.
Questioning	• Curiosity drives the inquiry process, generating questions and a search for answers. Questioning is the heart of the inquiry process. • Questioning includes asking questions about observations and selecting questions that are generative, long-lasting, interesting, and that can lead to fruitful investigations and experimentations.
Hypothesizing	• Hypothesizing suggests an explanation consistent with available observations, inferences, questions, and evidence. It includes the use of information and skills from past experiences that may explain both how and why events occur. • Hypothesizing begins after observation, comment, questioning, and exploration with materials.
Predicting	• Predictions are central to the process of testing whether or not a hypothesis is on the right track. Predictions use evidence to suggest an event that will occur in the future. • Predictions are usually based on evidence from knowledge, experiences, and observation.
Investigating	• Measuring, gathering data, and performing "fair tests" are used to gain the evidence necessary to provide a consistent interpretation. • Investigating includes planning, conducting, measuring, gathering data, and consideration of dependent, independent, and controlled variables.
Interpreting	• Interpretation means making sense of the data gathered through investigation. • It includes finding pattern, synthesizing information, and making statements about their combined meaning. It may include making associations between variables and making sure that the data support the hypothesized connections. • All interpretation should relate your findings to the initial questions and observations.
Communicating	• An inquiry classroom relies on open communication. For the students, that means talking to others, listening to their evidence and explanations, and representing their own results in a clear manner to others through oral, written and/or representational presentations.

From:
Ash, Doris. "The Process Skills of Inquiry" in *Inquiry: Thoughts, Views, and Strategies for the K-5 Classroom*. 51–62. Volume 2 of *Foundations: A monograph for professionals in science, mathematics, and technology education*. Published by the National Science Foundation: Division of Elementary, Secondary, and Informal Education. http://www.nsf.gov/pubs/2000/nsf99148/pdf/nsf99148.pdf.

Inquiry Questions

Good inquiry questions are interesting, reasonable, open ended, and researchable. They are questions to which the students do not already know the answer. They should have a clear focus, but should also invite multiple possible answers when initially asked. Frequently, the process of answering one inquiry question will generate another one. Inquiry questions encourage students to wonder, think, observe, classify, measure, predict, infer, interpret, analyze, evaluate and communicate.

Examples of Inquiry Questions

- What did you do next?
- What strategies do you see being used?
- How could you prove that?
- Who would like to share their thinking?
- Does that always work?
- Why did you do that? Tell me more.
- Who used this strategy to solve it?
- Who started the problem the same way?
- How does this relate to _____?
- How could you prove that?
- How was that strategy efficient, quick and simple?
- How did you figure it out?
- What would happen if _____?
- How did you think about that?
- Have we ever solved a problem like this before?
- What do you think would happen if _____?
- What does this make you think of?
- In what ways are these different?
- In what ways are these similar?
- What materials did you use?
- What might you try instead?
- What does it look like?
- What does it remind you of?
- What does it feel like?
- What can you do next time?
- What can you tell me about it?
- Tell me what happened.
- What could you do instead?
- Which one do you have more of?
- Is one object longer/shorter than another?
- What do you call the things you are using?
- What can you tell me about the things you have?
- How are you going to do that?
- What do you feel, see, hear, taste, smell?
- How did you do that?
- What will you do next after you finish that?
- Is there anything else you could do/use?
- How do you know?
- What are some different things you could try?
- What is it made of?
- What you could do with it?

Another Way to Look at Questions

Here's some other ways to categorize questions. Inquiry questions fall into a number of these categories.

Factual Questions are used to gather information. They are questions that you can usually answer by consulting a book, website or local expert.

- What is the name of this tree or shrub?
- How tall does this tree grow?
- Where does this tree grow?
- What color do the leaves turn in the fall?

Descriptive or Observational Questions are used when you want to focus students on what something looks like or acts like. These questions help to increase student attention to detail as they practice their skills of observation.

- What does it look like? feel like? smell like? sound like?
- When do the leaves turn color in the fall? Do all the leaves turn the same color?
- What animals use this tree for their habitat?
- What do twigs look like after the leaves have fallen off?

Comparative Questions compare similar things.

- How do the number of brook trout in the creek from last year compare to the number of brook trout in the creek this year?
- How do our chemical tests and biological samples compare to the state standards?
- Which species of tree grows the fastest?
- Which buds become flowers and which buds become leaves?
- Are deciduous or broadleaf evergreen leaves stronger?

Correlative Questions consider how one thing relates to another.

- How does the number of garlic mustard plants relate to the amount of sunlight in an area?
- Is fall leaf color dependent on the number of sunny fall days?
- How is hot weather related to disease in pine trees?
- How does water pollution impact the number of frogs in a pond?

Essential Questions are questions that require time to answer them.

- How do trees alter climate?
- What are the physical characteristics of the stream?
- What are the chemical conditions of the stream (dissolved oxygen, pH, etc.)?
- What are the percentages for the different macro invertebrate feeding groups?

Resources (Inquiry Questions & Another Way to Look at Questions):

- *Connect: Teachers' Innovations in Science, Math, and Technology*. Vol. 13.4. March/April 2000. Published by Synergy Learning International, Inc. http://www.exploratorium.edu/ifi/resources/classroom/connect/connect.pdf.
- Exploratorium Institute for Inquiry. http://www.exploratorium.edu/ifi
- Roy, Dale, Erika Kustra, and Paola Borin. "What is a good Inquiry question?" 2003. http://www.mcmaster.ca/cll/inquiry/good.inquiry.question.htm
- Scientific Inquiry: http://www.pwcs.edu/curriculum/sol/scientific.htm
- Questions for Science Exploration: http://tlc.ousd.k12.ca.us/~acody/inquiryquery.html
- "Field Investigations: Using Outdoor Environments to Foster Student Learning of Scientific Processes." Pacific Education Institute, Dec. 2007. http://www.tpwd.state.tx.us/publications/nonpwdpubs/media/field_investigation_guide.pdf