Science Process Skills and Examples

Observing: Using the senses and appropriate tools to gather information about an object, event, or phenomenon

Subskills include collecting evidence, identifying similarities and differences, classifying, measuring, and identifying relevant observations.

Example: Listing the similarities and differences of a cube of ice and a ball of ice.

Questioning: Raising questions about an object, event, or phenomenon

Subskills include recognizing and asking investigable questions; suggesting how answers to questions can be found; and turning a non-investigable question into a question that can be acted upon.

Example: Asking "Will ice melt faster with or without salt sprinkled on it?"

Hypothesizing: Giving a tentative explanation, based on experience, of a phenomenon, event, or the nature of an object. A hypothesis is testable. A hypothesis is not the same thing as a prediction, which is the expected outcome of a specific event. However, a hypothesis can be used to explain specific events.

Subskills include inferring, constructing models to help clarify ideas, and explaining the evidence behind a hypothesis.

Example: Increased surface area causes faster melting. (This explains why crushed ice will melt faster than a block of ice of the same mass.)

Predicting: Forecasting the outcome of a specific future event based on a pattern of evidence or a hypothesis (an explanation). A prediction based on a hypothesis can be used in planning a test of that hypothesis. A prediction is not a wild guess.

Subskills include justifying a prediction in terms of a pattern in the evidence, and making a prediction to test a hypothesis.

Example: Water flowing from a height of eight inches will wash away more sand than water flowing from a height of six inches; this prediction is based on the pattern that water flowing from six inches washed away more sand than water flowing from four inches, and water flowing from four inches washed away more sand than water flowing from two inches.

Planning and Investigating: Designing an investigation that includes procedures to collect reliable data. Planning includes devising a way to test a hypothesis. NOTE: Planning is not always formal.

Subskills include identifying and controlling variables, and using measuring instruments.

Example: Deciding to put a teaspoon of salt on one ice cube and a teaspoon of sugar on another identical ice cube; setting them side by side, and observing their relative melting rates in order to determine if one melts faster than the other.

Interpreting: Considering evidence, evaluating, and drawing a conclusion by assessing the data: In other words, answering the question, "What do your findings tell you?" Finding a pattern or other meaning in a collection of data.

Subskills include interpreting data statistically, identifying human mistakes and experimental errors, evaluating a hypothesis based on the data, and recommending further testing where necessary.

Example: After observing the melting rates of an ice cube sprinkled with salt and one without salt, concluding that salt reduces the freezing point of water.

Communicating: Representing observations, ideas, theoretical models, or conclusions by talking, writing, drawing, making physical models, and so forth

Subskills include talking with a more knowledgeable person, using secondary sources, presenting reports, constructing data tables, and creating charts and graphs.

Example: Describing the relationship between the melting time for an ice cube and amount of salt sprinkled on the cube by writing about it or by constructing a graph.

The 5E Instructional Model

The 5E Instructional Model is based on the constructivist approach to learning which states that learners build or construct new ideas on top of old ideas. Each of the 5E's describes a phase of learning; Engage, Explore, Explain, Elaborate, and Evaluate. The 5E's allows students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually assess their understanding of a concept.

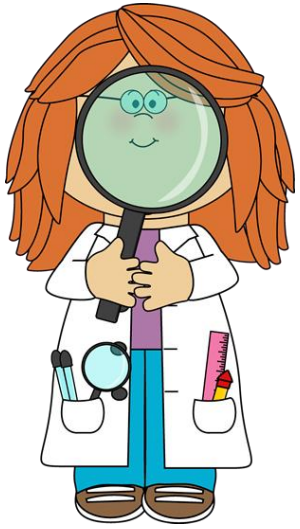
Facilitate Structured and Guided Inquiry

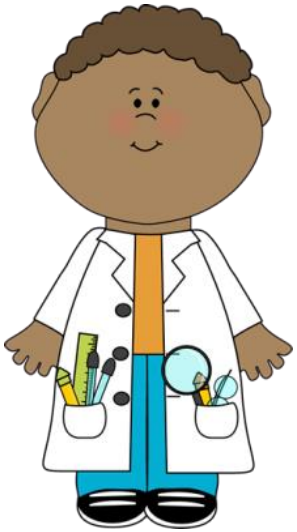
- **Engage** — In this stage, students first encounter and identify an instructional task. Here they make connections between past and present learning experiences, lay the organizational groundwork for the activities ahead and stimulate their involvement in the anticipation of these activities. Asking a question, defining a problem, showing a surprising event and acting out a problematic situation are all ways to engage students and focus them on the intructional task.
- **Explore** — In the Exploration stage, students have the opportunity to get directly involved with phenomena and materials. Students work together in teams, building a base of common experience which assists them in the process of sharing and communicating. The teacher acts as a facilitator, providing materials and guiding the students' focus. The students' inquiry process drives the instruction during an exploration.
- **Explain** — In the Explain stage, students begin to put the abstract information that they have been gathering into a more concrete, communicable form. Here formal definitions, explanations and labels are associated with the knowledge that the learner has experienced through the Engage and Explore activities. Students are also encouraged to put these explanations into their own words and demonstrate understanding.

- **Elaborate/Extend** — Elaborate activities encourage learners to expand on the concepts learned, make connections to other related concepts and apply their understandings to the world around them.
- **Evaluate** — The Evaluate stage should be an ongoing process that occurs throughout the lesson, providing for self assessment as well as formal assessment as the learning occurs. Redirection and remediation opportunities should be offered, as needed.

5E	Suggested Activity	Suggested Digital Media	What the Teacher Does	What the Student Does
Engage	Demonstration Interpret an image Reading Free Write Analyze a Graphic Organizer KWL chart Brainstorming	Images Clip Art Animations Simulations Songs Sound Effects Video Segments Writing Prompts	Creates interest Generates curiosity Raises questions Elicits responses that uncover what the students know or think about the concept/topic	Asks questions such as; Why did this happen? What do I already know about this? What can I find out about this? Shows interest in the topic
Explore	Hands on activity Perform an investigation Read authentic resource to collect information Solve a problem Construct a model	Fun-damental Exploration Virtual Lab Simulated Science Simulations Reading passages E-books	Encourages students to work together without direct instruction Observes and listens to the students as they interact Asks probing questions and redirects students investigations when necessary Provides time for students to puzzle through problems	Thinks freely but within the limits of the activity Tests predictions and hypothesis Forms new predictions and hypothesis Tries alternatives and discusses them with others Records observations and ideas
Explain	Supporting ideas with evidence Structured questioning Reading and discussion Teacher explanations	Video Segments E-books Reading passages Interactive videos Interactive glossary	Formally provides definitions, explanations, and new labels Uses students' previous experiences as a base for explaining concepts Encourages students to explain concepts and definitions in their own words	Listens officially to others explanations Questions others' explanations Listens and tries to comprehend explanations that the teacher offers Refers to previous activities Records observations and explanations Explains possible solutions to others
Elaborate	Problem solving Decision making Applying learning Creating products Experimental Inquiry Think Skill activities (compare, classify, apply)	Virtual Labs Integrated Science Simulations Science Sleuths Writing Prompts Video creation Digital storytelling Web 2.0 tools	Expects students to use formal definitions, explanations, and labels previously provided Encourages students to apply or extend concepts in new situations Reminds students to real live situations that apply concepts	Applies formal definitions, explanations, and labels in new, but similar situations Users previous information to ask questions, propose solutions, make decisions, and design experiments Draws reasonable conclusions from evidence Record observations Checks understanding among peers
Evaluate	Test/quizzes Preformance assessment Produce a product Journal entry Portfolio	Student self assessments Custom assessments Writing prompts Blogs Wikis Web 2.0 tools	Observes students as they apply new concepts and skills Assesses students' knowledge and/or skills Looks for evidence that students change thinking or behavior Allows students to assess their own learning Asks open ended questions	Answers open ended questions by using observations, evidence, and previously accepted explanations Demonstrates an understanding or knowledge of the concept or skill Evaluates his/her own progress Asks related questions that would encourage future investigations

Science Process Skills





observing

Using your 5 senses (seeing, hearing, touching, smelling, and tasting when appropriate) along with the right tools to gather information.

classifying

identifying similarities and differences

identifying relevant observations

collecting evidence

measuring

questioning

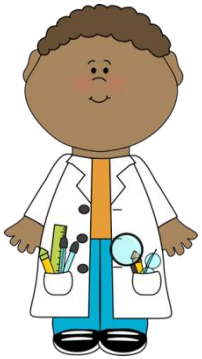
Thinking of and asking questions about an object, event, or a science topic.

suggesting how answers to questions can be found

recognizing and asking questions that can be investigated

turning a non-investigable question into one that can be acted upon

hypothesizing



Attempting to give an explanation of an event, the nature of an object, or a science topic – based on your experience.

constructing models to help clarify ideas

explaining the evidence behind a hypothesis

giving explanations based on ideas from prior experiences

inferring

predicting

Forecasting the outcome of a specific future event based on a pattern of evidence or a hypothesis. It is not a wild guess.

justifying a prediction in terms of a pattern in the evidence

searching for patterns in order to forecast a specific future outcome

making a prediction to test a hypothesis

planning & investigating

Designing an investigation that includes procedures to test a hypothesis and collect reliable data.

using measuring instruments

identifying and controlling variables

comparing results with what was planned

interpreting

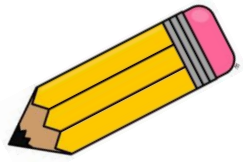
Looking at the evidence, evaluating it to look for a pattern, and drawing a conclusion from the data.

evaluating a hypothesis based on the data

recommending further testing where necessary

identifying human mistakes and experimental errors

communicating



Representing observations, ideas, models, or conclusions by talking, writing, drawing, making physical models, creating charts, and so on.

creating charts and graphs

presenting reports

constructing data tables

using drawings, writing and models to present ideas

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