Get Tuned-Up on Thinking Skills

Your brain is capable of an amazing variety of accomplishments! There are different levels and kinds of thinking that your brain can do – all of them necessary to get you set for good learning. To answer science questions, your brain must use many different processes. Here are some of the thinking skills that are frequently used in doing science tasks and the math tasks involved in science. Use this information to freshen up your mental flexibility and put these skills to use as you learn science concepts, use science processes, and investigate science problems.

Recall – To **recall** is to know and remember specific facts, names, processes, categories, ideas, generalizations, theories, or information.

Examples: *Recall helps you remember such things as the characteristics of the three forms of matter, the names and locations of the planets, the groups and sub-groups in the system of life classification, Newton's laws of motion, the names of the bones in the human body, or how to conduct a scientific investigation.*

Classify – To **classify** is to put things into categories. When you classify ideas, numbers, topics, or things, you must choose categories that fit the purpose and clearly define each category.

Example: ***octopus, snail, clam, oyster, conch, squid***

There are many different ways to classify these items. They are all organisms. They are all animals. They are also all sea creatures, mollusks, and invertebrates.

Generalize – To **generalize** is to make a broad statement about a topic based on observations or facts. A generalization should be based on plenty of evidence (facts, observations, and examples). Just one exception can prove a generalization false.

Examples:

Safe Generalization:

Climates at high latitudes are likely to be cooler than those at low latitudes.

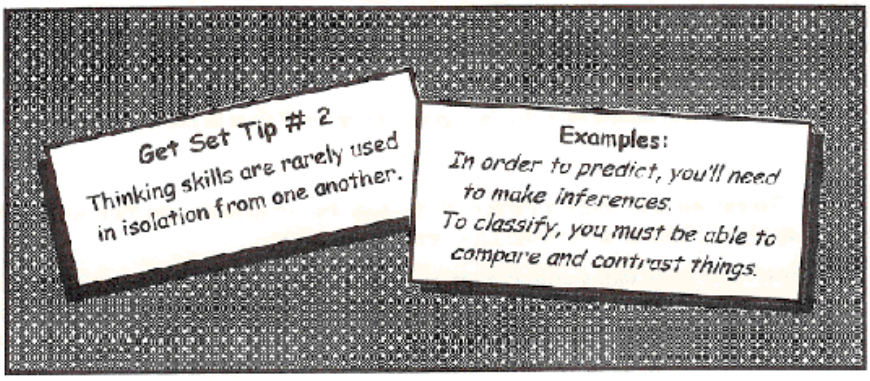
Invalid Generalizations:

faulty generalization - A faulty generalization is invalid because there are exceptions.

Average temperatures are lower at latitudes of 45° than at latitudes of 25°.

broad generalization - A broad generalization suggests something is *always* or *never* true about *all* or *none* of the members of a group. Most broad generalizations are untrue.

The climate is hot and dry at all locations between 0° and 10° latitude.

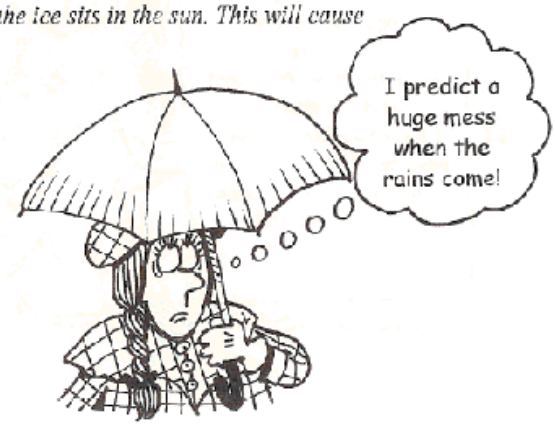


Elaborate – To **elaborate** is to provide details about a situation (to explain, compare, or give examples). When you elaborate, you might use words or phrases such as: *so, because, however, but, an example of this is, on the other hand, as a result, in addition, moreover, for instance, such as, if you recall, furthermore, another reason is.*

> **Example:** *Molecules move farther apart when a substance is heated. For instance, the molecules in ice cubes will move apart as the ice sits in the sun. This will cause the ice to turn into a liquid.*

Predict – To **predict** is to make a statement about what will happen. Predictions are based on some previous knowledge, experience, or understanding.

> **Example:** *The trees on the hill behind Axel's home burned last summer. All the underground brush also burned. This left bare, dusty ground. Axel predicts that there will be erosion and mudslides when the rains come this fall.*



Infer – To **infer** is to make a logical guess based on information.

> **Example:** *The plants out in Ann's yard were dead on a cold morning. The plants close to the house looked healthy. She inferred that frost had settled on the plants in the yard.*

Recognize Cause and Effect – When one event occurs as the result of another event, there is a **cause-effect relationship** between the two. Recognizing causes and effects takes skill. When reading a science equation or problem, pay careful attention to words or symbols that give clues to cause and effect (*the reason was, because, as a result, consequently, so*).

> **Example:** *The hinged leaves of the Venus's fly-trap snapped shut* (effect) *because an insect landed on them.* (cause)

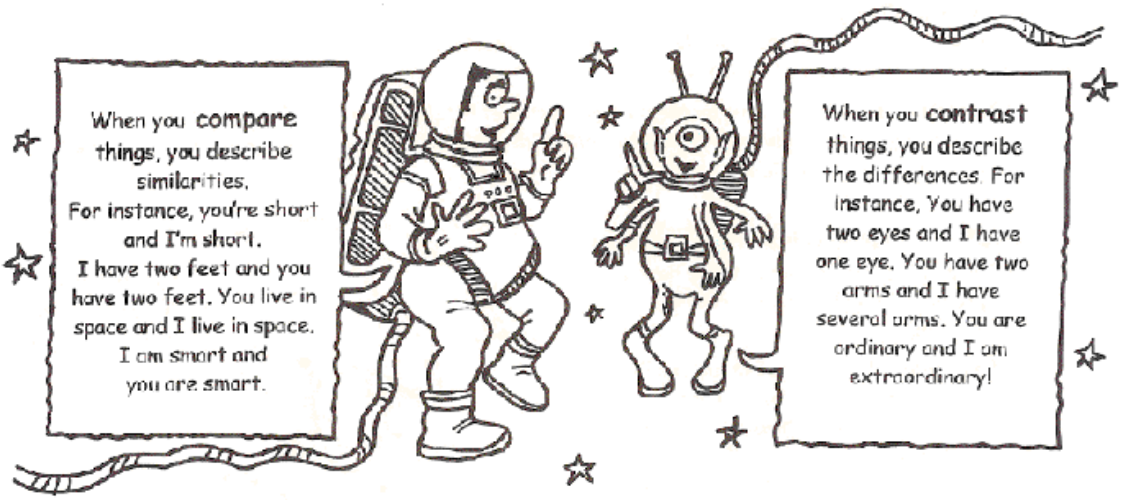
Hypothesize – To hypothesize is to make an educated guess about a cause or effect. A hypothesis is based on examples that support it but do not prove it. A hypothesis is something that can be—and should be—tested.

Example: *If salt is added to water in a glass, an egg will float in the water.*

Extend – To extend is to connect ideas or things together, or to relate one thing to something different, or to apply one idea or understanding to another situation.

Example: *You learn that a crab is a crustacean because it has a segmented body with two main regions, a hard exoskeleton, two pairs of antennae, and claw-like legs at the anterior end. Then you decide that a lobster (which has the same characteristics) is also a crustacean.*

Compare & Contrast



Draw Conclusions – A **conclusion** is a general statement that someone makes after analyzing examples and details. A conclusion generally involves an explanation someone has developed through reasoning.

Example: *Maxie bangs on bottles with various amounts of liquid in them. She notices that there are different pitches from the different bottles. She notices that the bottle with 1 inch of liquid gives a lower pitch than the bottle with about 5 inches of liquid.*

She draws these conclusions:

1) The amount of air in a bottle affects the sound made when banging on the bottle.

2) The greater the amount of air in the bottle, the lower the pitch which results from tapping

Analyze – To **analyze,** you must break something down into parts and determine how the parts are related to each other and how they are related to the whole.

Examples: *You must analyze to . . .*

. . . identify the different organs in the digestive system and describe their functions.

. . . describe the numbers and kinds of different atoms in a sodium chloride molecule.

. . . explain the difference between characteristics of an insect and an arachnid.

. . . discuss the functions of different organisms in an ecosystem.

Synthesize – To **synthesize,** you must combine ideas or elements to create a whole.

Examples: *You must synthesize to . . .*

. . . understand how muscles, tendons, ligaments, and bones work together to move the body.

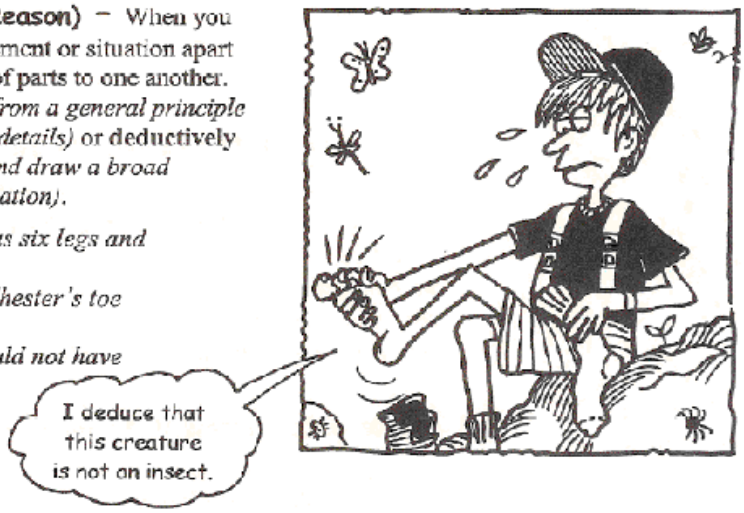
. . . explain how the movement of individual water molecules creates an ocean current.

. . . understand how salt and warm water mix together to form a solution.

. . . create a graph to show the results of an experiment.

Think Logically (or Reason) – When you think **logically,** you take a statement or situation apart and examine the relationships of parts to one another. You reason **inductively** *(start from a general principle and make inferences about the details)* or **deductively** *(start from a group of details and draw a broad conclusion or make a generalization).*

Example: *An insect has six legs and three body segments.*
The creature that bit Chester's toe had eight legs.
The biting creature could not have been an insect.



Evaluate – To **evaluate** is to make a judgment about something. Evaluations should be based on evidence. Evaluations include opinions, but these opinions should be supported or explained by examples, experiences, observations, and other forms of evidence.

Examples: *When you evaluate an argument, an explanation, a decision, a prediction, an inference, a conclusion, or a generalization, ask questions like these:*

Are the conclusions reached based on good examples and facts?
Is there good evidence for the generalization or inference?
Is this believable?
Does the explanation make sense?
Are the sources used to make the decisions reliable?
Is the argument effective?
Is it realistic?