

Learning from failure through lines of reasoning and interacting parts

The learning goals while designing things in class are predominantly the **knowledge (ideas)** and **skills** outlined in [Science for All Americans](#) and the [Benchmarks for Science Literacy](#). These learning goals for the beginner, intermediate, proficient, and advanced levels correspond to the **primary, P, (K-2)**, **elementary, E, (3-5)**, **middle, M, (5-8)**, & **high, H, (9-12)** grades in the [Benchmarks](#).

For example, to decode the Benchmark 12E/P1, click on 12. Habits of Mind, E. Critical-Response Skills, and look at the first bullet in **Kindergarten through Grade 2** to find **P1** in the [Benchmarks for Science Literacy](#).

Students will learn how to use the knowledge and skills in three labeled strands from the *Atlas for Science Literacy* (2001): lines of reasoning, failure, and interacting parts.

Level	Lines of Reasoning	Failure	Interacting Parts
Beginner	<i>Ask "How do you know?" in appropriate situations and attempt reasonable answers when others ask them the same question. 12E/P1 (SKILL)</i>	Something may not work if some of its parts are missing. 11A/P2	When parts are put together, they can do things that they couldn't do by themselves. 11A/P3
Intermediate	<i>Offer reasons for their findings and consider reasons suggested by others. 12A/E2 (SKILL)</i> <i>Seek better reasons for believing something than "Everybody knows that . . ." or "I just know" and discount such reasons when given by others. 12E/E3 (SKILL)</i> <i>Buttress their statements with facts found in books, articles, and databases, and identify the sources used and expect others to do the same. 12E/E1 (SKILL)</i>	Something may not work as well (or at all) if a part of it is missing, broken, worn out, or misconnected. 11A/E2	In something that consists of many parts, the parts usually influence one another. 11A/E1
Proficient	<i>Notice and criticize the reasoning in arguments in which fact and opinion are intermingled or the conclusions do not follow logically from the evidence given. 12E/M5 . . . (SKILL)</i>	Systems fail because they have faulty or poorly matched parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with. 3B/M4 . . .	Thinking about things as systems means looking for how every part relates to others. 11A/M2 . . .
Advanced	<i>Insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position being taken - whether one's own or that of others - can be judged. 12E/H4 (SKILL)</i>	To reduce the chance of system failure, performance testing is often conducted using small scale models, computer simulations, analogous systems, or just the parts of the system thought to be least reliable. 3B/H6	Understanding how things work and designing solutions to problems of almost any kind can be facilitated by systems analysis. In defining a system, it is important to specify the boundaries and subsystems, indicate its relation to the other systems, and identify what its input and output are expected to be. 11A/H2