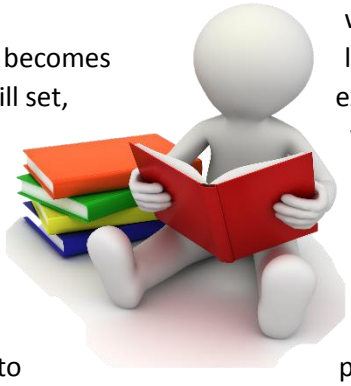
Building Critical Thinking Skills

What is critical thinking?

Critical thinking is a reflective and analytical style of thinking, with its basis in logic, rationality, and synthesis. It means delving deeper and asking questions like: why is that so? Where is the evidence? How good is that evidence? Is this a good argument? Is it biased? Is it verifiable? What are the alternative explanations?

Critical thinking moves us beyond mere description and into the realms of scientific inference and reasoning. This is what enables discoveries to be made and innovations to be fostered.



For many scientists, critical thinking becomes (seemingly) intuitive, but like any skill set, critical thinking needs to be taught and cultivated. Unfortunately, educators are unable to deposit this information directly into their students' heads. While the theory of critical thinking can be taught, critical thinking itself needs to be experienced first-hand.

So what does this mean for educators trying to incorporate critical thinking within their curricula? We can teach students the theoretical elements of critical thinking. Take for example working through statistical problems like this one:

> *In a 1,000-person study, four people said their favorite series was Star Trek and 996 said Days of Our Lives. Jeremy is a randomly chosen participant in this study, is 26, and is doing graduate studies in physics. He stays at home most of the time and likes to play videogames. What is most likely?*
>
> *Jeremy's favorite series is Star Trek*
>
> *Jeremy's favorite series is Days of Our Lives*

Some critical thought applied to this problem allows us to know that Jeremy is most likely to prefer Days of Our Lives.

Can you teach it?

It's well established that statistical training is associated with improved decision-making. But the idea of "teaching" critical thinking is itself an oxymoron: critical thinking can really only be learned through practice. Thus, it is not surprising that student engagement with the critical thinking process itself is what pays the dividends for students.

As such, educators try to connect students with the subject matter outside the lecture theatre or classroom. For example, problem based learning is now widely used in the health sciences, whereby students must figure out the key issues related to a case and direct their own learning to solve that problem. Problem based learning has clear parallels with real life practice for health professionals.

Critical thinking goes beyond what might be on the final exam and life-long learning becomes the key. This is a good thing, as practice helps to improve our ability to think critically over time.

Just for scientists?

For those engaging with science, learning the skills needed to be a critical consumer of information is invaluable. But should these skills remain in the domain of scientists? Clearly not: for those engaging with life, being a critical consumer of information is also invaluable, allowing informed judgment.

Being able to actively consider and evaluate information, identify biases, examine the logic of arguments, and tolerate ambiguity until the evidence is in would allow many people from all backgrounds to make better decisions. While these decisions can be trivial (does that miracle anti-wrinkle cream really do what it claims?), in many cases, reasoning and decision-making can have a substantial impact, with some decisions have life-altering effects. A timely case-in-point is immunization.

Pushing critical thinking from the realms of science and maths into the broader curriculum may lead to far-reaching outcomes. With increasing access to information on the internet, giving individuals the skills to critically think about that information may have widespread benefit, both personally and socially.

The value of science education might not always be in the facts, but in the thinking.

By Rachel Grieve Lecturer in Psychology at University of Tasmania: http://theconversation.com/thinking-critically-on-critical-thinking-why-scientists-skills-need-to-spread-15005

The Importance of Scientific Thinking

A critical approach to learning science is concerned less with accumulating undigested facts and scientific definitions and procedures, than with learning to think scientifically. As we learn to think scientifically, we inevitably organize and internalize facts, learn terminology, and use scientific procedures. But we learn them deeply, because they are tied into ideas we have thought through, and hence do not have to "re-learn" later. A critical approach to learning science requires us to ponder questions, propose solutions, and think through possible experiments.

A well cultivated scientific thinker:

- raises vital scientific questions and problems, formulating them clearly and precisely;
- gathers and assesses relevant scientific data and information, using abstract ideas to interpret them effectively;
- comes to well-reasoned scientific conclusions and solutions, testing them against relevant criteria and standards;
- thinks open-mindedly within convergent systems of scientific thought, recognizing and assessing scientific assumptions, implications, and practical consequences; and
- communicates effectively with others in proposing solutions to complex scientific problems.

Scientific thinking is, in short, self-directed, self-disciplined, self-monitored, and self-corrective. It presupposes assent to rigorous standards of excellence and mindful command of their use. It entails effective communication and problem solving abilities as well as a commitment to developing scientific skills, abilities, and dispositions.

By Richard Paul and Linda Elder: http://www.criticalthinking.org/store/products/scientific-thinking-for-students-and-faculty/170