

Marks of Scientific Literacy

(From "Teaching Introductory Physics" by Arnold B. Arons, John Wiley and Sons, 1997)

- 1** Recognize that scientific concepts (e.g., velocity, acceleration, force, energy, electric charge, gravitational and inertial mass) are invented (or created) by acts of human imagination and intelligence and are not tangible objects or substances accidentally discovered, like a fossil, or a new plant or mineral.
- 2** Recognize that to be understood and correctly used, such terms require careful operational definition, rooted in shared experience and in simpler words previously defined; to comprehend, in other words, that a scientific concept involves an idea first and a name afterwards, and that understanding does not reside in the technical terms themselves.
- 3** Comprehend the distinction between observation and inference and discriminate between the two processes in any context under consideration.
- 4** Distinguish between the occasional role of accidental discovery in scientific investigation and the deliberate strategy of forming and testing hypotheses.
- 5** Understand the meaning of the word "theory" in the scientific domain, and have some sense, through specific examples, of how theories are formed, tested, validated, and accorded provisional acceptance; recognize, in consequence, that the term does not refer to any and every personal opinion, unsubstantiated notion, or received article of faith and thus, for example, to see through the creationist locution that describes evolution as "merely a theory".
- 6** Discriminate, on the one hand, between acceptance of asserted and unverified end results, models, or conclusions, and, on the other hand, understand their basis and origin; that is, to recognize when questions such as "How do we know . . . ? Why do we believe . . . ? What is the evidence for . . . ?" have been addressed, answered, and understood, and when something is being taken on faith.

- 7 Understand, again through specific examples, the sense in which scientific concepts and theories are mutable and provisional rather than final and unalterable, and to perceive the way in which such structures are continually refined and sharpened by processes of successive approximations.**
- 8 Comprehend the limitations inherent in scientific inquiry and be aware of the kinds of questions that are neither asked nor answered; be aware of the endless regression of unanswered questions that resides behind the answered ones.**
- 9 Develop enough basic knowledge in some area (or areas) of interest to allow intelligent reading and subsequent learning without formal instruction.**
- 10 Be aware of at least a few specific instances in which scientific knowledge has had direct impact on intellectual history and on one's view of the nature of the universe and the human condition within it.**
- 11 Be aware of at least a few specific instances of interaction between science and society on moral, ethical, and sociological planes.**
- 12 Be aware of very close analogies between certain modes of thought in natural science and in other disciplines such as history, economics, sociology, and political science; for example, forming concepts, testing hypotheses, discriminating between observations and inference (i.e., between information from a primary source and the interpretations placed on this information), constructing models, and doing hypothetico-deductive reasoning.**