

Human Biology Book Notes

Chapter One - Science and the Real World

1.1 How does Science Impact the Everyday World?

We look to Scientists for factual information, to tell us about the natural world just as we look to politicians for political solutions and journalists to tell us about current events. Scientists are our eyes and ears on the natural world.

Society brings issues to scientists and scientists bring issues to society - global warming, stem cell research.

Through their discoveries, scientists present society with "options" from which society then chooses, either in the marketplace or the political arena.

Science and technology have always been in the business of providing options to society but more so now than in the past. EX: development of the internet, computer technology, reproductive/fertility options, genetically modified foods, DNA fingerprinting, cloning.

1.2 What is Science?

Science as a Body of Knowledge

Science - a way of learning; an activity carried out under certain loosely agreed-to rules; a body of knowledge about the natural world; a collection of insights about nature, the evidence for which is an array of facts.

Theory - insights of science; related set of insights well supported by evidence that explains some aspect of nature; some pieces are in dispute but as a whole they stand as a scientific theory. EX: Big Bang Theory.

In everyday life a "theory" is little more than a hunch - an unproven idea that may or may not have any evidence to support it. Different than a theory in a scientific context.

The Importance of Theories

Much more valued entity than a fact as the theory has an explanatory power while a fact is generally an isolated piece of information. EX: the universe being 14 billion years old is a fact but it explains very little in comparison to the Big Bang Theory.

Facts are important - theories couldn't be supported or refuted without them BUT science is in the theory-building business, not the fact-finding business.

Science as a Process: Arriving at Scientific Insights

When science is viewed as a process (scientific method) it could be defined as: a means of coming to understand the natural world through observation and the testing of hypotheses.

Scientific Method - a means of coming to understand the natural world through observation and the testing of hypotheses. The process by which scientists investigate the natural world. Involves testing of hypotheses through observation and experiment, as aided by the tools of statistics.

Observation: a piece of the natural world is observed to work in a certain way.

Question: Broadly speaking is one of 3 types - What, Why or How.

The **observation** is made, a **question** is presented, a **hypothesis** is created, an **experiment** is conducted and a **conclusion** is drawn.

Formulating Hypotheses, Performing Experiments

Following the formulation of the question, a hypothesis or multiple hypotheses are proposed that might answer the question.

Hypothesis - a tentative, testable explanation for an observed phenomenon.

Several hypotheses are proposed to account for the same observation. To determine which may be correct, **experiments** (controlled tests of the question) are conducted.

Not all hypotheses receive experiments as scientists usually have an idea of which hypothesis is the most promising so not all need to be tested.

The Test of Experiment: Pasteur and Spontaneous Generation

Louis Pasteur conducted experiments in 1860 to see if life regularly arises from "life" or if it is generated spontaneously through the coming together of basic chemicals.

Meat broth in glass flasks - showed that no growth appears in the broth unless dust is admitted from outside. Reject "spontaneous generation" hypothesis. Life did grow when the neck of the flask was broken or when the flask was tilted. Idea of spontaneous generation was not banished w/ this set of experiments. The results of these particular experiments theorized that life spawns from life.

Variable - An element of an experiment that is changed compared to an initial condition. An adjustable condition in an experiment. **EX:** shape of the flask neck in Pasteur's experiment, or the tilt of the flask.

Control Condition - a separate group where we do not change the independent variable. Independent variable is held steady. An experimental condition that exists prior to the introduction of any variables that are being tested for. **EX:** broth filled flask left sitting straight up w/ its particle trap intact.

Other Kinds of Support for Hypotheses

Some scientific questions are difficult or impossible to test purely through experiment. **EX:** Are birds direct descendents of dinosaurs? We can examine DNA from modern birds but not from dinosaurs. We can use observation to test a hypothesis as well - observing dinosaur and bird fossils.

When is a Theory Proven?

Provisional Assent to Findings: Legitimate Evidence and Hypotheses

Nothing is ever proven - every finding is given only provisional assent meaning it is believed to be true for now, pending the addition of new evidence. This is what separates science from belief systems such as those that operate in culture, politics or religion.

Scientists rarely think of this just as we rarely question why we drive on the right side of the road.

Every theory and "fact" in science is subject to modification and everything scientists "know" is subject to change.

The principle of science's openness to revision is one of **3 important scientific principles** having to do w/ hypotheses and evidence:

Every assertion regarding the natural world is subject to challenge and revision, based on evidence.

Results obtained in experiments must be *reproducible*. Different investigators must be able to obtain the same results from the same sets of procedures and materials.

Any scientific hypothesis or claim must be *falsifiable*, meaning open to negation through means of scientific inquiry. **EX:** the assertion that "UFO's are visiting the Earth" does not rise to the level of a scientific claim because there is no way to prove that this is not so.

1.3 The Nature of Biology

Biology - the study of life.

Life is not simple to define so there are characteristics given to things that are living:

Can assimilate and use energy - bacterium needs energy source no less than humans do - we use energy in the form of food, bacterium use things such as the remains of vegetation in the soil.

Can respond to their environment - we leave our homes if we smell gas, bacterium moves away if it encounters something noxious.

Can maintain a relatively constant internal environment - We sweat when we get hot.