

ScienceNews

Teacher Background Sheet: Fossils and Bias

Use this background sheet to introduce concepts about fossils and scientific bias with your students.

Fossils, casts and reconstructions

Fossils are the remains or impressions of organisms that are preserved in stone. Fossils can be parts of once-living organisms that have been preserved, such as bones, shells or exoskeletons.

Sometimes, fossils are imprints or impressions of some part of an organism, such as footprints, molds, casts or other indications of what the organism looked like or how it moved. Molds and casts are types of natural fossils. Molds form where an animal or plant was buried in mud or soft soil and then the soft parts of the body decayed, leaving behind an impression of their soft tissues. Casts form when these impressions (molds) are filled with minerals or sediments, which take the shape of the animal or plant. Scientists also make molds and casts of fossils.

Very few fossils of complex vertebrates are complete skeletal remains, and even fewer include information about the soft tissues of the body. When an organism dies, most of its body is consumed by predators, scavengers and decomposers. This process leaves scattered pieces behind, usually the hardest parts of the body, such as bones and teeth. Over time, these scattered remains are transported by water, buried in soil and sediment and compressed by the weight of overlying sediment and rock. Whatever biological material remains is commonly replaced by minerals in a process called petrification. These fragmented, petrified bones and teeth are the most common fossils found by paleontologists.

When scientists find new fossils, they meticulously search the surrounding area to locate as many fragments as they can. Sometimes, they find enough to reconstruct an entire bone, a limb or a significant portion of a skeleton. However, scientists often must estimate and insert the missing features based on the structures they can observe and on observations of other, similar fossils. This process involves making detailed measurements, comparing fossil features to known or expected features in that organism and then making the best guess possible about what the missing features are most likely to have been.

Many fossils of hominins are presented as reconstructed skulls, limbs or skeletons, with the actual fossil fragments identified in one color and the reconstructed or interpolated features indicated in another color. Because of the incomplete nature of most fossils, scientists commonly use casts, or detailed replicas, of fossils for research and comparison purposes. Scientists also use casts to construct composite reconstructions that combine features from all the known specimens of a particular species to make a more-or-less complete and accurate facsimile of what an entire fossil organism might have looked like.

Bias and scientific research

The information below comes from the *Science News* in High Schools activity “[How bias affects scientific research.](#)”

One of the guiding principles of scientific inquiry is one of objectivity. Objectivity is the idea that scientific questions, methods and results should not be affected by the personal values, interests or perspectives of researchers. However, science is a human endeavor, and experimental design and analysis of information are products of human thought processes. As a result, biases may be introduced into scientific processes or conclusions.

Bias is sometimes described as a tendency to prefer one thing over another, or to favor one person, thing or explanation in a way that prevents objectivity or that influences the outcome of a study or the understanding of a phenomenon.

In scientific circles, bias is described as any systematic deviation between measured values and the true values, or between observations or interpretations of data and an accurate description of a phenomenon. Systematic deviation, or systematic error, is an error that is not determined by chance but is introduced by an inaccuracy inherent in the system of observation or measurement or in the study design.

Bias can be introduced at multiple points during scientific research — in the experimental design, in the development or implementation of processes used to conduct the research, during collection or analysis of data or during the reporting of conclusions. If systematic errors occur in the design of a research study or in the collection, analysis or interpretation of data, then explanations that describe the natural world or natural processes might not accurately represent phenomena in the real world.

