Explain: Explaining Evolution

Essay - "Just a Theory?"

What do we mean when we say that we have a theory about something? Usually we mean that we have an idea about how to explain something. We may suggest a theory about who killed the butler in the late-night thriller. Or we may have a theory about why Ms. Figueroa always looks so tired when she delivers the mail on Monday morning. Or we may have a theory about what the coach of the local baseball team said to his pitcher after they lost last night's big game.

Figure 1 - The word "theory" often means different things to different people.

These theories that we develop about things are often tentative. That is, when we say that we have a theory about something, we may mean that we don't have much evidence. If we don't have much evidence, other people don't usually agree with or share our theories. Nevertheless, it is fun to suggest clever ideas.

In contrast, scientists use the word *theory* in a very different way than we do. Scientific theories are explanations that are extremely well accepted by the scientific community because a variety of strong evidence supports them.

A good example of a scientific theory is the atomic theory, an explanation developed in 1803 by the British teacher and chemist John Dalton. You may already be familiar with one of the most important ideas of Dalton's atomic theory: *All matter (or things) in the universe is composed of tiny particles called* ***atoms***. This idea was revolutionary at the time that Dalton first suggested it. But since then, physicists have accumulated an enormous body of evidence to support it. Part of that evidence is the result of our modern ability to detect, to manipulate, and even to subdivide atoms. Even though Dalton did not predict that atoms could be subdivided into smaller pieces such as electrons and protons, the general outline of his theory still stands.

Another example is the cell theory, which is the understanding that complex living organisms are comprised of small building blocks called cells. This is an example of a biological theory that is supported by an enormous body of evidence.

Despite the evidence that has accumulated in favor of the atomic and cellular theories, and despite the fact that no modern scientist questions most of these basic principles, we still refer to these ideas as *theories*. Clearly, scientists use the word *theory* very differently from the way most nonscientists do.

To understand how an explanation becomes known as a scientific theory, we have to consider first the meaning of the term **hypothesis**. You may have learned already that a hypothesis is a trial idea about something. During research, scientists develop hypotheses to explain the reasons underlying an event or a phenomenon. A hypothesis can also explain the relationships that scientists think they see among

objects, events, or processes. As you will see in Unit 2, predictions made from such hypotheses are useful because they can be tested. Testing our hypotheses allows us to distinguish these trial ideas that adequately explain what we study from those that do not.

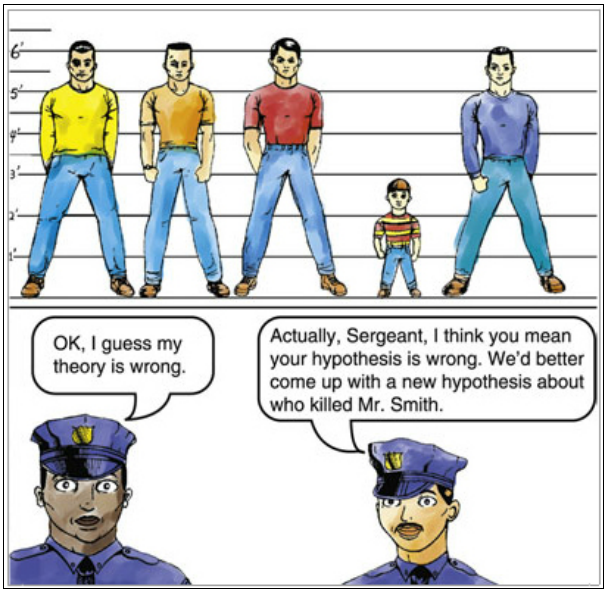

Figure 2 - When used by scientists, the word theory means an explanation that is supported by evidence and well accepted by other scientists.

You probably can see, then, that the explanations we develop for things and events around us actually are *hypotheses*, not scientific theories. As hypotheses, these trial ideas or tentative explanations can be tested. In scientific terms, the police who investigate the death of the butler do so by systematically testing a whole set of hypotheses, not theories.

By contrast, a scientific **theory** is a hypothesis that already has been extensively tested and is supported by a large body of observations and evidence. A good theory explains data that we already know and relates and explains additional data as they become known. In fact, a good theory also predicts new data and suggests new relationships that we may not already have recognized.

Why do scientists call Darwin's explanation of descent with modification the *theory* of evolution instead of the *hypothesis* of evolution? First, it is considered a theory because of the enormous amount of evidence that suggests it is a correct explanation. As you already have seen, this evidence spans a wide range of different scientific fields, from anatomy to geology to embryology to physical anthropology. Second, it is considered a theory because it explains both the evidence that Darwin saw and recorded, as well as the new data that we continue to collect. It also successfully predicts new phenomena. That is, Darwin's explanation for biological change across time continues to be supported, even by evidence collected more than 100 years after his work. For those reasons and others, this explanation is almost universally accepted by scientists around the world.

Does this wide acceptance of Darwin's work mean that Darwin explained everything there was to explain about evolution or that every part of his explanation is correct? No, not necessarily. Darwin was not able to explain exactly *how* characteristics passed from one generation to the next. He did not include in his theory an explanation of the relationship between natural selection and genetic inheritance. However, this omission does not make Darwin's ideas incorrect. Since Darwin's time, biologists have added information on natural selection and genetic inheritance to the theory of evolution. In fact, the addition of information to Darwin's basic proposal illustrates the power of a sound scientific theory. As new information about inheritance became available, it supported, rather than contradicted, the original explanation.

So, when we talk about explanations for things in the world around us, we need to be careful. We need to decide whether are we talking about a theory (as we typically use the term) or are we talking about a *theory* (as scientists use the term). The difference between the two is quite large, indeed.