

Understanding Science: An overview

To understand what science is, just look around you. What do you see? Perhaps, your hand on the mouse, a computer screen, papers, ballpoint pens, the family cat, the sun shining through the window Science is, in one sense, our knowledge of all that — all the stuff that is in the universe: from the tiniest subatomic particles in a single atom of the metal in your computer's circuits, to the nuclear reactions that formed the immense ball of gas that is our sun, to the complex chemical interactions and electrical fluctuations within your own body that allow you to read and understand these words. But just as importantly, science is also a reliable process by which we learn about all that stuff in the universe. However, science is different from many other ways of learning because of the way it is done. Science relies on testing ideas with evidence gathered from the natural world. This website will help you learn more about science as a process of learning about the natural world and access the parts of science that affect your life.



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Science helps satisfy the natural curiosity with which we are all born: why is the sky blue, how did the leopard get its spots, what is a solar eclipse? With science, we can answer such questions without resorting to magical explanations. And science can lead to technological advances, as well as helping us learn about enormously important and useful topics, such as our health, the environment, and natural hazards. Without science, the modern world would not be modern at all, and we still have much to learn. Millions of scientists all over the world are working to solve different parts of the puzzle of how the universe works, peering into its nooks and crannies, deploying their microscopes, telescopes, and other tools to unravel its secrets.

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Science is complex and multi-faceted, but the most important characteristics of science are straightforward:

Science focuses exclusively on the natural world, and does not deal with supernatural explanations.

Science is a way of learning about what is in the natural world, how the natural world works, and how the natural world got to be the way it is. It is not simply a collection of facts; rather it is a path to understanding.

Scientists work in many different ways, but all science relies on testing ideas by figuring out what expectations are generated by an idea and making observations to find out whether those expectations hold true.

Accepted scientific ideas are reliable because they have been subjected to rigorous testing, but as new evidence is acquired and new perspectives emerge these ideas can be revised.

Science is a community endeavor. It relies on a system of checks and balances, which helps ensure that science moves in the direction of greater accuracy and understanding. This system is facilitated by diversity within the scientific community, which offers a broad range of perspectives on scientific ideas.

To many, science may seem like an arcane, ivory-towered institution — but that impression is based on a misunderstanding of science. In fact:

Science affects your life everyday in all sorts of different ways.

Science can be fun and is accessible to everyone.

You can apply an understanding of how science works to your everyday life.

Anyone can become a scientist — of the amateur or professional variety.



It's all science.

Science doesn't just take place in laboratories. You can have fun with and make use of science in everyday life.

Where to begin?

Here are some places you may want to start your investigation:

What is science? Find out what makes science science.

How does it work? Probe the nuts and bolts of the process of science.

Why is it important? Learn how science affects your life everyday and how you can apply an understanding of the nature of science in your

Discovery: The spark for science



a galaxy and water droplets

"Eureka!" or "aha!" moments may not happen frequently, but they are often experiences that drive science and scientists. For a scientist, every day holds the possibility of discovery — of coming up with a brand new idea or of observing something that no one has ever seen before. Vast bodies of knowledge have yet to be built and many of the most basic questions about the universe have yet to be answered:

What causes gravity?

How do tectonic plates move around on Earth's surface?

How do our brains store memories?

How do water molecules interact with each other?

We don't know the complete answers to these and an overwhelming number of other questions, but the prospect of answering them beckons science forward.



Even making cookies can lead to scientific questions.

EVERYDAY SCIENCE QUESTIONS

Scientific questions can seem complex (e.g., what chemical reactions allow cells to break the bonds in sugar molecules), but they don't have to be. You've probably posed many perfectly valid scientific questions yourself: how can airplanes fly, why do cakes rise in the oven, why do apples turn brown once they're cut? You can discover the answers to many of these "everyday" science questions in your local library, but for others, science may not have the answers yet, and answering such questions can lead to astonishing new discoveries. For example, we still don't know much about how your brain remembers to buy milk at the grocery store. Just as we're motivated to answer questions about our everyday experiences, scientists confront such questions at all scales, including questions about the very nature of the universe.

To learn about how others have gotten involved in science and how you can develop your own scientific outlook on the world, check out this side trip:

Think science

Discoveries, new questions, and new ideas are what keep scientists going and awake at night, but they are only one part of the picture; the rest involves a lot of hard (and sometimes tedious) work. In science, discoveries and ideas must be verified by multiple lines of evidence and then integrated into the rest of science, a process which can take many years. And often, discoveries are not bolts from the blue. A

discovery may itself be the result of many years of work on a particular problem, as illustrated by Henrietta Leavitt's stellar discovery ...

Henrietta Leavitt

Henrietta Leavitt

STELLAR SURPRISES

Astronomers had long known about the existence of variable stars — stars whose brightness changes over time, slowly shifting between brilliant and dim — when, in 1912, Henrietta Leavitt announced a remarkable (and totally unanticipated) discovery about them. For these stars, the length of time between their brightest and dimmest points seemed to be related to their overall brightness: slower cycling stars are more luminous. At the time, no one knew why that was the case, but nevertheless, the discovery allowed astronomers to infer the distances to far-off stars, and hence, to figure out the size of our own galaxy. Leavitt's observation was a true surprise — a discovery in the classic sense — but one that came only after she'd spent years carefully comparing thousands of photos of these specks of light, looking for patterns in the darkness.

Read more about Henrietta Leavitt's investigation of variable stars.

The process of scientific discovery is not limited to professional scientists working in labs. The everyday experience of deducing that your car won't start because of a bad fuel pump, or of figuring out that the centipedes in your backyard prefer shady rocks shares fundamental similarities with classically scientific discoveries like working out DNA's double helix. These activities all involve making observations and analyzing evidence — and they all provide the satisfaction of finding an answer that makes sense of all the facts. In fact, some psychologists argue that the way individual humans learn (especially as children) bears a lot of similarity to the progress of science: both involve making observations, considering evidence, testing ideas, and holding on to those that work.

To learn more about the analogy between the progress of science and human learning, take an advanced side trip to Baby's first research.