In science, a model is a representation of an idea, an object or even a process or a system that is used to describe and explain phenomena that cannot be experienced directly. Models are central to what scientists do, both in their research as well as when communicating their explanations.

Models are a mentally visual way of linking theory with experiment, and they guide research by being simplified representations of an imagined reality that enable predictions to be developed and tested by experiment.

**Why scientists use models**

Models have a variety of uses – from providing a way of explaining complex data to presenting as a hypothesis. There may be more than one model proposed by scientists to explain or predict what might happen in particular circumstances. Often scientists will argue about the ‘rightness’ of their model, and in the process, the model will evolve or be rejected. Consequently, models are central to the process of knowledge-building in science and demonstrate how science knowledge is tentative.

Think about a model showing the Earth – a globe. Until 2005, globes were always an artist’s representation of what we thought the planet looked like. (In 2005, the first globe using satellite pictures from NASA was produced.) The first known globe to be made (in 150BC) was not very accurate. The globe was constructed in Greece so perhaps only showed a small amount of land in Europe, and it wouldn’t have had Australia, China or New Zealand on it! As the amount of knowledge has built up over hundreds of years, the model has improved until, by the time a globe made from real images was produced, there was no noticeable difference between the representation and the real thing.

**Building a model**

Scientists start with a small amount of data and build up a better and better representation of the phenomena they are explaining or using for prediction as time goes on. These days, many models are likely to be mathematical and are run on computers, rather than being a visual representation, but the principle is the same.

**Using models for predicting**

In some situations, models are developed by scientists to try and predict things. The best examples are [climate models](https://www.sciencelearn.org.nz/resources/2232-climate-models) and climate change. Humans don’t know the full effect they are having on the planet, but we do know a lot about carbon cycles, water cycles and weather. Using this information and an understanding of how these cycles interact, scientists are trying to figure out what might happen. Models further rely on the work of scientists to collect quality data to feed into the models.

Scientists can use data to predict what the climate might be like in 20 years if we keep producing carbon dioxide at current rates – what might happen if we produce more carbon dioxide and what would happen if we produce less. The results are used to inform politicians about what could happen to the climate and what can be changed.

Models can also be used when field experiments are too expensive or dangerous, such as models used to predict how [fire spreads in road tunnels](https://www.sciencelearn.org.nz/resources/740-a-truck-and-a-tunnel) and how a [fire might develop in a building](https://www.sciencelearn.org.nz/videos/198-computational-modelling).

**How do we know if a model works?**

Models are often used to make very important decisions, for example, reducing the amount of fish that can be taken from an area might send a company out of business or prevent a fisher from having a career that has been in their family for generations.

The costs associated with combating climate change are almost unimaginable, so it’s important that the models are right, but often it is a case of using the best information available to date. Models need to be continually tested to see if the data used provides useful information. A question scientists can ask of a model is: Does it fit the data that we know?

**Nature of science**

Models have always been important in science and continue to be used to test hypotheses and predict information. Often they are not accurate because the scientists may not have all the data. It is important that scientists test their models and be willing to improve them as new data comes to light. Model-building can take time – an accurate globe took more than 2,000 years to create – hopefully, an accurate model for climate change will take significantly less time.