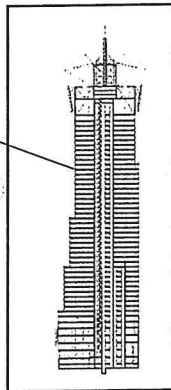


Scale Models

A scale model is a physical or conceptual representation of an object that is proportional in size to the object it represents. Examples include model trains, model airplanes, and dollhouses. Most model trains are built to a scale of 1:87. This ratio means that the model is $\frac{1}{87}$ the size of an actual train. On the model, 1 cm represents 87 cm on the train.

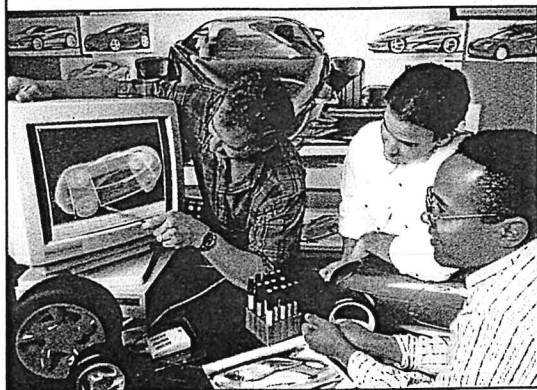
Scale models aren't just for hobbyists—scientists and engineers use them, too. A simple scientific model in the classroom is a globe, which is a small-scale model of Earth. (A globe with a diameter of 30 cm has a scale of 1:42,500,000.) **Applying Concepts** *How do you use the scale of a model as a conversion factor?*

Architectural drawing
East-west elevation



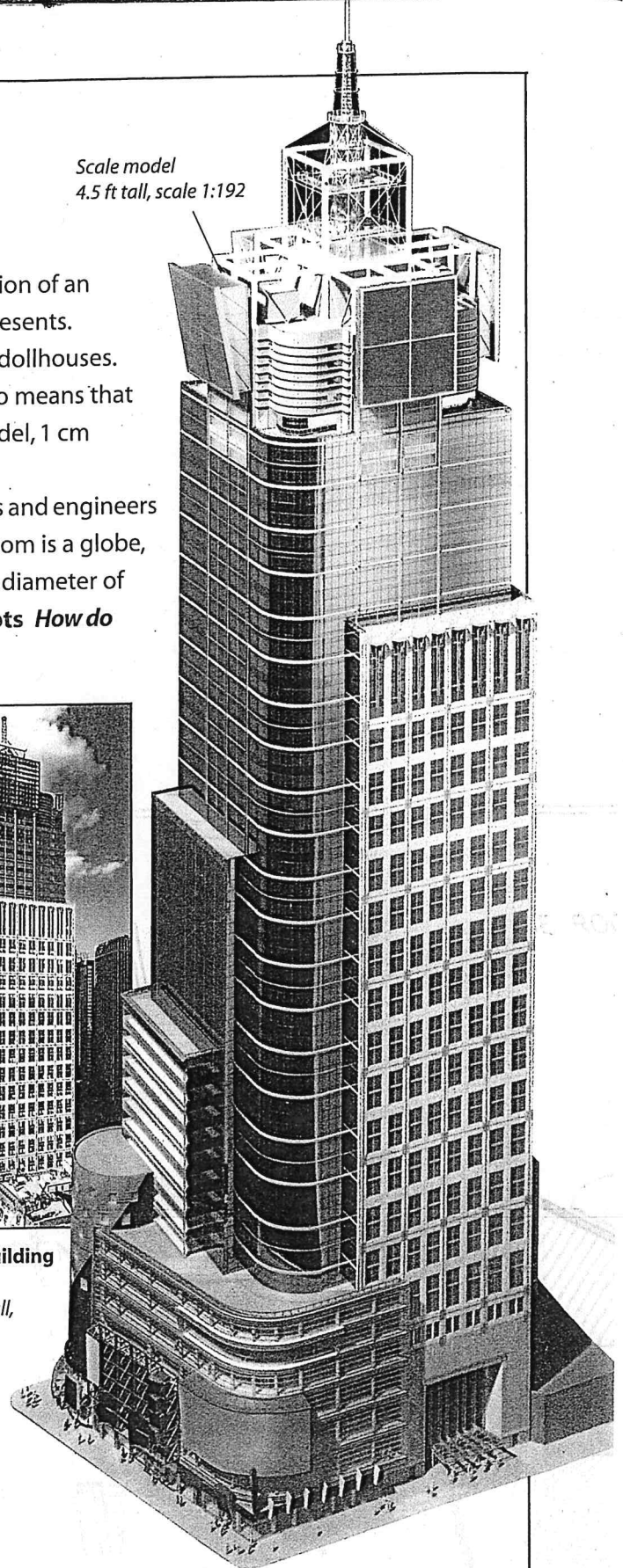
Computer modeling

By testing a model, engineers can make the product better before it is built. Engineers often design scale models on computers. These automotive engineers are using a computer-aided design (CAD) program to view a digital scale model of a car. Physical models of the car's wheels are on the desk.



Condé Nast Building
New York City
866 ft (264 m) tall,
48 floors

Scale model
4.5 ft tall, scale 1:192

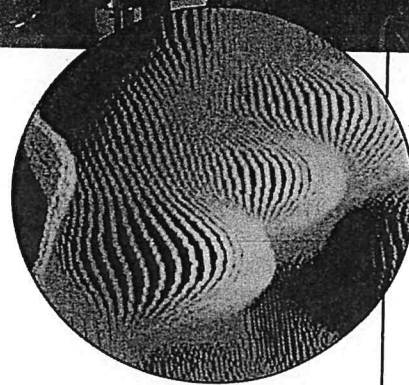
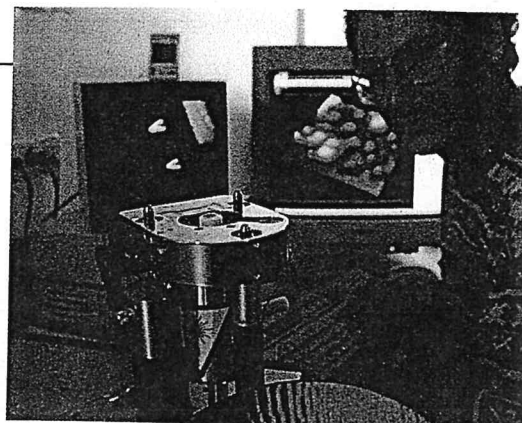


Model building

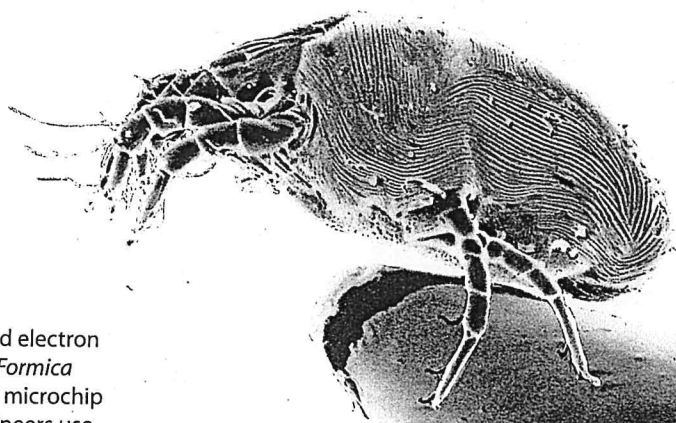
Architects use both two-dimensional and three-dimensional scale models to design buildings. A common scale for floor plans is 1:48.

Electron Microscopy

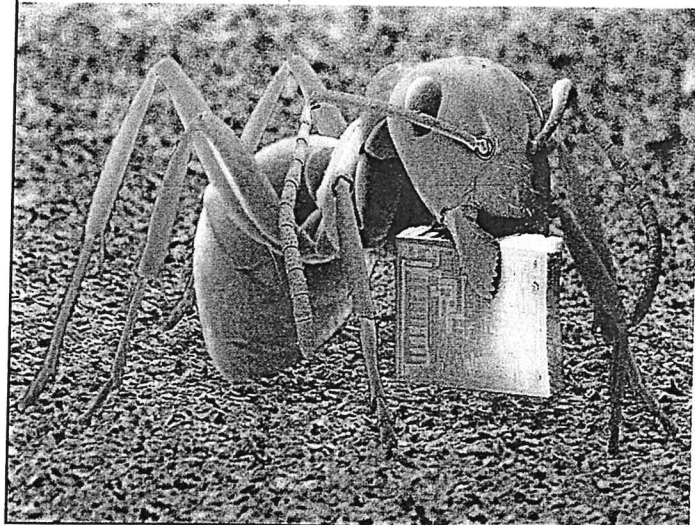
Within 30 years of J.J. Thomson's discovery of the electron, scientists were studying how to produce images of objects by using an electron beam. In 1931, German scientists Ernst Ruska and Max Knoll built the first electron microscope. While an ordinary light microscope uses a beam of light and lenses to magnify objects, an electron microscope uses an electron beam and "lenses" consisting of magnetic or electric fields. A typical light microscope is capable of magnifying an object 1000 times. An electron microscope can magnify an object over 100,000 times. **Interpreting Photographs** What characteristics of the images below provide the viewer with a sense of scale?



Biochemistry A scientist uses an electron microscope to look at the surface of DNA molecules.



Microelectronics In the colorized electron micrograph below, a wood ant (*Formica fusca*), about 5 mm long, holds a microchip in its jaws. Microelectronics engineers use electron microscopes to measure and analyze the characteristics of microcircuits.

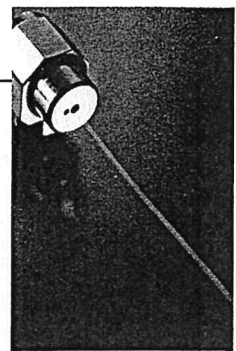


Biology A dust mite (*Dermatophagoides pteronyssinus*), smaller than the period at the end of this sentence, sits on the point of a sewing needle.

Lasers at Work

A laser produces an intense beam of light with the unusual property that the waves contributing to it have crests that coincide. The properties of laser light make it useful for many different purposes, including reading CD-ROMs and DVDs in electronic equipment and scanning bar codes at cash registers. Some industries use high-intensity lasers to cut metal. Other lasers are used in surgery. **Inferring Explain** *how the properties of a laser beam make it useful for the kind of eye surgery shown.*

1 A surgeon prepares for laser eye surgery to reshape the cornea, or clear outermost part of the eye, so that the patient no longer needs eyeglasses to see clearly.

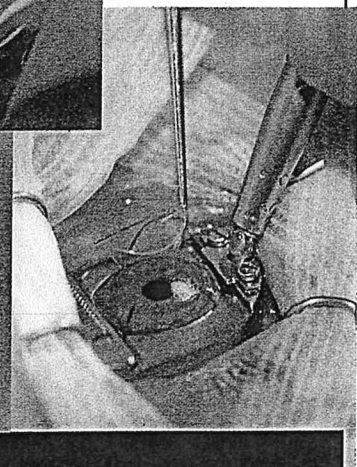


Flashlight beam vs. laser beam Light from a flashlight travels in different directions, covering a wide area. Light rays from a laser travel parallel to one another, resulting in a narrow beam of intense light in a specific direction.

2 The surgeon uses a tool called a microkeratome to make a partial cut in the cornea.



3 The doctor lifts and folds back the cornea.



4 A laser removes some tissue to change the shape of the cornea and correct the patient's vision.



The Chemistry of Adhesives

Most common adhesives are sticky substances that you can use to bind two surfaces together. The diagram shows how some adhesives work. The adhesive is a liquid until the surfaces are in position. Then the adhesive sets into a solid. Adhesion can work in three ways: Molecules of the polymer may fill crevices in the surfaces being connected, the molecules may also become attracted by intermolecular forces, or they may react by forming covalent bonds.

Interpreting Diagrams *Explain the purpose of a stabilizer in an adhesive.*

It also sticks handles to teapots

Permanent adhesion An epoxy resin attached this full-size automobile to the billboard. Epoxy resins are often stored in two parts that are mixed just before the epoxy is used. Strong binding forces in these adhesives make them heat- and water-resistant.

Temporary adhesion The sticky strip on a reusable note is a microsphere adhesive. The microspheres limit the amount of surface area contact, so the paper sticks lightly and repositions easily.

