Exciting careers in Computer Modeling

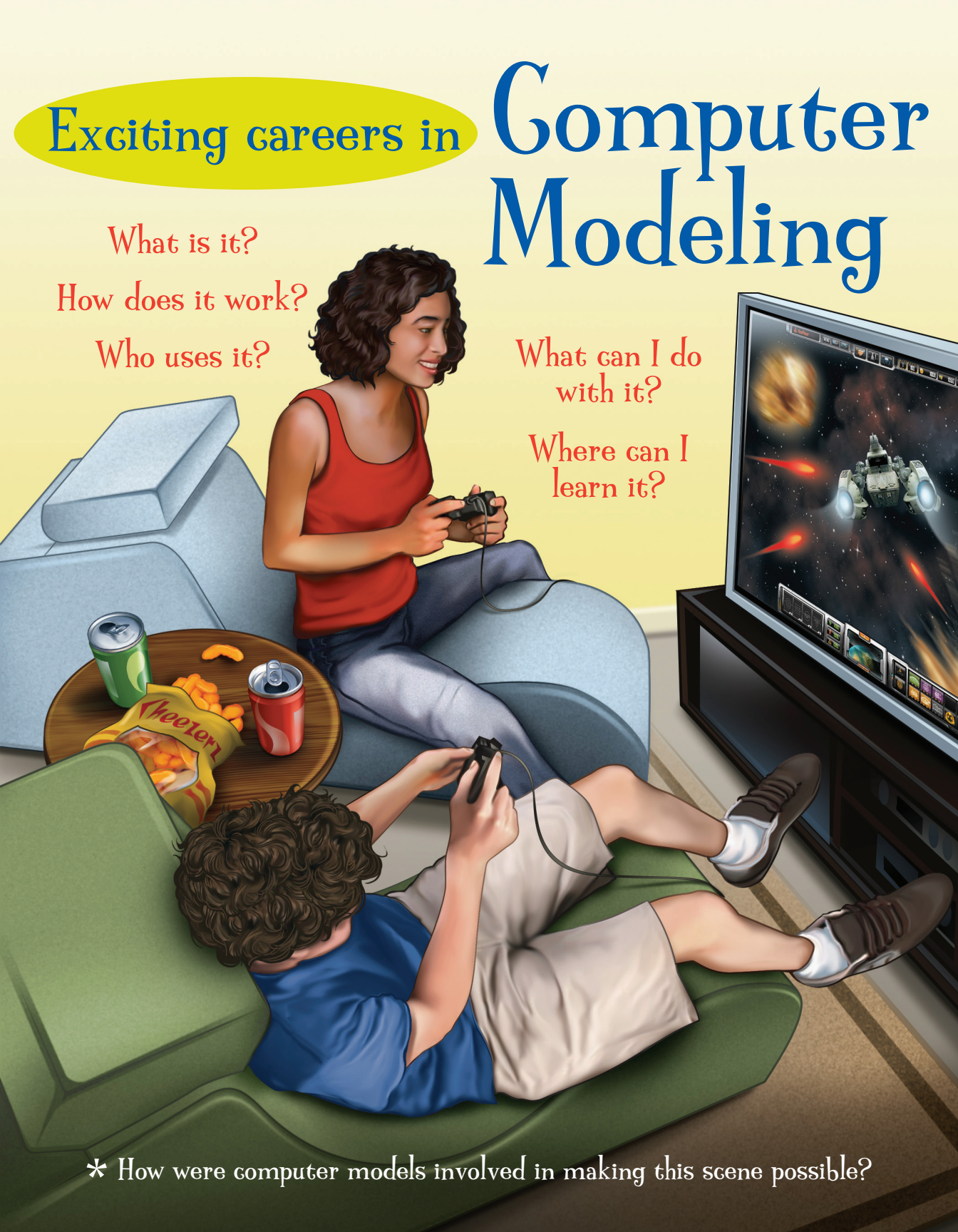
What is it?

How does it work?

Who uses it?

What can I do with it?

Where can I learn it?



* How were computer models involved in making this scene possible?

What is Computer Modeling?

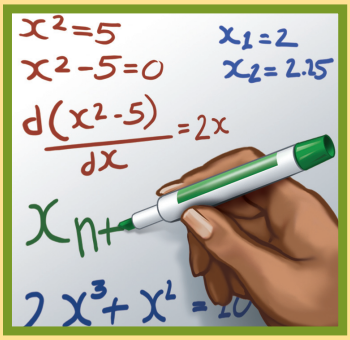
If you've ever checked the weather, driven through the downtown area of a large city, or discussed global warming, then you've relied on computer models to inform and guide you. Computer models are used to influence government decisions about health care and the economy. They're used in research and industry to predict everything from the effectiveness of a new cancer drug to the likelihood that you'll buy sneakers in the next six months.

Computer models consider various pieces of information, perform calculations, and then report results, which are often visualized using images, graphs, and tables. For example, to predict the weather, the computer needs many different things, including current wind speed, temperature, humidity, air pressure, and surface characteristics (e.g., land, water, mountains) that affect the region covered by the prediction. In fact, hundreds of weather balloons are released around the world every day to record atmospheric information for weather models.

The weather forecast model must be programmed to analyze how these things interact with each other. How does air with different temperatures and humidity levels react when surrounded by a cooler or warmer environment? What happens when air at a specific temperature passes over a large body of water at another temperature? How do different air streams flowing in different directions at different altitudes affect each other? The computer model calculates answers to these questions—and many more—to give an accurate prediction. Weather forecasts are the result of these calculations and help you decide if you'll need an umbrella, a sweater, or sunscreen when you leave your house!

Computer models are used in almost every area of research and industry. By developing your modeling skills now, you will be prepared for many possible career paths.

How does it work?



1 Designing a computer model is the most important step. What pieces of information will the model need? What calculations should it perform with that information? (You can think of the model as a series of equations that represent the relationships between the data.)

2 Data is fed into a computer model, which then performs calculations, often hundreds or thousands of times, to predict what will happen over time.

3 The output of a computer model is typically the numerical results of all the calculations. Images, graphs, and tables are used to display these calculations.

What can you do with computer models?

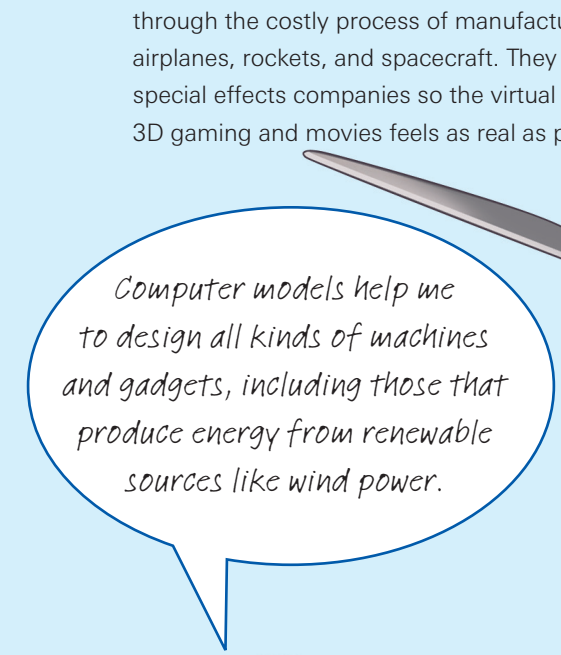
Computer modeling is used in a wide variety of careers. Scientists use computer models in every field of research. Designers use models to predict everything from the best shape for a new race car to the stability of bridges and buildings. Stock traders and investment companies try to predict stock prices using computer models.

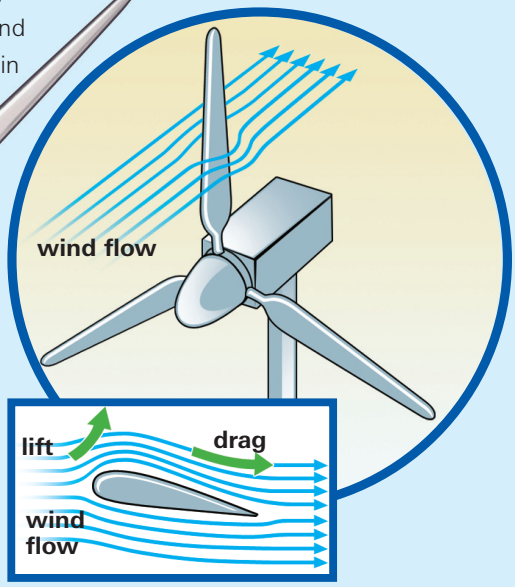
This list includes just a few of the many jobs that rely on computer modeling. Look inside to see more.

- Actuaries
- Aerospace Engineers
- Astronomers
- Atmospheric and Space Scientists
- Bioengineers
- Chemical Engineers
- Drug Designers
- Economists
- Epidemiologists
- Geneticists
- Geoscientists
- Hydrologists
- Materials Scientists
- Meteorologists
- Microbiologists
- Pathologists
- Physicists
- Political Scientists
- Sociologists
- Statisticians
- Urban planners
- Wildlife biologists

Engineer

Scientists working in physics-related fields use computer models to understand the origins and fate of the universe. They use models to test designs for new electronic devices before going through the costly process of manufacturing them. They design airplanes, rockets, and spacecraft. They even work for game and special effects companies so the virtual world you experience in 3D gaming and movies feels as real as possible.





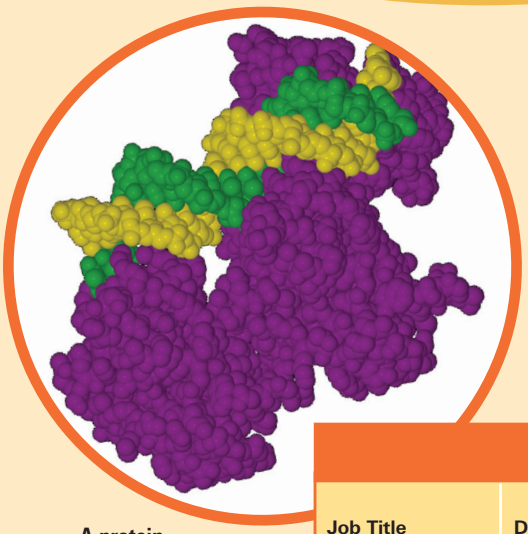
The blade of a windmill is very similar to an airplane wing, so engineering designs and model results from aviation can be applied to wind energy.

Other Careers in Physics

Job Title	Description	Education Level Required	Average Salary
Electronics Technician	Maintain, adjust, calibrate, and repair electronic, electromechanical, and hydraulic equipment.	High school diploma	$40,580
Meteorologist	Study the atmosphere's physical characteristics, motions, and processes, to predict the weather.	Bachelor's degree	$77,150
Mechanical Engineer	Research, design, develop, manufacture, and test tools, engines, machines, and other mechanical devices.	Bachelor's degree	$69,850
Software Publisher (Game Designer)	Analyze users' needs, and then design, test, and develop software to meet those needs.	Bachelor's degree	$79,780
Astronomer	Observe, measure, interpret, and develop theories to explain celestial and physical phenomena. Develop the instrumentation and techniques used to observe and collect astronomical data.	Ph.D.	$95,740

Scientists working in chemistry-related fields use computer models to design molecules that can interact with our cells. They help companies find raw materials like gold, diamonds, and oil. They help model climate change and predict the results of changes in regulations that affect the cleanliness of our air and water. The new field of nanotechnology relies on computer models to guide the design of objects that are too small to see even with a microscope, objects that will ultimately have unique electrical or chemical properties.

Drug Designer



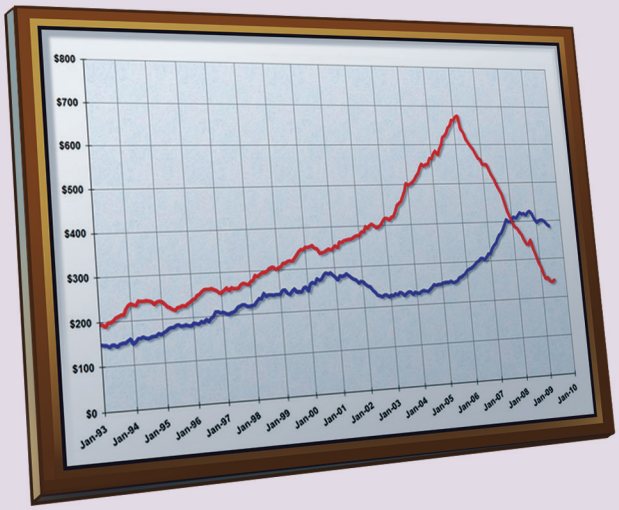
A protein (in purple) specially designed to bind to DNA is shown here. Using computer models chemists can design molecules to perform many functions.

Other Careers in Chemistry

Job Title	Description	Education Level Required	Average Salary
Forensic Science Technician	Investigate crimes by collecting and analyzing physical evidence.	Associate's degree	$45,320
Food Scientist	Develop new or better ways of preserving, processing, packaging, storing, and delivering foods.	Master's degree	$53,810
Materials Scientist	Research chemicals and how they can be used in the development of new and improved synthetic fibers, paints, drugs, cosmetics, electronic components, and thousands of other products.	Bachelor's degree	$74,610
Environmental Engineer	Develop solutions to environmental problems, including water and air pollution control, recycling, waste disposal, and public health issues.	Bachelor's degree	$69,940
Computational Chemist (Drug Designer)	Design new molecules to solve problems in medicine and other fields. Model atomic level behavior of materials to better understand fundamental principles of chemistry.	Ph.D.	$68,760

The field of human behavior covers a wide range of topics from business management to the study of how the brain functions. Some scientists model social interactions between large populations of people while others create models to help them predict the direction of the stock market. Robotics designers who develop human-like robots model the way we move and even the way we think and express emotion.

Economist

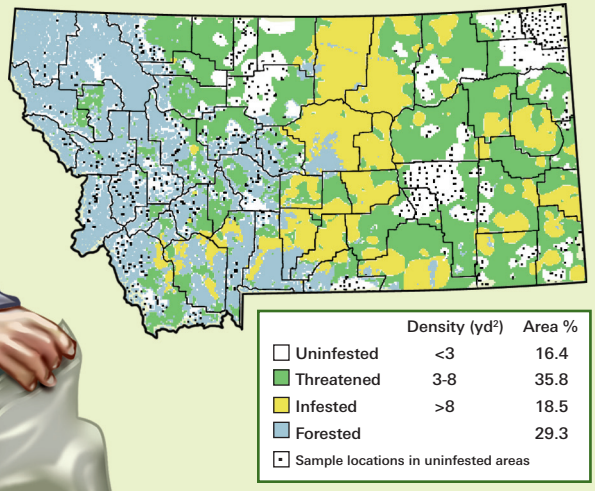


Other Careers in Human Behavior

Job Title	Description	Education Level Required	Average Salary
Actuary	Assess the risk of events occurring and help create policies that minimize risk and its financial impact on companies and clients.	Bachelor's degree	$82,800
Market and Survey Researcher	Help companies understand what types of products people want and at what price.	Bachelor's degree	$58,820
Urban Planner	Develop plans for the use of land and the growth and revitalization of urban, suburban, and rural communities.	Master's degree	$56,630
Economist	Conduct research, collect and analyze data, monitor economic trends, and develop forecasts.	Master's or Ph.D.	$77,010
Sociologist	Study society and social behavior, including how people react to the spread of technology, health epidemics, crime, and social movements.	Master's or Ph.D.	$60,290

Wildlife Biologist

Scientists working in biology-related fields use computer models to predict the spread of disease. They use models to understand how the body works at many different levels, from the way breathing is affected by pollution to the specific details of how a nerve cell sends signals to the brain. Biologists use computer models to decide what organisms to introduce and what changes to make to restore the environment to a state of ecological balance. With the help of computer models, huge amounts of data in our genes are now being analyzed to better understand genetic disorders and how to treat them.



A map showing regions that have been infested by an invasive species. Biologists will feed this data into a computer model that can help test plans for restoring balance to the environment.

Other Careers in Biology

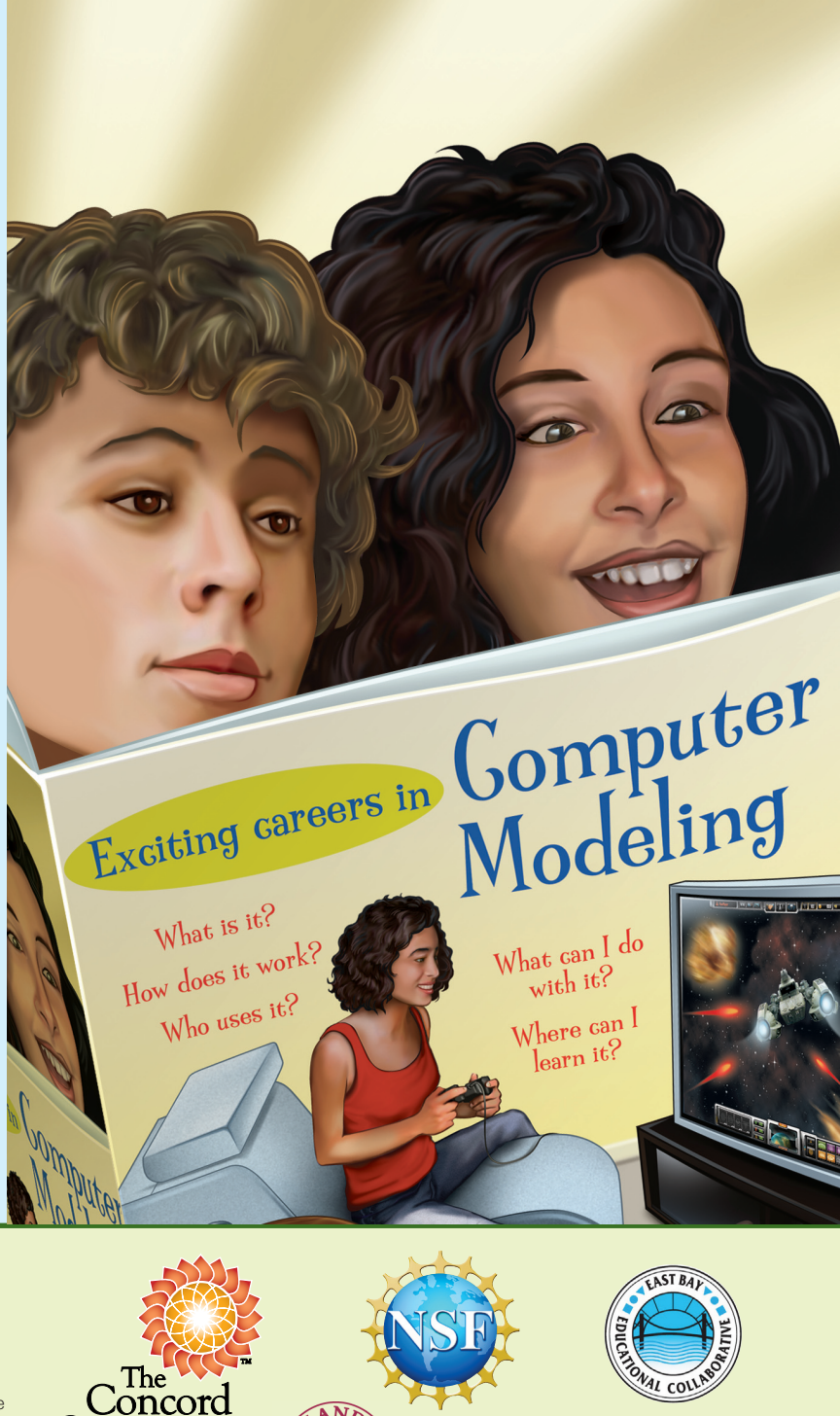
Job Title	Description	Education Level Required	Average Salary
Lab Technician	Prepare specimens, operate automated analyzers, and perform manual tests with detailed instructions.	Associate's degree	$32,840
Biomedical Engineer	Apply knowledge of engineering, biology, and biomechanical principles to the design, development, and evaluation of biological and health systems and products.	Bachelor's degree	$51,350
Epidemiologist	Investigate and describe the causes and spread of disease—such as influenza or cholera—and develop the means for prevention or control.	Master's degree	$56,670
Wildlife Biologist	Study animals and wildlife—their origin, behavior, diseases, and life processes.	Ph.D.	$53,300
Cancer Researcher	Conduct biomedical research to develop new preventive measures, drugs, and treatment procedures.	Ph.D.	$61,680

ANSWERS TO QUESTION ON COVER:

How were computer models involved in making this scene possible?

1. The video game uses a computer model to guide the motion and behavior of objects on the screen.
2. The electronics of the game console, the TV, and the sound system were designed using computer models.
3. The furniture was designed with computer drafting tools that allow the designer to see what an object will look like before it's produced.
4. The health effects of food additives in the soda and snack were studied using models to predict how many people might experience side effects.
5. New materials like those in the flat panel TV were designed and tested using computer models.
6. The marketing of the video game, food, and clothes was guided by computer models that helped define the advertising campaigns, the audience of potential buyers, and the potential profit for the companies.

Can you think of anything else?



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Source of inside tables: Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2008-09 Edition*. (http://www.bls.gov/oco/)

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RI ITEST

More information and interactive model-based activities for teaching science can be found at http://ri-itest.concord.org