Chemists and Materials Scientists

Summary

Chemists and materials scientists perform experiments that require creative problem solving and detailed record keeping.

Quick Facts: Chemists and Materials Scientists

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</thead>
<tbody>
<tr>
<td><strong>2012 Median Pay</strong></td>
<td>$73,060 per year</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
<td>96,200</td>
<td>6% (Slower than average)</td>
<td>5,400</td>
</tr>
<tr>
<td><strong>Pay</strong></td>
<td>$35.13 per hour</td>
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</table>

What Chemists and Materials Scientists Do

Chemists and materials scientists study substances at the atomic and molecular levels and the ways in which substances react with each other. They use their knowledge to develop new and improved products and to test the quality of manufactured goods.

Work Environment

Chemists and materials scientists work in laboratories and offices. They typically work full time and keep regular hours.

How to Become a Chemist or Materials Scientist

Chemists and materials scientists need at least a bachelor’s degree in chemistry or a related field. However, a master’s degree or Ph.D. is needed for many research jobs.

Pay

In May 2012, the median annual wage for chemists was $71,770. The median annual wage of materials scientists was $88,990 in May 2012.

Job Outlook

Employment of chemists and materials scientists is projected to grow 6 percent from 2012 to 2022, slower than the average for all occupations. Chemists and materials scientists with an advanced degree, particularly those with a Ph.D., are expected to experience better opportunities.

Similar Occupations
Compare the job duties, education, job growth, and pay of chemists and materials scientists with similar occupations.

More Information, Including Links to O*NET

Learn more about chemists and materials scientists by visiting additional resources, including O*NET, a source on key characteristics of workers and occupations.

What Chemists and Materials Scientists Do

Most chemists and materials scientists work as part of a team.

Chemists and materials scientists study substances at the atomic and molecular levels and the ways in which substances react with each other. They use their knowledge to develop new and improved products and to test the quality of manufactured goods.

Duties

Chemists and materials scientists typically do the following:

- Plan and carry out complex research projects, such as the development of new products and testing methods
- Direct technicians and other workers in testing and analyzing components and the physical properties of materials
- Instruct scientists and technicians on proper chemical processing and testing procedures, such as ingredients, mixing times, and operating temperatures
- Prepare solutions, compounds, and reagents used in laboratory procedures
- Analyze substances to determine their composition and concentration of elements
- Conduct tests on materials and other substances, to ensure that safety and quality standards are met
- Write technical reports that detail methods and findings
- Present research findings to scientists, engineers, and other colleagues

Many chemists and materials scientists work in basic and applied research. In basic research, chemists investigate the properties, composition, and structure of matter. They also experiment with combinations of elements and the ways in which they interact. In applied research, chemists investigate possible new products and ways to improve existing ones. Chemistry research has led to the discovery and development of new and improved drugs, plastics, cleaners, and thousands of other products.

Materials scientists study the structures and chemical properties of various materials, to develop new products or enhance existing ones. They determine ways to strengthen or combine materials or develop new materials for use in a variety of products. Applications of materials science include inventing or improving superconducting materials, ceramics, and metallic alloys.

Chemists and materials scientists use computers and a wide variety of sophisticated laboratory instrumentation for modeling, simulation, and experimental analysis. For example, some chemists use three-dimensional (3D) computer modeling software to study the structure and other properties of complex molecules.

Most chemists and materials scientists work as part of a team. An increasing number of scientific research projects involve multiple disciplines, and it is common for chemists and materials scientists to work on teams with other scientists, such as biologists and physicists, computer specialists, and engineers. For example, in pharmaceutical research, chemists may work with biologists to develop...
new drugs and with engineers to design ways to mass produce the new drugs. For more information, see the profiles on biochemists and biophysicists, microbiologists, zoologists and wildlife biologists, physicists and astronomers, computer and information technology occupations, and engineers.

Chemists often specialize in a particular branch of the field. The following are examples of some types of chemists:

**Analytical chemists** determine the structure, composition, and nature of substances, by examining and identifying their various elements or compounds. They also study the relationships and interactions between the parts of compounds. Some analytical chemists specialize in developing new methods of analysis and new techniques for carrying out their work. Their research has a wide range of applications, including food safety, pharmaceuticals, and pollution control.

**Inorganic chemists** study the structure, properties, and reactions of molecules that do not contain carbon, such as metals. They work to understand the behavior and the characteristics of inorganic substances. Inorganic chemists figure out how these materials can be modified, separated, or used in products, such as ceramics and superconductors.

**Medicinal chemists** research and develop chemical compounds that can be used as pharmaceutical drugs. They work on teams with other scientists and engineers to create and test new drug products. They also help develop new and improved manufacturing processes to produce new drugs on a large scale effectively.

**Organic chemists** study the structure, properties, and reactions of molecules that contain carbon. They also design and make new organic substances that have unique properties and applications. These compounds have, in turn, been used to develop many commercial products, such as pharmaceutical drugs and plastics.

**Physical chemists** study the fundamental characteristics of how matter behaves on a molecular and atomic level and how chemical reactions occur. Based on their analyses, physical chemists may develop new theories, such as how complex structures are formed. Physical chemists often work closely with materials scientists, to research and develop potential uses for new materials.

**Theoretical chemists** investigate theoretical methods that can predict the outcomes of chemical experiments. Theoretical chemistry encompasses a variety of specializations itself, though most specializations incorporate advanced computation and programming. Some examples of theoretical chemists are computational chemists, mathematical chemists, and chemical informaticians.

Materials scientists tend to specialize by the material they work with most often. A few examples of materials in which these scientists specialize are ceramics, glass, semiconductors, and composite materials.

A growing numbers of chemists work in interdisciplinary fields, such as biochemistry and geochemistry. For more information, see the profile on geoscientists.

Many people with a chemistry background become professors or teachers. For more information, see the profiles on high school teachers and postsecondary teachers.

### Work Environment

Chemists must wear protective clothing such as gloves and goggles when handling hazardous chemicals.

Chemists and material scientists held about 96,200 jobs in 2012. The industries that employed the most chemists in 2012 were as follows:

<table>
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<tr>
<th>Industry</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Research and development in the physical, engineering, and life sciences</td>
<td>20%</td>
</tr>
</tbody>
</table>

Most materials scientists work in manufacturing and scientific research and development. The industries that employed the most materials scientists in 2012 were as follows:

<table>
<thead>
<tr>
<th>Industry</th>
<th>Employment Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and development in the physical, engineering, and life sciences</td>
<td>34%</td>
</tr>
<tr>
<td>Colleges, universities, and professional schools; state, local, and private</td>
<td>11%</td>
</tr>
<tr>
<td>Pharmaceutical and medicine manufacturing</td>
<td>6%</td>
</tr>
<tr>
<td>Computer and electronic product manufacturing</td>
<td>6%</td>
</tr>
<tr>
<td>Basic chemical manufacturing</td>
<td>5%</td>
</tr>
</tbody>
</table>

Chemists and materials scientists typically work in laboratories and offices, where they conduct experiments and analyze their results. In addition to laboratories, materials scientists work with engineers and processing specialists in industrial manufacturing facilities. Some chemists also work in these facilities and usually are responsible for monitoring the environmental conditions at the plant. Chemists and materials scientists, who work for manufacturing companies, may have to travel occasionally, especially if their company has multiple facilities.

Chemists and materials scientists typically work on research teams. They need to be able to work well with others towards a common goal. Many serve in a leadership capacity and need to be able to motivate and direct other team members.

### Injuries and Illnesses

Chemists and materials scientists can be exposed to health or safety hazards when handling certain chemicals, but there is little risk if proper procedures are followed.

### Work Schedules

Chemists and materials scientists typically work full time and keep regular hours.

### How to Become a Chemist or Materials Scientist

Most chemists and materials scientists work in laboratories.

Chemists and materials scientists need at least a bachelor’s degree in chemistry or a related field. However, a master’s degree or Ph.D. is needed for many research jobs.

### Education

A bachelor's degree in chemistry or in a related field is needed for entry-level chemist jobs. Although some materials scientists hold a degree in materials science, these scientists commonly have a degree in chemistry, physics, or engineering. Many jobs require master's degrees or Ph.D.s and may also require significant levels of work experience. Chemists and materials scientists with Ph.D.s and postdoctoral experience typically lead basic and applied research teams.

Many colleges and universities offer degree programs in chemistry. There are few programs specifically in materials science, but the number of programs is gradually increasing. Some engineering schools offer degrees in the joint field of materials science and engineering.

Undergraduate chemistry majors typically are required to take courses in analytical, organic, inorganic, and physical chemistry. In addition to chemistry coursework, they also take classes in mathematics, biological sciences, and physics. Computer science courses are essential, because chemists and materials scientists need computer skills to perform modeling and simulation tasks, manage and manipulate databases, and to operate computerized laboratory equipment.

Laboratory experience, either at a college or university, or through internships, fellowships, or work-study programs in industry, is also useful.

Graduate students studying chemistry commonly specialize in a subfield, such as analytical chemistry or inorganic chemistry. For example, those interested in doing research in the pharmaceutical industry usually develop a strong background in medicinal or organic chemistry.

**Important Qualities**

*Analytical skills.* Chemists and materials scientists carry out scientific experiments and studies. They must be precise and accurate in their analyses, because errors could invalidate their research.

*Communication skills.* Chemists and materials scientists need to communicate with team members and other scientists. They must be able to read and write technical reports and give presentations.

*Critical-thinking skills.* Chemists and materials scientists carefully evaluate their own work and the work of others. They must determine if results and conclusions are based on sound science.

*Mathematical skills.* Chemists and materials scientists regularly use complex mathematical equations and formulas, and they need a broad understanding of mathematics, including calculus, algebra, and statistics.

*Organizational skills.* Chemists and materials scientists need to carefully document processes to conform to regulations and industry procedures. Disorganization in the workplace can lead to legal problems, damage to equipment, and chemical spills.

*Problem-solving skills.* Chemists and materials scientists research and develop new and improved chemical products, processes, and materials. This work requires a great deal of trial and error on the part of chemists and materials scientists before a unique solution is found.

**Advancement**

Chemists typically receive greater responsibility and independence in their work as they gain experience. Greater responsibility also is gained through further education. Ph.D. chemists usually lead research teams and have control over the direction and content of projects, but even Ph.D. holders have room to advance as they gain experience. They may take on larger, more complicated, and more expensive projects as they become more proficient in managing research projects.


**Pay**

<table>
<thead>
<tr>
<th>Chemists and Materials Scientists</th>
<th>Median annual wages, May 2012</th>
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<tbody>
<tr>
<td>Materials scientists</td>
<td>$88,990</td>
</tr>
<tr>
<td>Chemists and materials scientists</td>
<td>$73,060</td>
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</tbody>
</table>


The median annual wage for chemists was $71,770 in May 2012. The median wage is the wage at which half the workers in an occupation earned more than that amount and half earned less. The lowest 10 percent earned less than $41,080, and the top 10 percent earned more than $120,600.

In May 2012, the median annual wages for chemists in the top five industries employing these scientists were as follows:

- Federal government, excluding postal service: $100,920
- Research and development in the physical, engineering, and life sciences: $79,140
- Pharmaceutical and medicine manufacturing: $70,480
- State and local government, excluding education and hospitals: $57,190
- Testing laboratories: $55,060

The median annual wage for materials scientists was $88,990 in May 2012. The lowest 10 percent earned less than $46,960, and the top 10 percent earned more than $134,130.

In May 2012, the median annual wages for materials scientists in the top five industries employing these scientists were as follows:

- Basic chemical manufacturing: $106,770
- Research and development in the physical, engineering, and life sciences: $96,630
- Computer and electronic product manufacturing: $96,620
- Colleges, universities, and professional schools; state, local, and private: $66,720
- Pharmaceutical and medicine manufacturing: $66,230

Chemists and materials scientists typically work full time and keep regular hours.

**Job Outlook**

<table>
<thead>
<tr>
<th>Chemists and Materials Scientists</th>
<th>Percent change in employment, projected 2012-22</th>
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<tbody>
<tr>
<td>Total, all occupations</td>
<td>11%</td>
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<tr>
<td>Chemists</td>
<td>6%</td>
</tr>
<tr>
<td>Chemists and materials scientists</td>
<td>6%</td>
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Note: All Occupations includes all occupations in the U.S. Economy. 
Employment of chemists and materials scientists is projected to grow 6 percent from 2012 to 2022, slower than the average for all occupations.

Employment of chemists is projected to grow 6 percent, as they will continue to be needed in scientific research and development and to monitor the quality of products and processes.

Employment of materials scientists is projected to grow 5 percent, owing to demand for cheaper, safer, and better quality materials for a variety of purposes, such as electronics, energy, and transportation.

Chemists research and solve a wide range of problems and are employed in a similarly wide range of industries. About a quarter of all chemists are employed in chemical manufacturing industries; but the remainder work at colleges and universities, in government, and for independent testing and research laboratories. Some chemical manufacturing industries, such as pharmaceutical manufacturing, increasingly may be outsourcing their research and development activities, rather than doing the research in-house. This is likely to cause faster growth in the employment of chemists in small, independent research and development firms than in the more traditional large manufacturers. However, as the economy improves and the expansion in domestic natural gas production lowers the cost of energy and raw inputs, manufacturers may have less of an incentive than they have in the past to outsource their research and development (R&D) activities.

Environmental research will offer many new opportunities for chemists and materials scientists. For example, chemical manufacturing industries will continue to develop technologies and processes that reduce pollution and improve energy efficiency at manufacturing facilities. Chemists also will continue to be needed to monitor pollution levels at manufacturing facilities and to ensure compliance with local, state, and federal environmental regulations.

Job Prospects

In addition to job openings resulting from employment growth, some job openings will result from the need to replace chemists and materials scientists who retire or otherwise leave the occupations.

Chemists and materials scientists with advanced degrees, particularly those with a Ph.D. and work experience, are expected to experience better opportunities. Large pharmaceutical and biotechnology firms provide openings for these workers at research laboratories, and many others work in colleges and universities. Furthermore, chemists with advanced degrees will continue to fill most senior research and upper-management positions.

Employment projections data for Chemists and Materials Scientists, 2012-22

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</thead>
<tbody>
<tr>
<td>Chemists and materials scientists</td>
<td>—</td>
<td>96,200</td>
<td>101,600</td>
<td>6</td>
<td>5,400</td>
</tr>
<tr>
<td>Chemists</td>
<td>19-2031</td>
<td>87,900</td>
<td>92,900</td>
<td>6</td>
<td>5,000</td>
</tr>
<tr>
<td>Materials scientists</td>
<td>19-2032</td>
<td>8,300</td>
<td>8,800</td>
<td>5</td>
<td>400</td>
</tr>
</tbody>
</table>


Similar Occupations

This table shows a list of occupations with job duties that are similar to those of chemists and materials scientists.
<table>
<thead>
<tr>
<th>Occupation</th>
<th>Job Description</th>
<th>Education Required</th>
<th>Average Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>and Food Scientists</td>
<td>Ensure that agricultural establishments are productive and food is safe.</td>
<td></td>
<td>$58,610</td>
</tr>
<tr>
<td>Biochemists and Biophysicists</td>
<td>Biochemists and biophysicists study the chemical and physical principles of living things and of biological processes, such as cell development, growth, and heredity.</td>
<td>Doctoral or professional degree</td>
<td>$81,480</td>
</tr>
<tr>
<td>Chemical Engineers</td>
<td>Chemical engineers apply the principles of chemistry, biology, physics, and math to solve problems that involve the production or use of chemicals, fuel, drugs, food, and many other products. They design processes and equipment for large-scale safe and sustainable manufacturing, plan and test methods of manufacturing products and treating byproducts, and supervise production.</td>
<td>Bachelor’s degree</td>
<td>$94,350</td>
</tr>
<tr>
<td>Environmental Scientists and Specialists</td>
<td>Environmental scientists and specialists use their knowledge of the natural sciences to protect the environment and human health. They may clean up polluted areas, advise policy makers, or work with industry to reduce waste.</td>
<td>Bachelor's degree</td>
<td>$63,570</td>
</tr>
<tr>
<td>Geoscientists</td>
<td>Geoscientists study the physical aspects of the Earth, such as its composition, structure, and processes, to learn about its past, present, and future.</td>
<td>Bachelor's degree</td>
<td>$90,890</td>
</tr>
<tr>
<td>High School Teachers</td>
<td>High school teachers help prepare students for life after graduation. They teach academic lessons and various skills that students will need to attend college and to enter the job market.</td>
<td>Bachelor’s degree</td>
<td>$55,050</td>
</tr>
<tr>
<td>Materials Engineers</td>
<td>Materials engineers develop, process, and test materials used to create a range of products, from computer chips and aircraft wings to golf clubs and snow skis. They work with metals, ceramics, plastics, composites, and other substances to create new materials that meet certain mechanical, electrical, and chemical requirements.</td>
<td>Bachelor’s degree</td>
<td>$85,150</td>
</tr>
<tr>
<td>Natural Sciences Managers</td>
<td>Natural sciences managers supervise the work of scientists, including chemists, physicists, and biologists. They direct activities related to research and development, and coordinate activities such as testing, quality control, and production.</td>
<td>Bachelor’s degree</td>
<td>$115,730</td>
</tr>
<tr>
<td>Physicists and Astronomers</td>
<td>Physicists and astronomers study the ways in which various forms of matter and energy interact. Theoretical physicists and astronomers may study the nature of time or the origin of the universe. Physicists and astronomers in applied fields may develop new military technologies or new sources of energy, or monitor space debris that could endanger satellites.</td>
<td>Doctoral or professional degree</td>
<td>$106,360</td>
</tr>
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</table>
Contacts for More Information

For information on career opportunities, earnings, and education for chemists and materials scientists, visit

- American Chemical Society
- American Chemistry Council
- ASM International
- Materials Research Society

To find job openings for chemists in the federal government, visit

- USAJOBS

O*NET

- Materials Scientists
- Chemists

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