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Chemistry in the Arts

Opportunities

- Conservation and Authentication
- Materials Chemistry
- Health and Safety

Education

- A career in art conservation requires a master's degree in conservation or a closely related field and substantial work experience.
- Materials chemists require a bachelor's degree in chemistry or a related field.
- Occupational health and safety specialists require a bachelor's degree at the entry level.

Salaries

- Museum technicians and conservators \$37,310 (2010)
- Federa - Museum technicians and conservators: \$38,790 (2010)
- Chemists: \$68,320 (2010)
- Materials scientists: 84,720 (2010)
- Occupational health and safety specialists: \$64,660 (2010)
- Occupational health and safety technicians: \$45,300 (2010)



Overview

Art and chemistry have been linked since the day the first cave dweller smeared mineral pigments on a rock wall. Today's chemists formulate pigments and dyes to precise specifications and ensure that they maintain their colors for decades. They develop polymers suitable for use in 3D printers. And they authenticate, preserve, and restore artifacts, from 1950s kitsch to 10,000-year-old cave paintings. Because many art supplies are made from toxic or hazardous materials, occupational health and safety is another career area for chemists.

Chemists may also develop makeup and special effects for theater and movie productions. Chemists and materials scientists work in the music industry as well, developing synthetic materials for manufacturing, maintaining, repairing, and restoring musical instruments and for use in electronic components, speakers, and amplifiers.

Typical Work Duties

- Document, clean, preserve, and repair works of art. Often, an analysis of the materials used in the artwork and in previous restoration efforts is necessary in order to select or custom-design a restoration method.
- Authenticate works of art and other artifacts using laboratory analysis and a knowledge of the materials and methods in use during the relevant period in history.
- Develop pigments, dyes, paints, and coatings in new colors or to match precise color specifications. Develop polymers, resins, alloys, and composites for sculptures and jewelry-making. Develop new materials for stereolithography (3D printing). Improve material properties so that they stand up over time or reduce harm to the environment.
- Develop makeup and special effects for theatrical and movie productions. Materials must produce the desired effect and meet safety and toxicity specifications for the actors, crew, and audience.
- Design and develop new materials for musical instruments (guitar bodies, drum heads) and sound equipment (amplifiers and speakers).
- Develop safety procedures and equipment for use in art studios and the use of art supplies. Develop and enforce regulatory and industry standards for production, labeling, safe use, and disposal of art materials.
- Inform and educate end users about the safe use and disposal of art supplies using printed and online guides and educational workshops and programs.



Education

A career in art conservation requires a master's degree in conservation or a closely related field and

substantial work experience. Entry to the limited number of graduate programs in the U.S. is very competitive, and requires prior work experience (or an internship or apprenticeship) and an academic background in chemistry, archaeology, studio art, art history, and possibly one or more foreign languages. Graduate programs last 2 to 4 years, which includes internship training.

Materials chemists require a bachelor's degree in chemistry or a related field. For many research positions, a master's or doctoral degree is required. Cross-training in physics or engineering and specialization in materials used in the arts is beneficial. Materials chemists without graduate degrees may work with art materials as a sideline or avocation, or they may hold technician positions with a manufacturing operation.

Occupational health and safety specialists require a bachelor's degree at the entry level. They receive training in specific laws, regulations, and inspection procedures in the classroom and on the job. Occupational health and safety technicians require a minimum of a high school diploma, with additional on-the-job training. They may also enter the field with an associate's degree or a certificate.



Licenses

Licensing or certification may be required for some jobs in [occupational health and safety](#).



Workspace

Art conservators may work for museums, historical sites, or universities. Many of the large museums have extensive laboratory and art restoration/authentication facilities (for example, the Smithsonian Museum Conservation Institute in Suitland, Maryland www.si.edu/MCI).

Chemists and materials scientists often work in laboratories and offices. They may, however, spend part of their time in manufacturing plants, engineering testing facilities, or working with artists and other end users of their products.

Color chemists work in laboratories and manufacturing plants. Because they risk exposure to some hazardous chemicals, and they often wear protective clothing on the job. Many of the job opportunities are in cities where large manufacturing operations are located, including locations overseas. (This is especially true in the textile industry.)

Materials chemists working on music-related projects may work for universities, musical instrument manufacturers, and manufacturers of electronic audio equipment. Some chemists do musical instrument development work as a sideline or an avocation.

Occupational health and safety specialists and technicians may be required to travel or do field work, inspecting the conditions in university art studios or chemical manufacturing plants. Other such specialists may work in an office environment as regulatory standards developers or writing and producing guides and documentation. Some health and safety specialists may work as educators, teaching formal classes and workshops, or offering informal training at work sites or in schools.



Is This Career a Good Fit for You?

Conservators

Conservators must work with irreplaceable objects, many of them very old and fragile. They are often asked to strike a balance between restoring or repairing an object and leaving it "as is" to convey a sense of authenticity and antiquity. Laboratory test samples are often very small, to avoid excessive damage to the object, and nondestructive testing is preferred. Laboratory instruments are sometimes adapted to accommodate very large works of art to avoid having to extract samples.

Art authenticators and conservators must have good analytical and critical thinking skills, as the objects they deal with present a wide variety of unconventional challenges. They must be meticulous because of the rarity and great value of the objects they deal with. They must have an avid interest in the materials and techniques typical of various periods in history, and they must keep current on advances in technology and methods.

Materials Chemists

Materials chemists working with art-related products are applications-oriented. They solve structural, optical, acoustic, or aesthetic problems and develop materials with novel properties. They may also find unusual or creative uses for existing materials. They must use considerable creativity and be willing to experiment to produce special effects.

Materials chemists may also work as technicians, which requires them to ensure that products meet a set of specifications. For example, they may ensure that a batch of dye reflects light in a specific range of wavelengths when it is applied to a specific type of fabric. This type of work requires attention to detail, routine testing, and strict adherence to standards.

New materials for the visual arts include more advanced or environmentally benign coatings, solvents, and adhesives. New polymer resins can be used to dramatic effect in works of sculpture or jewelry. Materials chemists may use computer modeling to help them develop materials with novel coloring, weathering, or molding properties.

Chemists who specialize in polymers and other natural and synthetic materials may find a place in the music industry, developing materials for guitar bodies, wind instruments, drum heads, stereo and stereo speakers. They may develop new lacquers and varnishes, more durable adhesives, better strings and reeds, tuning pegs, sounding boards, or anything else that goes into the making of music.

Potential employers include universities, musical instrument manufacturers, and manufacturers of speakers and amplifiers. A strong engineering or physics background may be useful, as good acoustical and mechanical properties are key to the success of these materials. One upcoming field is the selection and development of materials for making instruments using stereolithography (3D printing).

Health and Safety

Health and safety specialists must be keenly observant while conducting inspections. They must keep current on regulatory requirements and new information on health and environmental hazards. They must be able to produce detailed and accurate documentation and reports. They must also be able to work and communicate with clients and colleagues. They must be persuasive in promoting best practices to artists and organizational leadership, overcoming resistance to change and reluctance to funding necessary repairs and improvements.

Occupational health and safety technicians collect data on the conditions of workspaces, including art studios and chemical manufacturing plants in order to minimize harm to the artists and other workers, property and equipment, the environment, and the general public.

Writers and artists produce educational guides on the safe use of arts and crafts materials for museum and university health and safety programs, the Consumer Product Safety Commission, and various government agencies. Producing these guides requires taking complex technical and regulatory information and translating it into practical terms for artists, hobbyists, and educators. These guides must be updated periodically to keep up with developments in art materials and new regulatory policies.

Federal regulations also require materials safety data sheets (MSDS) and labeling standards, including health precautions and instructions for safe use, storage, and disposal, for art materials sold commercially. This information must be updated as new information becomes available. Standards include special provisions for materials used by children and for persons who experience prolonged exposure to specific materials (as distinct from casual hobbyists). Policy-making bodies need consultants who understand the properties and hazards of various materials in order to ensure safe usage without being overly restrictive.

ASTM International sets standards for labeling, composition, color-fastness, and other aspects of art materials, and these must be updated periodically. Volunteers from chemical manufacturing companies, government agencies, universities, and consumers of art materials sit on committees that keep these standards up to date.



Technical Skills

- Laboratory analysis methods and instrumentation (sometimes customization)
- Computer imaging skills
- Documentation and databases
- Knowledge of historical materials, the time periods during which they were typically used, and

- their compatibility with contemporary materials
 - Mastery of fabrication and conservation techniques
 - Materials testing methods
 - Knowledge of materials aging, corrosion, weathering, and microbial degradation processes
 - Knowledge of health and safety factors and government regulations
 - Writing and other communications skills
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Career Path

Conservators

In the past, conservators entered their field through a series of apprenticeships. Today, however, it is more common to obtain an academic degree, often at the graduate level. Internships and apprenticeships remain an important part of this education, however. Post-graduate fellowships are also valued for professional development and broadening the conservator's base of knowledge.

Practicing conservators attend workshops, courses, and professional meetings, and they read professional publications to keep current with changes in technology and methodology. Conservators may start their careers at smaller local and regional establishments, and then move to larger facilities as they gain experience and build their reputations. Competition is intense for the top museum positions. Individual research and publications are important for advancement in larger institutions.

Materials Chemists

Materials chemists at the technical level typically start their careers working in a manufacturing plant or a lab. They ensure that textiles, paints and coatings, or other products have the correct properties by monitoring machinery, checking the formulation and purity of the coloring components, and troubleshooting problems. They may be promoted to management positions, where they oversee operations, work with customer orders, match colors, record recipe changes, and make production notes.

Materials researchers may work for corporate R&D labs, universities, or government agencies. They develop polymers and electronic components for audio and video devices and musical instruments, update dye and pigment manufacturing processes to reduce the risks to human health and the environment, or develop materials with novel properties to produce special effects. They may start at a technical level and move into research (employers will sometimes help to finance their graduate studies while they are still working full-time or part-time), or they may enter the field after obtaining their graduate degree.

Occupational Health and Safety

Some occupational health and safety workers enter the field from other career areas, through assignments to committees, as collateral duties, or as informal departmental safety monitors. They may pick up additional education and training as their interest in this field increases or as they take on more

advanced responsibilities. Others train specifically for work in health and safety, through academic programs, technical colleges, or certificate programs.

Chemical health and safety specialists may oversee manufacturing processes for materials used in the arts, or they may play a role in designing new processes or systems. They may assess the potential for risk or environmental and health effects of specific materials. Those with significant levels of experience may move into training and management positions.

Most occupational health and safety jobs are full-time, although some part-time work is available. Specialists with a great deal of experience may also find work as independent consultants and educators.



Future Employment Trends

Conservators

Public interest in science, art, history, and technology will continue to spur demand for curators, museum technicians, and conservators. Because museum attendance is expected to rise over the coming decade, many museums should remain financially healthy and are expected to schedule additional building and renovation projects.

However, competition is intense for the limited number of openings in conservation graduate programs. Conservators should be willing to relocate to fill available openings. The number of museum curators who move to other occupations is relatively low, and they tend to work beyond the typical retirement age of workers in other occupations.

During recessions, museums may experience government funding cuts that limit opportunities. Demand from the private sector may offset some of these cutbacks.

U.S. employment for museum technicians and conservators is expected to rise from 11,900 to 12,700 between 2010 and 2020, an increase of 7%, about half the predicted growth of 14% for all occupations, but more than the 4% predicted for chemists in general (from 82,200 to 85,400).

Materials Chemists

Some materials chemistry careers are in decline. Film photography, with its associated processing chemicals, has been largely replaced by digital photography. Computer graphics are replacing painting and sketching in many cases. On the other hand, advances in technology are opening up new applications for advanced colorants, structural materials, and 3D printing materials.

Computer-generated special effects are being used increasingly for such things as fire, explosions, and special-effects makeup in the movie industry, although physical effects are still necessary for live theater productions. Knowledge of materials properties is essential to creating realistic computer-generated special effects.

Demand for materials scientists in general (not specifically in the arts) is expected to grow slightly faster than the overall average between 2010 and 2020. Opportunities may be more plentiful for those with advanced degrees, especially Ph.D. degrees, but the absolute numbers remain comparatively small. U.S. job growth for materials scientists in general is projected at 10%, from 8700 to 9500, between 2010 and 2020.

Health and Safety

The demand for occupational health and safety specialists in general (not specifically in the arts) is expected to rise 9% between 2010 and 2020, from 58,700 to 63,700. For technicians (again, not specifically in the arts), the overall demand is expected to be 13%, an increase from 10,600 technicians to 12,000. Advances in technology, regulatory standards, and public expectations of safety and environmental protection drives demand for this career area.

Related Resources

Professional Organizations and Institutions

- [Chemists and Materials Scientists](#)
- [Occupational Health and Safety Specialists](#)
- [Smithsonian Museum Conservation Institute, Museum Support Center](#)
- [Yale University Library, Technical Art History and Conservation Research](#)

Articles and Books

- [The Ladder of Success: Board of Certified Safety Professionals](#)
- [Art in Chemistry; Chemistry in Art](#)
- [Conservation Science Research: Activities, Needs, and Funding Opportunities](#)
- [Special Effects Chemistry](#)

Resources

- [Become a Conservator: A Guide to Conservation Education and Training](#)
- [Health and Safety Resources for Arts and Crafts Materials](#)
- [Career Guide to the Safety Profession](#)