



# Chemistry

## Merit Badge Workbook

This workbook can help you but you still need to read the merit badge pamphlet.

The work space provided for each requirement should be used by the Scout to make notes for discussing the item with his counselor, not for providing the full and complete answers. Each Scout must do each requirement.

No one may add or subtract from the official requirements found in **Boy Scout Requirements** (Pub. 33216 – SKU 34765).

The requirements were last issued or revised in 2006 • This workbook was updated in April 2012.

Scout's Name: \_\_\_\_\_ Unit: \_\_\_\_\_

Counselor's Name: \_\_\_\_\_ Counselor's Phone No.: \_\_\_\_\_

<http://www.USScouts.Org> • <http://www.MeritBadge.Org>

Please submit errors, omissions, comments or suggestions about improving this workbook to: [Workbooks@USScouts.org](mailto:Workbooks@USScouts.org)

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1. Do EACH of the following activities:

a. Describe three examples of safety equipment used in a chemistry laboratory and the reason each one is used.

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b. Describe what a material safety data sheet (MSDS) is and tell why it is used. \_\_\_\_\_

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c. Obtain an MSDS for both a paint and an insecticide. Compare and discuss the toxicity, disposal, and safe-handling sections for these two common household products.

Toxicity: \_\_\_\_\_

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Disposal: \_\_\_\_\_

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Safe handling: \_\_\_\_\_

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d. Discuss the safe storage of chemicals. \_\_\_\_\_

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How does the safe storage of chemicals apply to your home, your school, your community, and the environment?

Home: \_\_\_\_\_

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\_\_\_\_\_

School: \_\_\_\_\_

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\_\_\_\_\_

Community: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Environment: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. Do EACH of the following activities:

- a. Predict what would happen if you placed an iron nail in a copper sulfate solution. \_\_\_\_\_

\_\_\_\_\_

Then, put an iron nail in a copper sulfate solution. Describe your observations and make a conclusion based on your observations.

Observations: \_\_\_\_\_

\_\_\_\_\_

Conclusion: \_\_\_\_\_

\_\_\_\_\_

Compare your prediction and original conclusion with what actually happened. \_\_\_\_\_

\_\_\_\_\_

Write the formula for the reaction that you described.

\_\_\_\_\_

- b. Describe how you would separate sand from water, table salt from water, oil from water, and gasoline from motor oil.

Sand from water: \_\_\_\_\_

\_\_\_\_\_

Table salt from water: \_\_\_\_\_

\_\_\_\_\_

Oil from water: \_\_\_\_\_

\_\_\_\_\_

Gasoline from motor oil: \_\_\_\_\_

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Name the practical processes that require these kinds of separations. \_\_\_\_\_

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c. Describe the difference between a chemical reaction and a physical change. \_\_\_\_\_

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3. Construct a Cartesian diver. Describe its function in terms of how gases in general behave under different pressures and different temperatures. \_\_\_\_\_

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Describe how the behavior of gases affects a backpacker at high altitudes and a scuba diver underwater. \_\_\_\_\_

Backpacker: \_\_\_\_\_

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Scuba diver: \_\_\_\_\_

4. Do EACH of the following activities:

- a. Cut a round onion into small chunks. Separate the onion chunks into three equal portions. Leave the first portion raw. Cook the second portion of onion chunks until the pieces are translucent. Cook the third portion until the onions are caramelized, or brown in color. Taste each type of onion. Describe the taste of raw onion versus partially cooked onion versus caramelized onion.

Raw onion: \_\_\_\_\_

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Partially cooked onion: \_\_\_\_\_

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Caramelized onion: \_\_\_\_\_

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Explain what happens to molecules in the onion during the cooking process. \_\_\_\_\_

- b. Describe the chemical similarities and differences between toothpaste and an abrasive household cleanser. \_\_\_\_\_

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Explain how the end use or purpose of a product affects its chemical formulation. \_\_\_\_\_

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c. In a clear container, mix a half-cup of water with a tablespoon of oil. Explain why the oil and water do not mix. \_\_\_\_\_

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Find a substance that will help the two combine, and add it to the mixture.

Describe what happened, and explain how that substance worked to combine the oil and water. \_\_\_\_\_

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\_\_\_\_\_

5. List the four classical divisions of chemistry. Briefly describe each one, and tell how it applies to your everyday life.

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6. Do EACH of the following activities:

a. Name two government agencies that are responsible for tracking the use of chemicals for commercial or industrial use. \_\_\_\_\_

1. \_\_\_\_\_

2. \_\_\_\_\_

Pick one agency and briefly describe its responsibilities to the public and the environment. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

b. Define pollution. \_\_\_\_\_

\_\_\_\_\_

Explain the chemical effects of ozone, global warming, and acid rain.

Ozone: \_\_\_\_\_

\_\_\_\_\_

Global warming: \_\_\_\_\_

\_\_\_\_\_

Acid rain: \_\_\_\_\_

\_\_\_\_\_

Pick a current environmental problem as an example. \_\_\_\_\_

Briefly describe what people are doing to resolve this hazard and to increase understanding of the problem. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

c. Using reasons from chemistry, describe the effect on the environment of ONE of the following:

- 1. The production of aluminum cans or plastic milk cartons
- 2. Sulfur from burning coal
- 3. Used motor oil
- 4. Newspaper

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d. Briefly describe the purpose of phosphates in fertilizer and in laundry detergent. \_\_\_\_\_

Fertilizer \_\_\_\_\_

Laundry detergent \_\_\_\_\_

Explain how the use of phosphates in fertilizers affects the environment. \_\_\_\_\_

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Also, explain why phosphates have been removed from laundry detergents. \_\_\_\_\_

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7. Do ONE of the following activities:

- a. Visit a laboratory and talk to a practicing chemist. Ask what the chemist does and what training and education are needed to work as a chemist. \_\_\_\_\_

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- b. Using resources found at the library and in periodicals, books, and the Internet (with your parent's permission), learn about two different kinds of work done by chemists, chemical engineers, chemical technicians, or industrial chemists. For each of the jobs, find out the education and training requirements.

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- c. Visit an industrial plant that makes chemical products or uses chemical processes and describe the processes used. What, if any, pollutants are produced and how they are handled. \_\_\_\_\_

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- d. Visit a county farm agency or similar governmental agency and learn how chemistry is used to meet the needs of agriculture in your county. \_\_\_\_\_

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**Requirement resources can be found here:**  
[http://www.meritbadge.org/wiki/index.php/Chemistry#Requirement\\_resources](http://www.meritbadge.org/wiki/index.php/Chemistry#Requirement_resources)

## Important excerpts from the [‘Guide To Advancement’](#), No. 33088:

Effective January 1, 2012, the ‘Guide to Advancement’ (which replaced the publication ‘Advancement Committee Policies and Procedures’) is now the *official* Boy Scouts of America source on advancement policies and procedures.

- **[ Inside front cover, and 5.0.1.4 ] — Unauthorized Changes to Advancement Program**  
**No council, committee, district, unit, or individual has the authority to add to, or subtract from, advancement requirements.**  
(There are limited exceptions relating only to youth members with disabilities. For details see section 10, “Advancement for Members With Special Needs”.)
- **[ Inside front cover, and 7.0.1.1 ] — The [‘Guide to Safe Scouting’](#) Applies**  
Policies and procedures outlined in the ‘Guide to Safe Scouting’, No. 34416, apply to all BSA activities, including those related to advancement and Eagle Scout service projects. [Note: Always reference the online version, which is updated quarterly.]
- **[ 7.0.3.1 ] — The Buddy System and Certifying Completion**  
Youth members must not meet one-on-one with adults. Sessions with counselors must take place where others can view the interaction, or the Scout must have a buddy: a friend, parent, guardian, brother, sister, or other relative —or better yet, another Scout working on the same badge— along with him attending the session. When the Scout meets with the counselor, he should bring any required projects. If these cannot be transported, he should present evidence, such as photographs or adult certification. His unit leader, for example, might state that a satisfactory bridge or tower has been built for the Pioneering merit badge, or that meals were prepared for Cooking. If there are questions that requirements were met, a counselor may confirm with adults involved. Once satisfied, the counselor signs the blue card using the date upon which the Scout completed the requirements, or in the case of partials, initials the individual requirements passed.
- **[ 7.0.3.2 ] — Group Instruction**  
It is acceptable—and sometimes desirable—for merit badges to be taught in group settings. This often occurs at camp and merit badge midways or similar events. Interactive group discussions can support learning. The method can also be attractive to “guest experts” assisting registered and approved counselors. Slide shows, skits, demonstrations, panels, and various other techniques can also be employed, but as any teacher can attest, not everyone will learn all the material.

There must be attention to each individual’s projects and his fulfillment of *all* requirements. We must know that every Scout — actually and *personally*— completed them. If, for example, a requirement uses words like “show,” “demonstrate,” or “discuss,” then every Scout must do that. It is unacceptable to award badges on the basis of sitting in classrooms *watching* demonstrations, or remaining silent during discussions. Because of the importance of individual attention in the merit badge plan, group instruction should be limited to those scenarios where the benefits are compelling.

- **[ 7.0.3.3 ] — Partial Completions**  
Scouts need not pass all requirements with one counselor. The Application for Merit Badge has a place to record what has been finished — a “partial.” In the center section on the reverse of the blue card, the counselor initials for each requirement passed. In the case of a partial completion, he or she does not retain the counselor’s portion of the card. A subsequent counselor may choose not to accept partial work, but this should be rare. A Scout, if he believes he is being treated unfairly, may work with his Scoutmaster to find another counselor. An example for the use of a signed partial would be to take it to camp as proof of prerequisites. Partials have no expiration except the 18th birthday.