

Chemistry

Merit Badge Workbook



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

This Workbook can help you organize your thoughts as you prepare to meet with your merit badge counselor.
You still must satisfy your counselor that you can demonstrate each skill and have learned the information.
You should use the work space provided for each requirement to keep track of which requirements have been completed,
and to make notes for discussing the item with your counselor, not for providing full and complete answers.
If a requirement says that you must take an action using words such as "discuss", "show",
"tell", "explain", "demonstrate", "identify", etc, that is what you must do.

Merit Badge Counselors may not require the use of this or any similar workbooks.

No one may add or subtract from the official requirements found in Boy Scout Requirements (Pub. 33216 – SKU 621535).
The requirements were last issued or revised in 2016 • This workbook was updated in January 2016.

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 this **workbook** to: Workbooks@USScouts.Org
Comments or suggestions for changes to the **requirements** for the **merit badge** should be sent to: Merit.Badge@Scouting.Org

---

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.

   b. Describe what a safety data sheet (SDS) is and tell why it is used.

Workbook © Copyright 2016 - U.S. Scouting Service Project, Inc. - All Rights Reserved
Requirements © Copyright, Boy Scouts of America (Used with permission.)

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

Toxicity:	
Disposal:	
Safe handling:	

d. Discuss the safe storage of chemicals.

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

Home:	
School:	
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:	

Name the practical processes that require these kinds of separations.

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

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

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

Backpacker:

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:

Partially cooked onion:

Caramelized onion:

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.

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

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.

☐ 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.

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

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

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.

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

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.

☐ 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 positions, find out the education and training requirements.

☐ 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.

☐ 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.

Requirement resources can be found here:
http://www.meritbadge.org/wiki/index.php/Chemistry#Requirement resources

Important excerpts from the Guide To Advancement - 2015, No. 33088 (SKU-620573)

[1.0.0.0] — Introduction
The current edition of the *Guide to Advancement* is the official source for administering advancement in all Boy Scouts of America programs: Cub Scouting, Boy Scouting, Varsity Scouting, Venturing, and Sea Scouts. It replaces any previous BSA advancement manuals and previous editions of the *Guide to Advancement*.

[Page 2, and 5.0.1.4] — Policy on 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 special needs. For details see section 10, "Advancement for Members With Special Needs".

[Page 2] — 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.

[7.0.3.1] — The Buddy System and Certifying Completion
A youth member must not meet one-on-one with an adult. 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. If merit badge counseling or instruction includes any Web-based interaction, it must be conducted in accordance with the BSA Social Media Guidelines (http://www.scouting.org/Marketing/Resources/SocialMedia). For example, always copy one or more authorized adults on email messages between counselors and Scouts.
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 verification. 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.
Note that from time to time, it may be appropriate for a requirement that has been met for one badge to also count for another. See "Fulfilling More Than One Requirement With a Single Activity," 4.2.3.6.

[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, fairs, clinics, 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.
It is sometimes reported that Scouts who have received merit badges through group instructional settings have not fulfilled all the requirements. To offer a quality merit badge program, council and district advancement committees should ensure the following are in place for all group instructional events.

- A culture is established for merit badge group instructional events that partial completions are acceptable expected results.
- A guide or information sheet is distributed in advance of events that promotes the acceptability of partials, explains how merit badges can be finished after events, lists merit badge prerequisites, and provides other helpful information that will establish realistic expectations for the number of merit badges that can be earned at an event.
- Merit badge counselors are known to be registered and approved.
- Any guest experts or guest speakers, or others assisting who are not registered and approved as merit badge counselors, do not accept the responsibilities of, or behave as, merit badge counselors, either at a group instructional event or at any other time. Their service is temporary, not ongoing.
- Counselors agree to sign off only requirements that Scouts have actually and personally completed.
- Counselors agree not to assume prerequisites have been completed without some level of evidence that the work has been done. Pictures and letters from other merit badge counselors or unit leaders are the best form of prerequisite documentation when the actual work done cannot be brought to the camp or site of the merit badge event.
- There is a mechanism for unit leaders or others to report concerns to a council advancement committee on summer camp merit badge programs, group instructional events, and any other merit badge counseling issues—especially in instances where it is believed BSA procedures are not followed. See "Reporting Merit Badge Counseling Concerns," 11.1.0.0.
- 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.

It is permissible for guest speakers, guest experts, or others who are not merit badge counselors to assist in the counseling process. Those providing such assistance must be under the direction of a registered and approved counselor who is readily available onsite, and provides personal supervision to assure all applicable BSA policies and procedures—including those related to BSA Youth Protection—are in place and followed.

[7.0.3.3] — Partial Completions
A Scout need not pass all the requirements of one merit badge with the same counselor. It may be that due to timing or location issues, etc., he must meet with a different counselor to finish the badge. 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, the counselor does not retain his or her 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 unit leader 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 Scout's 18th birthday. Units, districts, or councils shall not establish other expiration dates for partial merit badges.

[7.0.4.8] — Unofficial Worksheets and Learning Aids
Worksheets and other materials that may be of assistance in earning merit badges are available from a variety of places including unofficial sources on the Internet and even troop libraries. Use of these aids is permissible as long as the materials can be correlated with the current requirements that Scouts must fulfill. Completing "worksheets" may suffice where a requirement calls for something in writing, but this would not work for a requirement where the Scout must discuss, tell, show, or demonstrate, etc. Note that Scouts shall not be required to use these learning aids in order to complete a merit badge.