



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 637685).

The requirements were last issued or revised in 2016 • This workbook was updated in September 2017.

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.

Refer to OSHA Safety
Recommendations and complete before
12/9/2017

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

Refer to OSHA Safety
Recommendations and complete
before 12/9/2017
Note: MSDS = SDS

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- 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:	Find an SDS on the internet for a paint and an insecticide, print and bring both to the activity.
Safe handling:	Complete your Toxicity, Disposal and Safe handling comparisons before 12/9/2017.

- d. Discuss the safe storage of chemicals.

Refer to OSHA Chemical Storage Recommendations.
Complete discussion before 12/9/2017.

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

Home:	Complete before 12/9/2017
School:	
	Complete before 12/9/2017

Community:	Complete before 12/9/2017
Environment:	
	Complete before 12/9/2017

2. Do EACH of the following activities:

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

Complete this section prior 12/9/2017.

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

Observations:	Experiment will be done at the activity.
Conclusion:	This will be done following the experiment

Compare your prediction and original conclusion with what actually happened.

This will be done following the experiment

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:

Experiment will be done at the activity.

Table salt from water:

Experiment will be done at the activity.

Oil from water:

Experiment will be done at the activity.

Gasoline from motor oil:

This will be demonstrated at the activity.

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.

Supplies will be provided in class. This will be done in class.

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

Backpacker:	
Scuba diver:	Complete these descriptions before 12/9/2017

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:	We will do these experiments and write descriptions at the event.

Caramelized onion:

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

Read "Kitchen Science..." and write the explanation before 12/9/2017

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

Read "Cosmetic Formulation Basics-Toothpaste" and "4 Types of Abrasive Cleaners" and write a comparison prior to 12/9/2017

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

Write explanation before 12/9/2017

- 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.

We will do this experiment in class.

- 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.

Find this substance on the internet and bring a small amount to the activity. We will do an experiment with a mixing agent. Write your explanation then.

Write your description before 12/9/2017.

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

Ozone:

Global warming:

Write your descriptions before
12/9/2017.

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.

Write your description before 12/9/2017

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

Pick one of these environmental concerns
and write your description before 12/9/2017

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

Fertilizer

Write your description before 12/9/2017

Laundry detergent

Write your description before 12/9/2017.

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

Write your explanation before 12/9/2017.

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

Write your explanation before 12/9/2017.

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.

I will discuss what I did as a chemist working for NASA at Marshall Space Flight Center and my training and education.

- 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.

When working on merit badges, Scouts and Scouters should be aware of some vital information in the current edition of the *Guide to Advancement* (BSA publication 33088). Important excerpts from that publication can be downloaded from <http://usscouts.org/advance/docs/GTA-Excerpts-meritbadges.pdf>. You can download a complete copy of the *Guide to Advancement* from <http://www.scouting.org/filestore/pdf/33088.pdf>.