



**Tools and Resources**

***“Cupping: Harmless Fad or Sound Science?”***

December 2018/January 2019

<http://www.acs.org/chemmatters>

**Teacher’s Guide:**



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**Tools and Resources**

***“Cupping: Harmless Fad or Sound Science?”***

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# Connections to Chemistry Concepts

|  |  |
| --- | --- |
| **Chemistry Concept** | **Connection to Chemistry Curriculum** |
| **Gas pressure** | The article provides a good example of the effects of changing gas pressure. |
| **Charles’ law** | The preparation of the cups used in cupping therapy is a great application of Charles’ law if one considers the change in volume of the air from the cup as the heated air expands and spills out of the cup. |
| **Gay-Lussac’s (Amontons’) law** | The decrease in pressure inside a cup as the temperature of the warmed gas cools, serves as an example of the direct relationship between the temperature and pressure of a fixed volume of gas as defined by Amontons’ law also known as Gay-Lussac’s law. |
| **Vacuum/low pressure** | Cupping using a vacuum pump, rather than heat, provides an example of a low-pressure system in real life. |
| **Scientific inquiry** | The discussion about the lack of randomized control trials in studies evaluating the effectiveness of cupping can be used to support lessons about experimental design in a unit on scientific inquiry. |

# Teaching Strategies and Tools

## Standards

* Links to **Common Core Standards for Reading**:
  + **ELA-Literacy.RST.9-10.1:** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
  + **ELA-Literacy.RST.9-10.5:** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
  + **ELA-Literacy.RST.11-12.1:** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
  + **ELA-Literacy.RST.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
* Links to **Common Core Standards for Writing**:
  + **ELA-Literacy.WHST.9-10.2F:** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
  + **ELA-Literacy.WHST.11-12.1E:** Provide a concluding statement or section that follows from or supports the argument presented.

## Vocabulary

* **Vocabulary** and **concepts** that are reinforced in this issue:
  + Structural formulas
  + Crystalline structure
  + Environmental impacts of personal and societal decisions
  + Electromagnetic radiation
  + Colligative properties
  + Gas laws
* Consider asking students to read “Open for Discussion: A Slippery Slope” on page 4 to learn about concerns regarding using artificial snow prior to reading the article “What’s Artificial Snow, and How Is It Made?”
* Students from warmer climates may be unaware of the use of salt to melt ice on roadways. Ask them if they have ever traveled to cold climates and if they had trouble walking on icy sidewalks, or if they have seen this problem in movies or television. Show students the ACS Reactions video referenced on page 14 AFTER they have read the article to help them understand why salt is used to deice roads and how it works.
* Two of the articles relate to personal health (UV eye protection and cupping). Ask students how the articles might impact their decisions regarding their health and why.
* Two of the articles relate to environmental impacts of our decisions (artificial snow and salting roads). Ask students how the information from the articles might help them make decisions in the future, and factors they might consider as citizens asked to provide input on related projects.
* To help students engage with the text, ask students which article **engaged** them most and why, or what **questions** they still have about the articles, and what they would like to explore further.
* Ask students if they have questions about some of the issues discussed in the articles.

# Possible Student Misconceptions

1. **“When a burning splint or cotton ball is placed in a cupping container it uses up all the oxygen in the container creating a vacuum that draws the skin into the cupping container.”**

First of all, air contains other gases than just oxygen. Secondly, look at the equation for the combustion of alcohol—for every molecule of oxygen that is consumed two molecules of gaseous products are formed. Even though oxygen is being used in the reaction, more gas is being produced. So a vacuum is not created because of oxygen consumption.

**2 CH3OH (l) + 3 O2 (g) 🡪 2 CO2 (g) + 4 H2O (g)**

This is a good time to emphasize that it is the heat from the flame that causes the gases to expand and exit the cup before the cup is placed on the patient. After the cup is securely in place, the cup cools while the remaining gases contract creating the vacuum that causes the skin to rise into the cupping container.

1. **“When the air is heated in an open container it does not leave the container.”**

Since students cannot see air leaving an open container when it is heated, they might think that all the air being heated in the open cup stays there. Let students observe a burning candle placed in a shallow pan of water, and then cover it with a jar. They will see air bubbles coming from under the jar when the gas expands soon after the jar is put in place. This might help students visualize what is happening with the heated and cooled gases. (Letting the candle go out and watching the water level rise as the remaining gases inside the jar cool mimics the change in volume inside the cup as that air cools.)

1. **“Charles’ law was written by Jacques Charles—who else?”**

While it is true the Jacques Charles did experiments with gas relationships, some concerning the relationship between volume and temperature, he did not publish his results. Fifteen years after Charles did his experiments, Joseph Gay-Lussac performed experiments with gases and also discovered the relationship between the volume and temperature. He documented his work and published it, naming the relationship between gas volume and temperature Charles’ law in honor of Jacques Charles. (<https://www.sciencehistory.org/historical-profile/joseph-louis-gay-lussac>)

1. **“Cupping must hurt, eh?”**

Even though the bruises look like they would be painful, bruises caused by cupping are not. We are used to bruises accompanied by pain, but that is because the common bruise has been caused by blunt force trauma and it is that trauma which causes the painful muscle and tissue damage. In a *Medical News Today* article, “I Tried Cupping and This is How it Felt,” author Tim Newman describes his experience. There were moments during the experience that he said were a little painful. He also said that the bruises he acquired from the experience were not painful even the next day. Overall, he felt it was relaxing and seemed to make his back and neck feel better. (<https://www.medicalnewstoday.com/articles/320707.php>)

# Anticipating Student Questions

1. **“What conditions has cupping therapy been used to treat?”**

Cupping has been used to treat multiple ailments over the years. Athletes prone to sports injuries often use cupping to treat pain, ease scar tissue deep within muscles and connective tissues, and reduce swelling and muscle knots. Cupping is claimed to promote increased circulation so that circulating toxins can be drawn into the skin where they are more easily removed and the immune system is stimulated. As a consequence, cupping is used to treat colds, chest congestion, eczema, acne, viruses like herpes zoster in shingle attacks, fibromyalgia, diabetes, arthritis, and gout. Cupping has also been used to treat anxiety, depression, insomnia, high blood pressure, and varicose veins. There has even been an increase in the use of cupping for facial rejuvenation.

In a blog post from the Pacific College of Oriental Medicine the author reports that

Cupping is one of the best deep-tissue therapies available. It is thought to affect tissues up to four inches deep from the external skin. Toxins can be released, blockages can be cleared, and veins and arteries can be refreshed within these four inches of affected materials.

(<https://www.pacificcollege.edu/news/blog/2014/09/20/many-benefits-chinese-cupping>)

1. **“Are there any medical complications caused by cupping?”**

Cupping is a relatively safe procedure where patients encounter very few adverse medical complications. The bruising that is caused by the accumulation of blood under the cups on the skin is not painful like bruising that is the result of trauma. The possible side effects of cupping include light headedness and dizziness, sweating, and nausea. Blistering can be a problem if the cups are left in place for an extended period of time. If fire cupping is performed, then burns and resulting skin infection may be encountered. It is important that the practitioner follow precautions to prevent the introduction and spread of infection while performing a cupping. In wet cupping, where a lancet is used to pierce the skin so that blood will actually be removed from the body, there is an increased risk of skin infection. Cupping should not be used on patients who are on blood thinners, bleed easily or can’t stop bleeding, have skin ulcers or swelling. It is also unwise to cup over large blood vessels.

1. **“Why are small cups used on bony parts of the body, while larger cups are used on the fleshier parts?”**

Small cups are used on bony parts of the body because the cup needs to make a seal with the skin and it is harder for the larger cups to make a seal on areas of the body that are not flat. Smaller cups are typically used on the tops of the shoulders, the collar bone area, and on the vertebrae of the back.

Large cups are used on the flatter areas of the back and shoulders as well as the thighs.

1. **“How much does cupping typically cost?”**

A half-hour cupping session generally costs between $30 and $80.

1. **“The article mentions the science behind the placebo effect. What *is* the science behind this effect?**

The placebo effect is a psychological phenomenon that demonstrates the power of suggestion, where the act of treatment either in the form of taking a pill or injection that does not contain the active ingredient being studied produces results similar to those seen in persons taking the actual treatment. It is not entirely understood but underscores the power of positive thinking over brain chemistry. In studies evaluating drugs designed to treat Parkinson’s disease, pain, or depression, PET brain scans revealed that the expectation of benefit in the placebo group activated the same natural pathways in the brain as the medication. Therefore, in drug testing it is very important to have three groups of patients in the trial. One group receives the treatment, a second group does not receive any treatment, and a third group receives the same treatment as the first group without the active ingredient added to the pill or injection. In order for a medication to be judged effective, the group receiving the drug must perform statistically better than the group receiving the placebo.

Not all anticipatory effects are positive; sometimes a negative outcome can be anticipated. For example, if the patients are informed that headaches might be a side effect of the medication, some of the patients getting the placebo might develop headaches. This phenomenon of anticipating a negative outcome is referred to as a *nocebo* effect. The placebo effect is not entirely understood and is of interest to many brain researchers. If the power of the placebo effect could be harnessed, it could improve the treatment of some patients. Robert Buckman, a clinical oncologist and professor of medicine summarizes the interest in placebos in the following statement:

Placebos are extraordinary drugs. They seem to have some effect on almost every symptom known to mankind, and work in at least a third of patients and sometimes in up to 60 percent. They have no serious side-effects and cannot be given in overdose. In short, they hold the prize for the most adaptable, protean, effective, safe and cheap drugs in the world’s pharmacopeia. (<https://www.medicalnewstoday.com/articles/306437.php>)

1. **“Could you just use suction cups and pull the skin up that way?”**

Yes. While some practitioner’s still use fire cupping with glass jars or cups, others use plastic cups outfitted with a valve that can be attached to a small handheld pump to extract the air from the cup, effectively doing away with the need for fire. The suction is easier to adjust with these newer cups. Some cups are now made of flexible transparent silicone which can be squeezed to remove some of the air before placing them on the skin. They are shaped similarly to the traditional glass cups.

# Activities

**Labs and demos**

**“Make the Water Rise”:** A tea light floating on a shallow plate of water is covered by a glass cylinder. When the flame is extinguished, water rises into the cylinder carrying the tea light with it, similar to the way a person’s skin is drawn into a cupping cup. (Access is restricted to AACT members, but the article will be available for free until February 1, 2019 at <https://teachchemistry.org/classroom-resources/make-the-water-rise>.)

**“Gas Law Lab”:** Students rotate through 7–8 stations to perform a series of gas-law experiments. Complete instructions and a video to show the teacher how to set up each experiment is included.

(<https://betterlesson.com/lesson/638115/gas-laws-lab>)

**Simulations**

**“Gas Law Simulation”:** Students can manipulate the temperature, pressure, and volume of a sample of gas while watching the resulting graph of the changes. Questions and problems are provided for students to answer during their exploration. (Access is restricted to AACT members, but the article will be available for free until February 1, 2019 at <https://teachchemistry.org/classroom-resources/gas-laws-simulation>.)

**Virtual chemistry gas law lab**: In these Boyle’s law, Charles’ law, and Gay-Lussac’s law labs, students manipulate the knobs of the equipment and observe the response. Student instructions are linked to a lab manual, while the lab sheet is an Excel worksheet to graph the data. (<https://www.uccs.edu/vgclintro/gas-laws> )

**Media**

**“Cupping Therapy” video (2:50):** This video shows a practitioner giving a cupping massage using fire cupping and another giving cupping massage using a manual suction system. (<https://www.youtube.com/watch?v=lv0cp6RfO-0>)

**“6 Reasons Everyone Should Try Cupping Therapy” (3:27)**: Besides demonstrating cupping, this video discusses six conditions that cupping is used to treat. (<https://www.youtube.com/watch?v=56Kmw6AaFEM>)

**Lessons and lesson plans**

**“The Gas Laws Unit Plan”:** This 7–10 day unit plan is a compilation of several labs, activities, simulations, a video, and four demonstrations (including the egg-in-a-flask and balloon-in-a-flask demos that illustrate the effects of pressure changes) to help students explore and understand gas relationships. (Access is restricted to AACT members, but the article will be available for free until February 1, 2019 at <https://teachchemistry.org/classroom-resources/the-gas-laws-unit-plan>.)

**Gas-law lesson:** This three-day lesson plan involves a primary lesson covering the gas laws, followed by a hands-on exploration of activities that employ the laws, and concludes with a quiz over the gas laws.

(<http://www.cpalms.org/Public/PreviewResourceLesson/Preview/127952>)

**Projects and extension activities**

**Gas-pressure kinesthetic class activity:** Students gain a better understanding of what causes pressure in a container by role-playing gas molecules within a container as the volume and temperature of the gas change, while some of their classmates use a piece of rope around them to represent the container.

(<https://teachchemistry.org/classroom-resources/gas-pressure>)

**Experimental design activity:** Students could be assigned to different “research” groups where they design a study that would test the physical and psychological effectiveness of cupping. You may provide students with additional information on designing studies, like those below, to use while they formulate their ideas and, after the students complete an outline of their study, they can present it to the class for peer review.

* This article provides the basic steps of conducting a research study and gives numerous links at the end of the article for further exploration of conducting research in psychology. (<https://www.verywellmind.com/steps-of-the-scientific-method-2795782>)
* The experimental design chapter from the book *Research Methods in Psychology* provides extensive information about using a placebo in an experiment and is accompanied by a thorough explanation of the placebo effect in research studies. (<https://opentextbc.ca/researchmethods/chapter/experimental-design/>)

# References

**The references below can be found on the *ChemMatters* 30-year DVD, which includes all articles published from the magazine’s inception in October 1983 through April 2013; all**

**available Teacher’s Guides, beginning February 1990; and 12 *ChemMatters* videos. The DVD is available from the American Chemical Society for $42 (or $135 for a site/school license) at this site:** [***http://www.acs.org/chemmatters***](http://www.acs.org/chemmatters)**. Click on the “Teacher’s Guide” tab to the left, directly under the “*ChemMatters Online"* logo and, on the new page, click on “Get 30 Years of *ChemMatters* Magazine!” (the icon on the right of the screen).**

**Selected articles and the complete set of Teacher’s Guides for all issues from the past three years are available free online at the same Web site, above. Click on the “Issues” tab just below the logo, *“ChemMatters Online”*.**



In “Model Rockets: Chemistry for Lift-off”, author Rohrig applies Charles’ law to rocketry, as he explains how escaping gases provide the thrust for lift-off.

(Rohrig, B. Model Rockets: Chemistry for Lift-off. *ChemMatters*. 2001, *19* (2), pp 13–15)

“Hot Air Balloons: Gas and Go” presents some history behind the discovery of Charles’ law and how it is applied to hot air balloons. Instructions for making a hot air balloon as a class activity follows the article. (Vanderborght, C. Hot Air Balloons: Gas and Go. *ChemMatters*. 2002, *20* (2), pp 4–6)

Author Michalovic includes considerable biographical information about Joseph-Louis Gay-Lussac in this article about the rivalry between Gay-Lussac and Humphrey Davy during the discovery of Iodine. (Michalovic. M. “ChemHistory”: The Race for Iodine. *ChemMatters*. 2006, *24* (4), p 18–19)

In “Fireworks!” author DeAntonis uses Charles’ law to help explain the chemistry of fireworks. (DeAntonis, K. Fireworks! *ChemMatters*. 2010, *28* (3), pp 8–10)

In “What Makes Magic Tricks Tick”, author Tinnesand includes a discussion of the demonstration of a hard-boiled egg being drawn into a flask that has been heated and is cooling (very similar to the result of cupping), in the section titled “Performing Under Pressure”.

(Tinnesand, M. What Makes Magic Tricks Tick. *ChemMatters*, 2010, *28* (3), pp 5–7)

# Web Resources for More Information

**History of cupping**

At this site, the history of cupping is presented as it was practiced in cultures around the world.

(<https://cuppingresource.com/history-of-cupping/>)

This site contains information about the history, as well as the practice, of cupping.

(<http://www.greekmedicine.net/therapies/Hijama_or_Cupping.html>)

**Cupping procedures**

“Cupping Therapy: An Overview from a Modern Medicine Perspective” contains information about cupping and proposes a classification scheme for the different types.

(<https://www.sciencedirect.com/science/article/pii/S2005290117302042>)

**Cupping studies**

This paper conducts a literature search and meta-analysis using six research trials to assess the effectiveness and safety of using cupping.

(<https://www.sciencedirect.com/science/article/pii/S2095754814000040>)

This abstract summarizes the biochemical reactions that are initiated by increased tissue blood flow to an area with resulting capillary rupture and the antioxidant, anti-inflammatory, and neuromodulatory effects observed in animal and human systems.

(<https://www.ncbi.nlm.nih.gov/pubmed/29122256>)

**Placebo effect**

This paper presents information on how placebos are used and cites some studies where the placebo effect refutes the effectiveness of the treatment.

(<https://www.medicalnewstoday.com/articles/306437.php>)

This site provides information about placebos and their role in medical research.

(<http://n.neurology.org/content/neurology/71/9/e25.full.pdf>)

**Scientific inquiry and experimental design**

The experimental design chapter from the book *Research Methods in Psychology* provides extensive information about using a placebo in an experiment. It is accompanied by a thorough explanation of the placebo effect in research studies.

(<https://opentextbc.ca/researchmethods/chapter/experimental-design/>)

This paper provides insight into scientific inquiry applied in psychological research, including links at the end of the article for further exploration.

(<https://www.verywellmind.com/steps-of-the-scientific-method-2795782>)

**Charles’ law**

This article is an explanation of the gas law.

(<https://www.scientificamerican.com/article/what-is-charles-law/>)

This site provides additional information including graphics about Charles’ law.

(<http://scienceprimer.com/charles-law>)

**Gay-Lussac’s (or Amontons’) law**

This site contains a tutorial, simulation, and video that demonstrate and explain examples.

(<https://www.ck12.org/c/chemistry/gay-lussacs-law/>)

This is a lesson on Amontons’ law, from Pearson education group. [Note that the Kelvin temperature data in the table is offset by one row.]

(<https://chemdemos.uoregon.edu/demos/Amontons-Law>)

This chapter on the gas laws from a free, online chemistry textbook refers to both Amontons and Gay-Lussac in the establishment of the pressure-temperature relationship.

(<https://chem.libretexts.org/Textbook_Maps/General_Chemistry/Book%3A_Chemistry_(OpenSTAX)/09%3A_Gases/9.2%3A_Relating_Pressure%2C_Volume%2C_Amount%2C_and_Temperature%3A_The_Ideal_Gas_Law>)

**Possible class discussion (debate?) on cupping as a legitimate treatment**

This BBC video (5:26) demonstrates dry cupping done by a chiropractor, while another invited guest refutes cupping and chiropractic as rubbish. This video might be a good segue into a pro-con discussion about cupping.

(<https://www.youtube.com/watch?v=JBnZdxCUXbk>)

In this video (9:00), an anatomy teacher and cupping practitioner explains the different aspects and results of cupping, including the interpretation of the color of the welts produced.

(<https://www.youtube.com/watch?v=FW6FXcDi5oM>)

**Articles that do not support the use of cupping in modern medicine**

This article presents a case, complete with photographs, where cupping created a life-threatening situation for the patient.

(<http://scienceblogs.com/insolence/2016/07/01/whats-the-harm-cupping-edition/>)