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**“Towing Icebergs”**

*April/May 2018*

**Teacher’s Guide**



**Teacher's Guide for**

***“Towing Icebergs”***

**April/May 2018**

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# Connections to Chemistry Concepts

|  |  |
| --- | --- |
| **Chemistry Concept** | **Connection to Chemistry Curriculum** |
| **Density** | Planning to tow an iceberg is not an easy process, due to its huge mass below the ocean’s surface; the amount below the surface can be predicted by comparing the density of ice with the density of seawater. |
| **Buoyancy** | The Titanic disaster might have resulted at least partially because engineers onboard the ship were unaware that, although barely visible, a huge piece of the iceberg (approximately 90%) was situated below the ocean surface. This tragic example can be used to illustrate the importance of understanding Archimedes’ principle of buoyancy. |
| **Phase changes** | Although ocean water is usually considered very cold, it is still warmer than ice, as explained in the article. The temperature difference between ice and the ocean water through which they travel is sufficient to cause a phase change from solid ice to liquid water, melting the iceberg. |
| **Melting** | The loss of significant amounts of water from an iceberg that would occur if it were towed in the long journey over open water, from icy areas to the hot, water-scarce United Arab Emirates, provides an example of the process of melting. |
| **Heat exchange** | This article provides an example of a real-world problem due to heat exchange. During iceberg towing, when heat flows from the warmer ocean water (15–20 oC) to the colder iceberg (<0 oC), the heat energy melts the ice. |

# 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 the April/May 2018 issue:

Food Chemistry

Structural Formulas

Chemical Reactions

Reaction Rates

Oxidation & Reduction

Distillation

Environmental chemistry

* Some of the articles in this issue provide information to help students consider their impact on the environment.
* Consider asking students to read “Open for Discussion: Weighing in on calories” to learn about calories in food prior to reading the article “The Protein Myth: Getting the Right Balance.”
* Students may find the infographic on page 19, “As a Matter of Fact: The Aroma of the Seaside” interesting after reading the article “Toxic Shorelines: The Science of Algal Blooms.
* 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.
* You might also ask them how information in the articles might affect their choices regarding food or water use. Also, ask them if they have questions about some of the issues discussed in the articles.
* The Background Information in the *ChemMatters* Teachers Guide has suggestions for further research and activities.

# Reading Supports for Students

The pages that follow include reading supports in the form of an Anticipation Guide, a Graphic Organizer, and Student Reading Comprehension Questions. These resources are provided to help students as they prepare to read and in locating and analyzing information from the article.

The borders on these pages distinguish them from the rest of the pages in this Teacher’s Guide—they have been formatted for ease of photocopying for student use.

* **Anticipation Guide (p. 8):** The Anticipation Guide helps to engage students by activating prior knowledge and stimulating student interest before reading. If class time permits, discuss students’ responses to each statement before reading each article. As they read, students should look for evidence supporting or refuting their initial responses.
* **Graphic Organizer (p. 9):** The Graphic Organizer is provided to help students locate and analyze information from the article. Student understanding will be enhanced when they explore and evaluate the information themselves, with input from the teacher, if students are struggling. Encourage students to use their own words and avoid copying entire sentences from the article. The use of bullets helps them do this.

If you use the aforementioned organizers to evaluate student performance, you may want to develop a grading rubric such as the one below.

|  |  |  |
| --- | --- | --- |
| **Score** | **Description** | **Evidence** |
| 4 | Excellent | Complete; details provided; demonstrates deep understanding. |
| 3 | Good | Complete; few details provided; demonstrates some understanding. |
| 2 | Fair | Incomplete; few details provided; some misconceptions evident. |
| 1 | Poor | Very incomplete; no details provided; many misconceptions evident. |
| 0 | Not acceptable | So incomplete that no judgment can be made about student understanding |

* **Student Reading Comprehension Questions (p. 10-11):** The Student Reading Comprehension Questions are designed to encourage students to read the article (and graphics) for comprehension and attention to detail, to provide the teacher with a mechanism for assessing how well students understand the article and/or whether they have read the assignment, and, possibly, to help direct follow-up, in-class discussion, or additional, deeper assignments.

Some of the articles in this issue provide opportunities, references, and suggestions for students to do further research on their own about topics that interest them.

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. The “Web Sites for Additional Information” section of the Teacher’s Guide provides sources for additional information that might help you answer these questions.

“Towing Icebergs”, *ChemMatters*, April/May 2018

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Anticipation Guide

“A Close-up Look at the Quality of Indoor Air” (*ChemMatters*, April/May 2016 Issue)

**Directions:**  ***Before reading the article*,** in the first column, write “A” or “D,” indicating your agreement or disagreement with each statement. As you read, compare your opinions with information from the article. In the space under each statement, cite information from the article that supports or refutes your original ideas.

|  |  |  |
| --- | --- | --- |
| **Me** | **Text** | **Statement** |
|  |  | 1. More than 2 billion people around the world live with insufficient clean water. |
|  |  | 1. About 10% of the water on Earth is available as freshwater. |
|  |  | 1. Most of Earth’s freshwater is trapped in glaciers and ice caps. |
|  |  | 1. Distillation of water was discovered in the 1800s. |
|  |  | 1. As salt water is distilled, salt becomes increasingly concentrated in the solution being boiled. |
|  |  | 1. Reverse osmosis requires high pressure to separate fresh water from saltwater. |
|  |  | 1. Desalination currently produces about 10% of the world’s drinking water. |
|  |  | 1. More than16 desalination plants have been approved in California. |
|  |  | 1. Solid water is more dense than liquid water. |
|  |  | 1. Middle Eastern countries have proposed towing icebergs to drought-stricken areas. |

## Graphic Organizer

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

“Towing Icebergs”, *ChemMatters*, April/May 2018

**Directions**: ***As you read***, complete the graphic organizer below to describe ideas that have been put forward to tow icebergs to areas needing fresh water.

|  |  |  |
| --- | --- | --- |
| 3 | **People who proposed towing icebergs, and when** |  |
| 2 | **Problems with towing icebergs** |  |
| 1 | **Number or statistic from the article that surprised you (and why)** |  |
| Contact! | **What do *you* think about the idea of towing icebergs to drought-stricken areas?** |  |

## Student Reading Comprehension Questions

“Towing Icebergs”, *ChemMatters*, April/May 2018

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name

**Directions**: Use the article to answer the questions below.

* 1. What event prompted the interest in towing icebergs to prevent disasters at sea?
  2. What stimulated the idea of towing icebergs to California?
  3. List two possible problems with the Saudi Arabian prince’s plan in 1977 to supply fresh water to his country.
  4. When estimating the cost of towing an iceberg, why is it important to consider the wind and ocean current flows in the cost analysis?
  5. In addition to considering the wind and ocean current flows, give two other variables to consider when computing the estimated cost of towing an iceberg from Newfoundland to the Canary Islands.

**Student Reading Comprehension Questions, cont.**

“Towing Icebergs”, *ChemMatters*, April/May 2018

* 1. Why is melting considered a serious problem during the iceberg towing?
  2. What has been suggested as a solution to the problem of iceberg melting during towing?
  3. How did researchers determine that towing the iceberg from near Newfoundland to the Canary Islands would be physically possible?
  4. According to Georges Mougin’s simulation, (a) how long would the journey take, and (b) how much ice would melt?
  5. Since the Mougin plan was never carried out, has everyone given up on towing icebergs? Explain your answer.

## Answers to Student Reading Comprehension Questions

1. **What event prompted the interest in towing icebergs to prevent disasters at sea?**

*The sinking of the Titanic prompted the interest in towing icebergs, to prevent future disasters at sea.*

1. **What stimulated the idea of towing icebergs to California?**

*The idea of towing icebergs to California was stimulated by the need for freshwater in southern California.*

1. **List two possible problems with the Saudi Arabian prince’s plan in 1977 to supply fresh water to his country.**

*To reach Saudi Arabia,*

*the iceberg would have to be towed across 11,500 kilometers of water, and*

*if it weighed 100 million tons, the estimated cost to do this would be $100 million.*

1. **When estimating the cost of towing an iceberg, why is it important to consider the wind and ocean current flows in the cost analysis?**

*It is important to consider the wind and ocean current flows in the cost analysis when estimating the cost of towing an iceberg because the wind and ocean current flows may either help or hinder the movement of the iceberg through the sea.*

1. **In addition to considering the wind and ocean current flows, give two other variables to consider when computing the estimated cost of towing an iceberg from Newfoundland to the Canary Islands.**

*Two other variables to consider when computing the cost of towing an iceberg from Newfoundland to the Canary Islands are*

*the size of the iceberg, and*

*the number and power of the tugboats.*

1. **Why is melting considered a serious problem during the iceberg towing?**

*Melting is considered a serious problem during iceberg towing because if an iceberg at 0 oC is towed through the seawater that has a higher temperature (and at 15 to 20 oC, it is warmer), heat would flow from the warmer seawater and melt the ice en route.*

1. **What has been suggested as a solution to the problem of iceberg melting during towing?**

*A suggested solution to the problem of iceberg melting during towing is to develop a way to wrap a skirt around the iceberg to trap the freshwater as it melts.*

1. **How did researchers determine that towing the iceberg from near Newfoundland to the Canary Islands would be physically possible?**

*Researchers used a computer simulation to determine that it is physically possible to tow an iceberg from near Newfoundland to the Canary Islands (although not financially reasonable).*

1. **According to Georges Mougin’s simulation, (a) how long would the journey take, and (b) how much ice would melt?**

*According to this Mougin’s simulation,*

1. *the journey would take 141 days, and*
2. *approximately 38% of the iceberg would melt.*
3. **Since the Mougin simulation was never carried out, has everyone given up on towing icebergs? Explain your answer.**

*No, everyone has not given up on towing icebergs. In 2017, the United Arab Emirates, countries with plenty of oil but very little water, introduced another plan.*

# Possible Student Misconceptions

1. **“Icebergs are always found in the ocean, so they must be frozen sea water that will have to be desalinated before drinking.”** *Actually, icebergs are formed on land, they are freshwater pieces of glaciers or ice caps that break off, or* calve*, and float in the ocean.*
2. **“I’ve seen the advertisements for towing icebergs that picture the penguins and polar bears still on the huge iceberg.”** *First, iceberg tugs do not bring animals on the icebergs and, second, penguins inhabit the Antarctic, but polar bears live only in Arctic regions.*
3. **“Since icebergs are frozen, they cannot support life.”** *The glaciers that formed icebergs were covered by dirt, microbes, and other airborne debris, along with snow. As the snow melted, its water mixed with biological material, and colonies of bacteria formed. This “living surface” was part of the iceberg that formed when the glacier broke (“calved”) into the ocean.*
4. **“Polluted icy seawater must contaminate icebergs.”** *The deep layers of the iceberg have formed from years of heavy pressure, making them impermeable to seawater. Even when the sea freezes, only the pure freshwater forms sea ice; the salt and other contamination does not freeze, nor can it contaminate icebergs.*
5. **“I hear a lot about the sea-water level rising due to global warming; this must be caused by icebergs melting.”** *No, icebergs are already floating in the ocean, so the sea level doesn’t change as they melt. Sea-level rise occurs when glaciers and ice caps on land melt, and that water flows into the ocean, increasing the ocean volume and flooding low land areas.*

# Anticipating Student Questions

1. **“Why is it important that oceans freeze from the top to the bottom?** *Thick ice on the top of seawater allows people and animals to travel across the ice and marine life to survive under the ice.*
2. **“How much of an iceberg is located beneath the surface?”** *Approximately 90% of the iceberg is located underwater. Ice floats in liquid water because the ice is less dense than the liquid water that it displaces. Ice has a density of .917g/mL compared to 1.03g/mL, the density of seawater:*

*917g/mL ice / 1.03g/mL seawater x 100% = 89.0%*

*Thus, approximately 90% of the iceberg will remain underwater because it is not supported by the buoyant force of water.*

1. **“I’ve heard of glaciers *calving*. What causes this?”** *Glaciers are huge masses of dense ice that move slowly under their own weight (like rivers of ice). Their forward motion to the sea makes the forward end of the glacier unstable, so the ice breaks (calves) into the ocean, forming icebergs.*
2. **“Why does an iceberg made of freshwater appear white instead of clear?”** *Tiny air bubbles trapped in layers of snow on top of the iceberg reflect sunlight so the iceberg looks white (just like snow).*
3. **“I’ve seen photos of blue icebergs, how is this possible?”** *After the snow on top of an iceberg melts, the internal compressed layers of glacial ice are exposed. These layers lack a reflective surface, allowing long red wavelengths to penetrate and be absorbed by this ice; thus, light is transmitted through the ice as blue or blue-green.*

# Activities

**Labs and demos**

**“How much of an iceberg floats above the surface”, ~~a~~ hands-on activity (20 min.):** Students float a frozen piece of freshwater in salt water, measure, and calculate the percentage of the “iceberg” above water. The teachers’ guide includes a list of lab materials and directions, NGSS alignment, discussion questions, and an extension idea. (<https://www.cresis.ku.edu/sites/default/files/Education/K-12/IceIceBaby/4.1-IIB_lesson.pdf>)

**“Sea Level Change Experiment”, student investigation:** To dispel a common misconception**,** students investigate the effect of global warming on sea-level rise by constructing an island with a glacier, surrounded by a sea with icebergs. They measure the sea level rise as a glacier melts, compared to the effect when an iceberg melts. (<http://www.dynamicearth.co.uk/media/1238/sea-level-change-experiment.pdf>)

**Media**

**“How are icebergs formed?”, terrific video (4:10):** As excellent narration explains this process, the viewer is taken from the probable birth of an iceberg to its death. A description of an iceberg near the end of its life cycle suggests the probable behavior of the one that destroyed the Titanic. (<https://www.youtube.com/watch?v=LCeIiNEhUWk>)

**“Have you ever harvested an iceberg?”, video (6:06):** Hunters capture chunks to melt and sell as “Iceberg Water”, deemed fresh, clean, and ready to bottle for sale. In Newfoundland, hunters must be licensed to catch iceberg chunks, and the use of explosives to break icebergs into smaller pieces, as shown in the film, is prohibited. [Note: other sources say this iceberg-melt must be tested for possible iceberg surface pollution/contamination.] (<https://www.youtube.com/watch?v=07imCx95vXg>)

**Lessons and lesson plans**

**“Do-it-yourself iceberg science”, film canisters with frozen water act as icebergs:** This scientific inquiry lesson includes the study of density and phase changes to explain the position and movement of icebergs. The lesson is referenced to NGSS standards, with extensions that include experimental design. (<https://www.units.miamioh.edu/cryolab/education/documents/MS%20Icebergs.pdf>)

**“Witnessing Icebergs” (60:00), high school environmental class, NGSS-aligned lesson:** Students study how glaciers affect global stability by considering how melting changes sea levels, weather, and marine environments. Readings and internet resources form the basis for discussion questions and reflective prompts. (<https://www.globalonenessproject.org/resources/lesson-plans/witnessing-icebergs>)

**Projects and extension activities**

**“Activity Guide: Titanic Science”, history and hands-on activities woven into the story of the Titanic:** This K-12 “Teachers’ Guide” can be used as an excellent, very complete unit of study that contains many activities, including buoyancy, designing a ship, making an iceberg, plotting icebergs, and calculating their frequency. A matrix displays connections to the National Standards and suggested videos are from the Discovery Channel. (<http://www.theteachersguide.com/sciencemisc/titanicscienceteachersguide.pdf>)

# 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://ww.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 the past 30 Years of *ChemMatters* on DVD!” (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”*.**



***30* Years of *ChemMatters !***

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This article includes the history of the Titanic and a clearly-illustrated description of buoyant force. The author describes various modern hypotheses to explain the sinking and loss of life on the “unsinkable” Titanic, including the brittleness of the steel hull, hitting the iceberg from the side rather than from the stronger front of the ship, insufficient life rafts, and the lack of modern warning systems. (Rohrig, B. Titanic. *ChemMatters*, 2011, *29* (4) pp.17–19)

# Web Sites for Additional Information

**History of towing icebergs**

“The Many Failures and Few Successes of Zany Iceberg Towing Schemes”, a terrific article with many iceberg tales to spice classroom lessons, includes links for additional information. The history of iceberg towing adventures from the 1800s to 2007 describes small Chilean icebergs equipped with sails to add wind power to ships towing them north, and the 1835 British Arctic Expedition ship that was stuck on an iceberg which towed it about the ocean. (<https://www.theatlantic.com/technology/archive/2011/08/the-many-failures-and-few-successes-of-zany-iceberg-towing-schemes/243364/#slide3>)

With tales to add fun to your classroom discussions, this article goes from describing modern day “snake oil salesmen” who peddle bottled glacier water as legitimate businesses, to multi-million dollar scams. A brief history of the “cold rush” and ice-related climate changes are described in both the text and as picture columns on the right side of pages. (<http://www.icebergwatereurope.com/wp-content/uploads/2014/01/ModernFarmer_jan141.pdf>)

**Feasibility studies**

At the 1977 International Iceberg Summit in Iowa, a Saudi Arabian prince submitted a proposal developed by the French scientist Georges Mougin to tow a 100-million-ton iceberg wrapped in a “skirt” to save melted water from the North Pole to Red Sea drought areas at a cost of $100 million. Dismissed by its impracticality and cost, Mougin set the idea aside for 35 years and then tackled the problem in 2011 by simulation using 3-D technology, modern ocean forecasting, and strong tugboats. (<https://www.fastcompany.com/1755444/watch-tugboat-drag-arctic-iceberg-parched-people-half-world-away-video>)

This article details the 2017 United Arab Emirates (UAE) plan to launch the “Emirates Iceberg Project”, with ways to tow icebergs from the Antarctic to the Arabian Peninsula, the least water-secure area in the world. They note that with 80% of the ice under water and a white surface that reflects sunlight, icebergs melt slowly. (<https://fanack.com/icebergs-uae/>)

**Desperate need for water**

Following several years of drought, attributed to global warming and explosive population growth, April 12, 2018 is “Day Zero” for Cape Town, South Africa. This is the day when water taps will run dry—unless drastic conservation and recycling and/or iceberg towing occur immediately. (<http://abcnews.go.com/International/wireStory/cape-town-set-disaster-operations-hq-water-crisis-52664503>)

Proposals for Antarctic iceberg towing as a temporary solution for Cape Town’s water shortage come from (also water-poor) Abu-Dhabi of the United Arab Emirates (UAE). The UAE has long considered iceberg towing as a probably less expensive option than desalination to provide water during extreme drought. This article also suggests the need for a deep harbor in which to float the iceberg and describes the process of freshwater retrieval. (<https://www.dailymaverick.co.za/article/2017-10-16-capewatergate-could-towing-an-iceberg-to-cape-town-help-solve-future-water-problems/#.WnISuHmpVMs>)

**Dangers of towing icebergs**

The International Ice Patrol (IIP), launched following the Titanic disaster to monitor the location of icebergs, now uses data from satellites, radar, and airplanes to locate icebergs in shipping lanes and recommends safe routes around them. The information collected is used by contractors that tow icebergs away from oil rigs in ocean waters, a risky business, as tugs must maintain a safe distance (as seen in the photo) in case the iceberg flips. (<http://www.neatorama.com/2014/05/23/Risky-Business-Towing-Icebergs/>)

In addition to collisions with ships, icebergs can flip over due to melting that leaves them unbalanced, releasing enough energy to cause rough seas, tsunamis, and occasional earthquakes. This article contains a photo of a recently-flipped iceberg’s glassy underwater belly, with no white snow from the original iceberg top visible. (<https://www.smithsonianmag.com/science-nature/photographer-captures-stunning-underside-flipped-iceberg-180953951/>)

**Problems with harvesting icebergs for fresh water**

The article “Can we use icebergs as a source of water?” suggests two problems with towing icebergs: melting, and pulling an iceberg near land; ways to solve them; and easier ways to harvest their water. (<https://www.scienceabc.com/nature/can-we-use-icebergs-as-a-source-of-water.html>)

This *Newsweek* article discusses the problems of towing an iceberg from Antarctica to Dubai. Beyond the expense, melting, and difficult land approaches, there are extremely strong ocean undercurrents in the South Atlantic, as well as multi-nation environmental regulations that span the route. (<http://www.newsweek.com/iceberg-move-expert-climate-change-dubai-uae-south-pole-antarctica-610623>)

**Iceberg harvesting in Newfoundland**

Another *Newsweek* article describes the dangers faced by iceberg hunters as they drag pieces of icebergs that have calved from the Greenland ice shelf and floated to the coast of Newfoundland. Onshore, the chunks are melted, bottled, and sold as expensive, bottled “Iceberg” water. (<http://www.newsweek.com/iceberg-hunters-newfoundland-414728>)

“Iceberg Harvesting: Suggesting a Federal Regulatory Scheme” was published in the *Boston College Environmental Affairs Law Review*, April 2015. This article contains some recent history about the possible plans to tow icebergs to thirst-hungry areas of the world, and it cautions that currently, this activity is in a “legal vacuum” with no international laws or treaties designed for regulation. (<http://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=2175&context=ealr>)

**Effects of icebergs on climate change**

As the earth warms, sea levels rise and more fresh water joins the ocean from melted ice shelves and icebergs. This article describes how this destabilizes ocean currents that bring warm water to Northern Europe and the effects on climate and marine life. (<http://www.sciencemag.org/news/2016/06/crippled-atlantic-currents-triggered-ice-age-climate-change>)

Robert Brears, founder of the climate think tank Mitidaption, describes how towing an iceberg to the parched Saudi Arabian peninsula may produce climate change. He suggests that cold air from icebergs will initiate rainstorms. (<http://www.newsweek.com/iceberg-move-expert-climate-change-dubai-uae-south-pole-antarctica-610623>)

# About the Guide

Teacher’s Guide team leader William Bleam and editors Pamela Diaz, Steve Long and Barbara Sitzman created the Teacher’s Guide article material.

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Articles from past issues of *ChemMatters* and related Teacher’s Guides can be accessed from a DVD that is available from the American Chemical Society for $42. The DVD contains the entire 30-year publication of *ChemMatters* issues, from February 1983 to April 2013, along with all the related Teacher’s Guides since they were first created with the February 1990 issue of *ChemMatters*.

The DVD also includes “Article”, “Title”, and “Keyword” indexes that cover all issues from February 1983 to April 2013. A search function (similar to a Google search of keywords) is also available on the DVD.

The *ChemMatters* DVD can be purchased by calling 1-800-227-5558. Purchase information can also be found online at <http://tinyurl.com/o37s9x2>.