

American Chemical Society

Chemists Celebrate Earth Week

February 21, 2024

1:00 PM- 2:30 PM ET



April 21-27, 2024 | #CCEW

www.acs.org/ccew



GET A

CHARGE

OUT OF *CHEMISTRY*



ACS
Chemistry for Life[®]

AMERICAN CHEMICAL SOCIETY

April 21-27, 2024 | #CCEW





***Dr. Bill Doria
Chemistry Professor at Rockford
University (Rockford, IL)***

Agenda

- Welcome and Introductions
- What is CCEW?
- What is CCA and the Theme team?
- Why batteries and what do we want you to know?
- Let's Talk about batteries
- Resources (activities library, CCEW website, ACS Store, CCEW Coordinator)
- Questions



What is CCEW and CCA?

What is CCEW

- **Chemists Celebrate Earth Week (CCEW)** is a community-based program of the American Chemical Society (ACS). This annual program unites ACS local sections, student communities, technical divisions, businesses, schools, and individuals in communicating the positive role that chemistry plays in the world. Earth Day is observed on April 22 and CCEW is celebrated the week of Earth Day.
- Earth Day was first officially recognized on April 22, 1970, as a way to demonstrate support for a healthy environment, raise awareness about environmental issues, and remind people that we all need to contribute to a sustainable planet. ACS joined the Earth Day celebration in 2003. There have been annual CCEW events ever since.
- CCEW is administered by the ACS Office of Science Outreach, which is part of the Education Division.

What is CCA?



About CCA

The purpose of the Committee on Community Activities is to improve the public perception of chemistry by providing programs to connect chemists with their communities by:

- Providing guidance to the Society's community outreach programs and activities, and developing and implementing new resources/technologies to support, evaluate, and sustain them;
- Encouraging participation in community outreach programs through recruitment, retention and recognition of volunteers; and
- Informing the Board, Council and other Society bodies of the Committee's activities.

CCA's vision is promoting understanding and appreciation of chemistry, and CCA's mission is supporting the global chemistry community through engaging outreach, resources, training, and recognition. CCA works as an advisory group to the American Chemical Society's Office of Science Outreach.

Who We Are

The CCA is organized into three subcommittees and theme teams for the purpose of achieving its goals in the areas of community programming and public outreach. The subcommittees are composed of members of CCA, while the theme teams consist of members from CCA and other groups associated with the specified program.

What is CCA?



- The CCA works alongside the ACS Office of Science Outreach to develop and support ACS-sponsored community outreach programs such as National Chemistry Week (NCW) and Chemists Celebrate Earth Week (CCEW). CCA authors the biannual children's publication, Celebrating Chemistry, which features interviews from active chemists and hands-on activities that can be done at home.
- CCA reviews applications for international Chemistry Festival Grants and provides feedback for the Outreach Training Program.
- CCA also oversees the Volunteer of the Year program and the Salutes to Excellence program. The chair also writes annual comments in Chemical & Engineering News (C&EN).

2024 CCEW Theme Team



Lori Stepan, CCA Chair

Sara Delgado-Rivera (CCEW Theme team co-chair)

Bill Doria (CCEW Theme team co-chair)

Rick Rogers (PDP Co-Chair)

Weslene Tallmadge

Dave Heroux (PDP Co-Chair)

Tracy Hamilton

Gina Malczewski

Veronica Jaramillo

Susan Hershberger

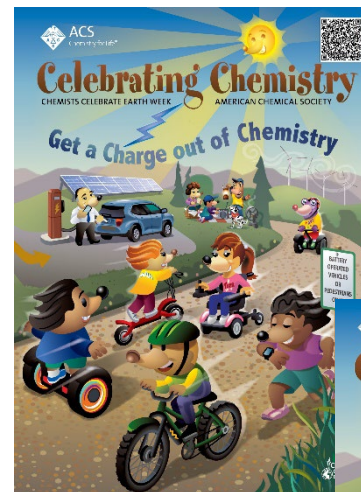
Duy Le

Cheryl Trusty

Sherri Rukes

Neal Abrams

Juan C. Aponte-Santini



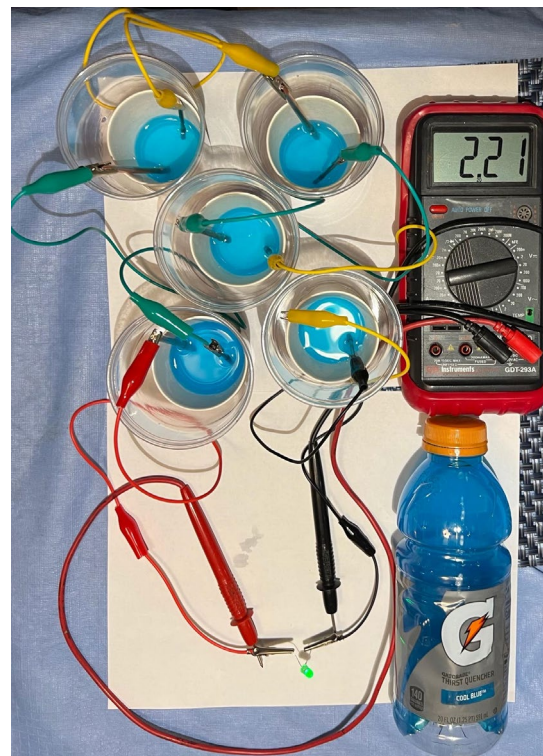


Dr. Neal Abrams
Associate Professor of Chemistry –
SUNY College of Environmental Science
and Forestry (Syracuse, NY)

Build a Battery

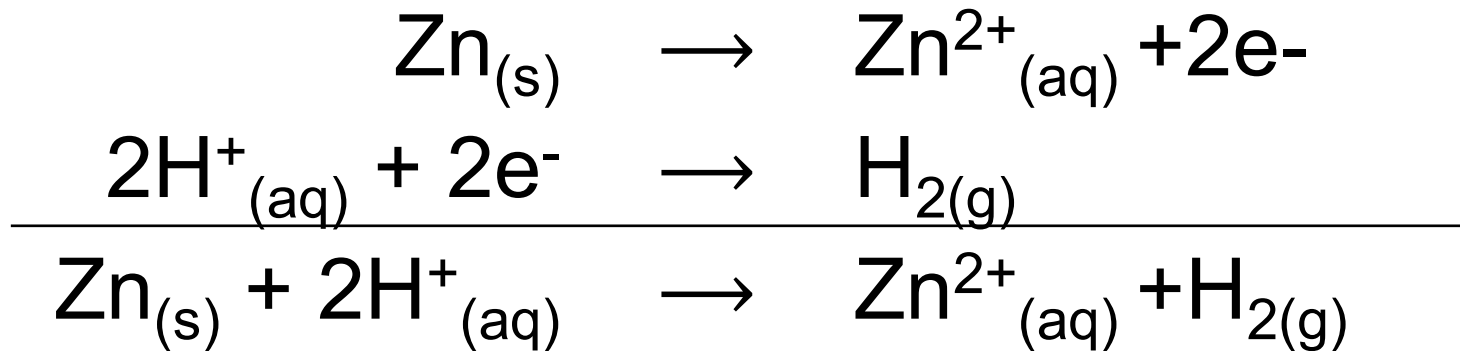
Build a Battery

- Supplies: nails, a sports drink, and a few wires to light up an LED



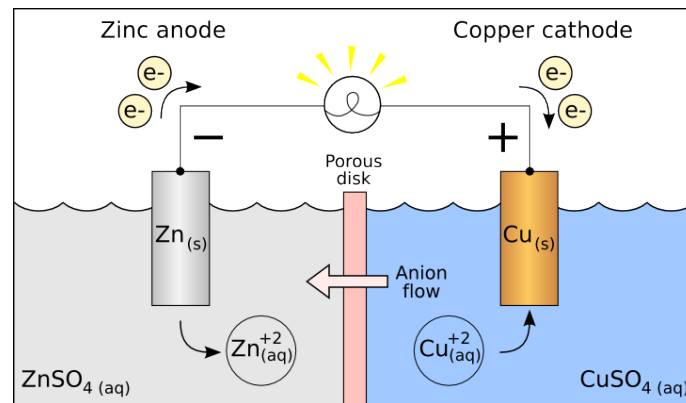
Chemical Principle

- Zinc is oxidized in the presence of an ionic solution
- Theoretical voltage of +0.76 V
- Basis of cathodic protection



Why no copper?

- Consider what is in solution!
- For the Cu/Zn couple, the spontaneous reaction requires Cu^{2+} ions in solution
- Still a battery – current flows from the dissolution of zinc.



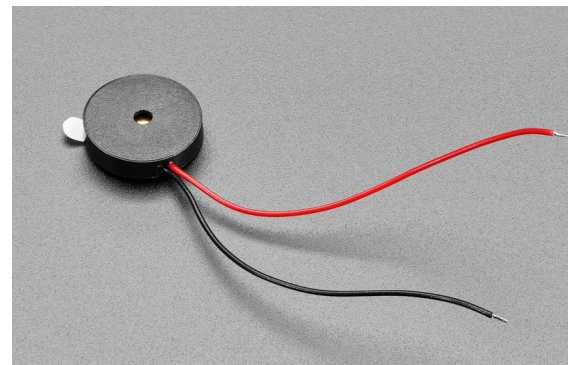
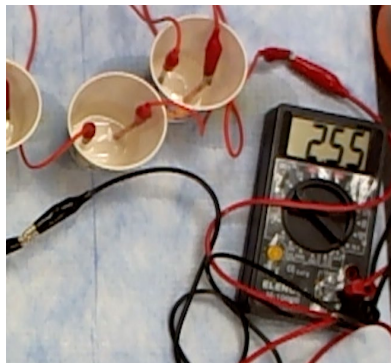
Materials

- Copper roofing nails
- Galvanized nails (electroplated)
- Alligator clips
- LEDs
- Paper cups or ice cube tray



Adaptations

- Replace the LED with an audible cue
 - Search for “low voltage toy buzzer”
- Use a multimeter to confirm the voltage



adafruit.com
amazon.com

Modifications and substitutions

- Substitute an ice cube tray for cups
- Replace a sports drink with other conductive solution
 - Sea water, salt water
- Try non-galvanized nails (*won't work*)





Victoria Russell
Outreach Coordinator at NSF Center for
Synthetic Organic Electrochemistry
(CSOE) – University of Utah

More About Batteries!

The Basics

Battery: converts chemical energy into electrical energy.

Three main parts:

Anode (-): gives up electrons (oxidation)

Cathode (+): takes electrons (reduction)

Electrolyte: helps energy flow through system

Two different metals and something salty or acidic will make a battery. But it might not be a “good” battery.

There are other types of batteries that use non-metals (e.g. graphite) or differences in concentration to produce electricity.

Better at
taking
electrons

Better at
losing
electrons

Half Reaction	potential
$\text{F}_2 + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+2.87 V
$\text{Pb}^{4+} + 2\text{e}^- \rightleftharpoons \text{Pb}^{2+}$	+1.67 V
$\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	+1.36 V
$\text{Ag}^+ + 1\text{e}^- \rightleftharpoons \text{Ag}$	+0.80 V
$\text{Fe}^{3+} + 1\text{e}^- \rightleftharpoons \text{Fe}^{2+}$	+0.77 V
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+0.34 V
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2$	0.00 V
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	-0.04 V
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$	-0.13 V
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	-0.44 V
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	-0.76 V
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	-1.66 V
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	-2.36 V
$\text{Li}^+ + 1\text{e}^- \rightleftharpoons \text{Li}$	-3.05 V

↑ increasing strength as an oxidizing agent

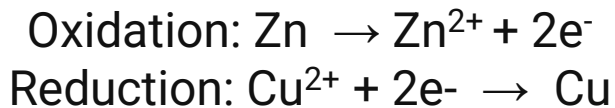
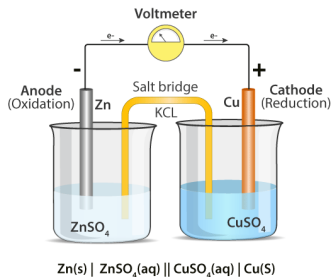
↓ increasing strength as a reducing agent

1.10 V

Battery Demonstrations

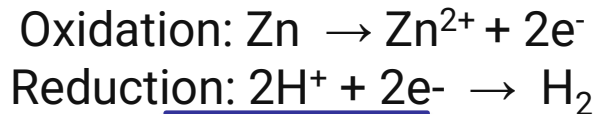
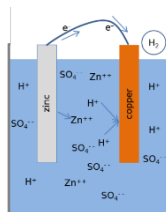
Copper and Zinc most common cathode and anode material in demonstrations.

If you have a source of copper ions (e.g. CuSO_4)



$$E^0 = 1.10 \text{ V}$$

If you DON'T have a source of copper ions:



$$E^0 = 0.76 \text{ V}$$



Half Reaction	potential
$\text{F}_2 + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+2.87 V
$\text{Pb}^{4+} + 2\text{e}^- \rightleftharpoons \text{Pb}^{2+}$	+1.67 V
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$\text{Ag}^+ + 1\text{e}^- \rightleftharpoons \text{Ag}$	+0.80 V
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$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2$	0.00 V
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	-0.04 V
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$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	-0.44 V
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	-0.76 V
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	-1.66 V
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	-2.36 V
$\text{Li}^+ + 1\text{e}^- \rightleftharpoons \text{Li}$	-3.05 V

0.76 V

1.10 V

The OG Battery: the Voltaic Pile (~1800)

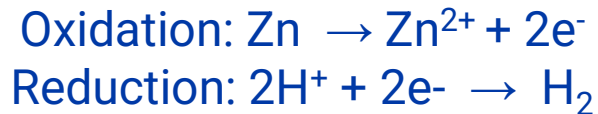


Alessandro Volta (1745-1827)

Voltaic Pile: a controllable, continuous source of voltage.

Composed of alternating layers of:

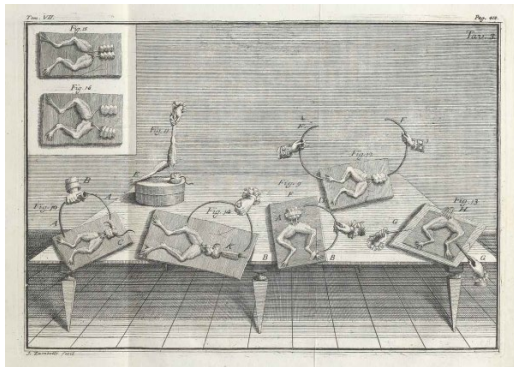
- Copper (cathode, reduction)
- Zinc (anode, oxidation)
- Fabric soaked in sea water or acid (electrolyte)



What makes a frog twitch?

Observation:

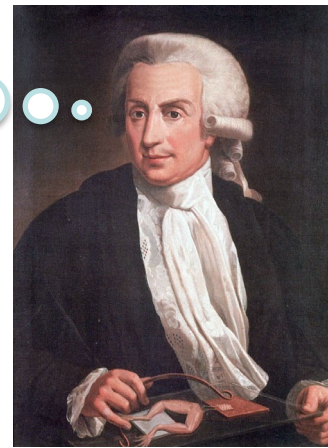
Applying two different metals to a frog's leg and to each other will cause that frog's leg to "kick."



It's the frog!



Animal Electricity:
Nerve or tissue
generates its own
electricity

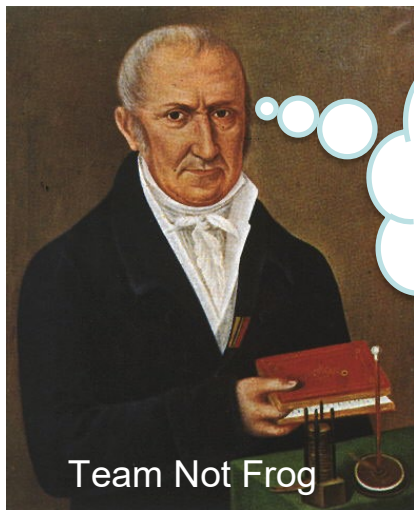


Luigi Galvani (1737-1798)

Giovanni Aldini
(1762-1834)



What makes a frog twitch?



Team Not Frog

Alessandro Volta (1745-1827)



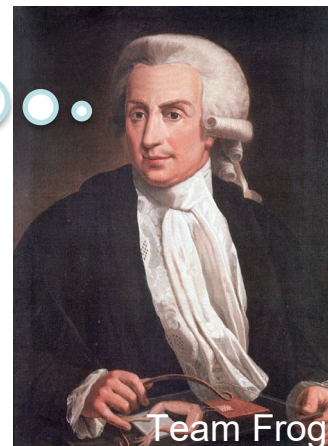
Externally applied
electricity excites
the tissue

VS

It's the frog!



Animal Electricity:
Nerve or tissue
generates its own
electricity



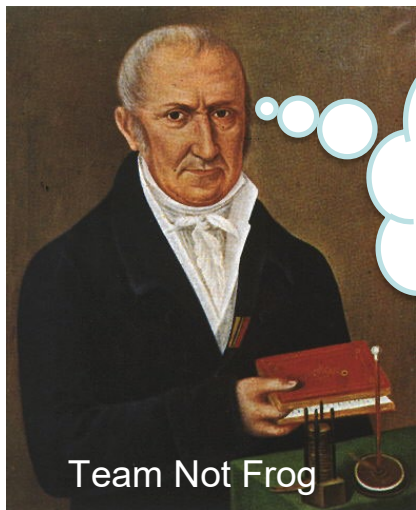
Team Frog

Luigi Galvani (1737-1798)

Giovanni Aldini
(1762-1834)



What makes a frog twitch?

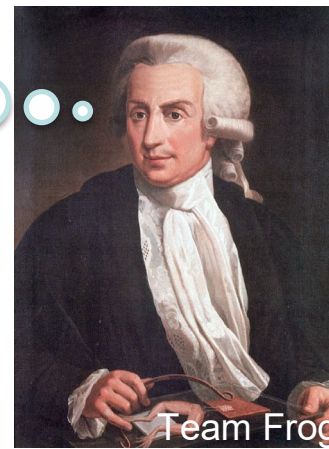


Alessandro Volta (1745-1827)



VS

It's the frog!



Luigi Galvani (1737-1798)

Mary Shelley



Frankenstein (1813)



Vanni Aldini
(1802-1834)

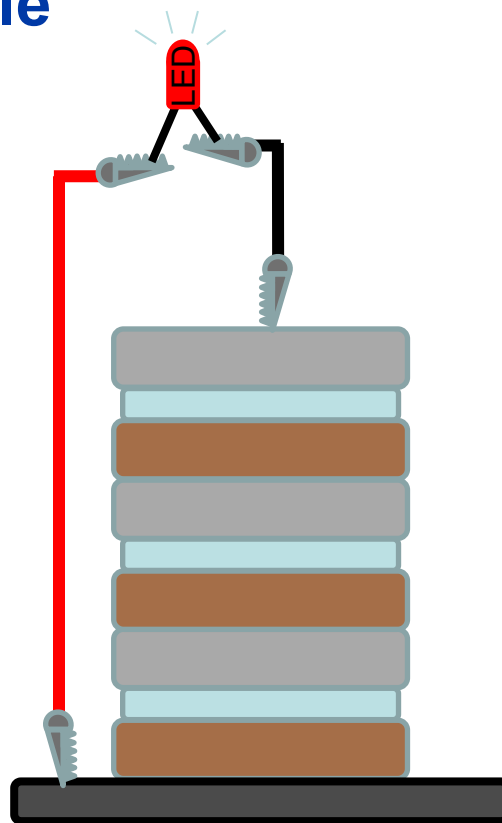


Demo- Build a voltaic pile

Cathode: copper- penny, copper washer

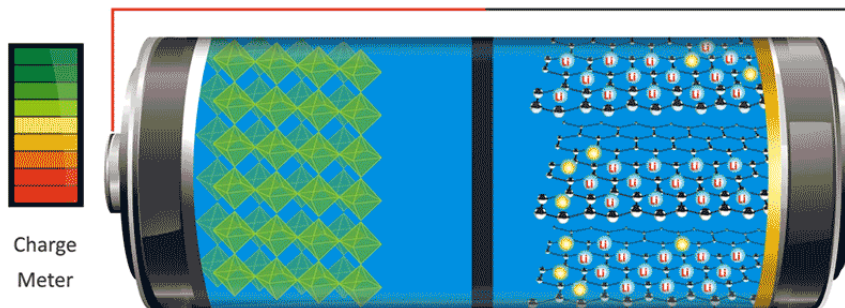
Anode: zinc- zinc/galvanized washer

Electrolyte: vinegar, lemon juice, salt water



Lithium-ion Batteries

Discharge



Cathode (+)

(Reduction, electrons gained during discharge)

Lithium Oxides:



Charge
Meter

Anode (-)

(Oxidation, electrons are lost during discharge)

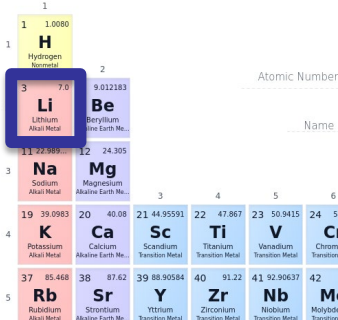
Often graphite

U.S. DEPARTMENT OF
ENERGY | Office of ENERGY EFFICIENCY
& RENEWABLE ENERGY

Electrolyte

Lithium salts: LiPF_6 , LiBF_4 , LiClO_4

Organic Solvent: ethylene carbonate, dimethyl carbonate, diethyl carbonate



1	2	3	4	5	6
1 1.0080 H Hydrogen Nonmetal					
3 7.0 Li Lithium Alkali Metal	4 9.012183 Be Beryllium Alkaline Earth Me...				
11 22.989 Na Sodium Alkali Metal	12 24.305 Mg Magnesium Alkaline Earth Me...				
19 39.0983 K Potassium Alkali Metal	20 40.08 Ca Calcium Alkaline Earth Me...	21 44.95591 Sc Scandium Transition Metal	22 47.867 Ti Titanium Transition Metal	23 50.9415 V Vanadium Transition Metal	24 51.9961 Cr Chromium Transition Metal
37 85.468 Rb Rubidium Alkali Metal	38 87.62 Sr Strontium Alkaline Earth Me...	39 88.90584 Y Yttrium Transition Metal	40 91.224 Zr Zirconium Transition Metal	41 92.90637 Nb Niobium Transition Metal	42 95.94 Mo Molybdenum Transition Metal

Lithium-ion Battery Safety

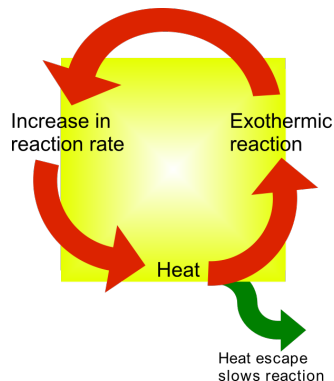


Tampa residents urged to properly dispose of lithium-ion batteries after garbage truck fires

(NEWS)
Lithium-ion batteries a growing fire hazard in NYC garbage trucks, DSNY says

Physical damage to a lithium battery can cause the flammable electrolyte to ignite. Don't throw lithium-ion batteries in the trash! Check for lithium battery collections near you.

Thermal Runaway: An uncontrollable self-heating state. When a lithium-ion cell generates heat at a rate several times higher than the rate at which heat dissipates from the cell.



What do you want batteries to do better?

Can we make batteries:

- Safer
- Cheaper
- Less toxic/more environmentally friendly
- Charge faster
- Hold charge longer
- Store more energy
- Have a higher **energy density** (amount of energy in a given volume). Small, light, powerful battery.
- Last for more charge/discharge cycles
- Recyclable



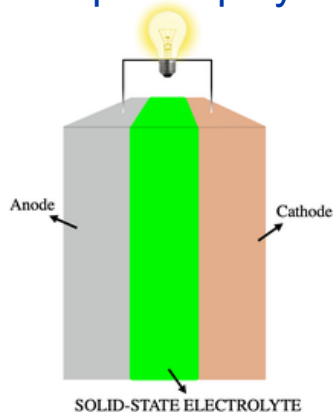
**Chemists are on
the job!**

Coming Next?

Solid Electrolytes:

Use solid electrolyte instead of liquid or gel. Less flammable, safer, faster charging. Lighter, thinner rechargeable battery!

- Inorganic solids
- Solid polymers
- Composite polymer

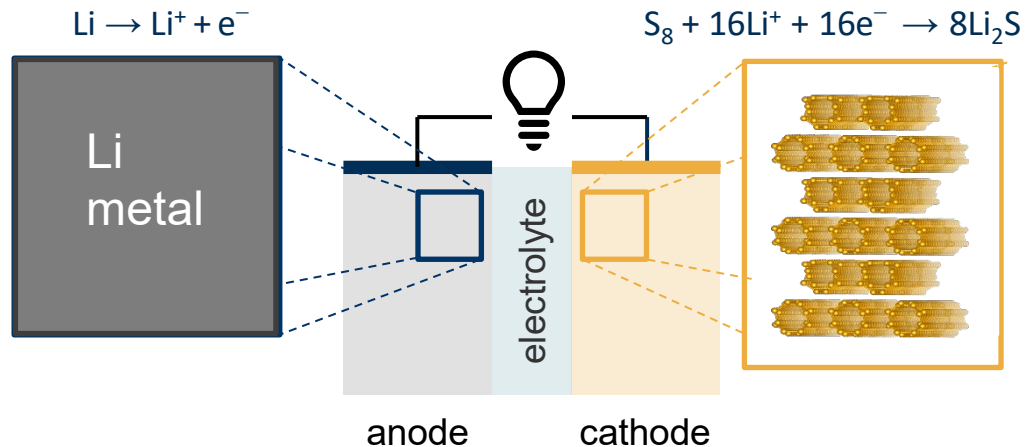


Evolving lithium batteries Lithium-Sulfur:

- Sulfur: Cheaper and abundant
- Higher energy density than lithium-ion batteries



ACS
Chemistry for Life®



Resources

ACS CCEW Resources



During CCEW, ACS provides lots of resources to assist our local sections with their programs and events:

- We provide online resources for outreach programs and activities; and
- Encourage participation in community outreach programs through recruitment, retention and recognition of volunteers.
- Resources can be located on our website at www.acs.org/ccew

April 21-27, 2024

Chemists Celebrate Earth Week

Theme: Get a Charge out of Chemistry

GET A
CHARGE
OUT OF CHEMISTRY

[Plan an Event](#)

[Find an Event](#)

[Spread the Word](#)

[Educational Resources](#)

[General Interest Resources](#)

[Design Toolkit](#)

[About CCEW](#)



To promote the positive role that chemistry plays in the world, ACS established the Chemists Celebrate Earth Week (CCEW) public awareness campaign. During CCEW, ACS members and chemistry enthusiasts celebrate by coordinating events and communicating the importance of chemistry. [Read more about CCEW.](#)

Celebrate batteries and their role in creating a more sustainable world during April 21-27, 2024, which is Chemists Celebrate Earth Week.

Upcoming Themes

[CCEW Themes](#)

[NCW Themes](#)

This year is all about batteries. Batteries have the power because they can accept energy from alternative energy sources such as solar, wind, and hydropower, then store it in chemical bonds. Anywhere and anytime we want, batteries release electrical energy. Today, batteries are an indispensable part of our world. We use them in devices, such as remote controls, wheelchairs, hearing aids, cars, mobile phones, laptops, bike lights, and more.

Did you know that by 2025, the global EV (electric vehicle) market is expected to be valued at \$567 billion? Innovations in battery design and efficiency for the entire lifecycle of batteries will protect our environment even more. *Get a Charge out of Chemistry* as you learn about batteries and their impact on our everyday lives!

Featured Content



Resources - Design Toolkit



- PowerPoint slide
- Social media images
- Web banners
- Flyers
- Mole artwork

**www.acs.org/CCEW*

2024 Illustrated Poem Contest

- Local Section Winner Submission Deadline (students must submit to the local section by)
 - Sunday, April 28 by 11:59 p.m. ET
- Visit the [Illustrated Poem Contest web page](#) for more details
- To nominate your local winners, you must submit the online form located on the website



2023 CCEW Illustrated Poem Contest The Curious Chemistry of Amazing Algae

The [Section name] Local Section of the American Chemical Society (ACS) is sponsoring an illustrated poem contest for students in kindergarten through 12th grade.

Contest Deadline: [Enter deadline]

Prizes: [Enter prize information]

Contact: [Enter contact and address information for submission]

Winners of the [Section name] Local Section's Illustrated Poem Contest will advance to the National Illustrated Poem Contest for a chance to be featured on the ACS website and to win prizes!

Write and illustrate a poem using the CCEW theme, "The Curious Chemistry of Amazing Algae." Your poem must be **no more** than 40 words and in the following styles to be considered:

HAIKU - LIMERICK - ODE - ABC POEM - FREE VERSE - END RHYME - BLANK VERSE

Possible topics related to the theme include:

- Seaweed
- Micro- or macro- algae
- Photosynthesis
- Bioluminescent algae
- Algae as food & habitat for animals
- Consumer products from algae
- Oxygen from algae
- Biofuels from algae

Entries will be judged based upon:









- Artistic Merit - use of color, quality of drawing, design, and layout
- Poem Message - fun, motivational, inspiring about yearly theme
- Originality Creativity - unique, clever and/or creative design
- Neatness - free of spelling and grammatical errors

Contest rules:

- All poems must be no more than 40 words, and in one of the following styles to be considered: Haiku, Limerick, Ode, ABC poem, Free verse, End rhyme, and Blank verse.
- Entries are judged based upon relevance to and incorporation of the CCEW theme, word choice and imagery, colorful artwork, adherence to poem style, originality and creativity, and overall presentation.
- All entries must be original works without aid from others. Poems may be submitted by hand on an unlined sheet of paper not larger than 11" by 14" or scanned and sent via email. Illustrations may be created using crayons, watercolors, other types of paint, colored pencils or markers. The illustration may also be electronically created by using a digital painting and drawing app on a computer, tablet, or mobile device.
- The text of the poem should be easy-to-read and may be typed before the hand-drawn or digital illustration is added, or the poem may be written on lined paper, which is cut out and pasted onto the unlined paper with the illustration.
- No clipart or unoriginal images can be used.
- Only one entry per student will be accepted; all entries must include an entry form.
- If the illustration is created using a digital painting or drawing app, the name of the program must be included on the entry form.
- Acceptance of prizes constitutes consent to use winners' first name and last initial, along with the name of the ACS Local Section, on the ACS web pages and in the magazine, Chemical & Engineering News.



Resources – ACS Store

<p><u>Química Marina</u> (250/R3)</p> <p>Price: \$46.00 Members Pay: \$43.60 On Sale: \$7.50</p>	<p><u>Química del Papel</u> (250/R3)</p> <p>Price: \$46.00 Members Pay: \$43.60 On Sale: \$7.50</p>	<p><u>Protecting Our Planet through Chemistry</u> (250/R3)</p> <p>Price: \$15.00 Members Pay: \$13.50</p>	<p><u>Protegiendo Nuestro Planeta Mediante la Química</u> (250/R3)</p> <p>Price: \$15.00 Members Pay: \$13.50</p>
 <p>2021 CCEW Celebrating Chemistry - English (250/R3)</p> <p>Price: \$15.00 Members Pay: \$13.50</p>	 <p>2021 CCEW Celebrating Chemistry - Spanish (250/R3)</p>	 <p>2022 CCEW Celebrating Chemistry - English (250/R3)</p> <p>Price: \$15.00 Members Pay: \$13.50</p>	 <p>2022 CCEW Celebrating Chemistry - Spanish (250/R3)</p> <p>Price: \$15.00 Members Pay: \$13.50</p>
 <p>CCEW Banner</p>	 <p>CCEW Enviro-Moles (25/R3)</p>	 <p>CCEW Enviro-Tote</p>	 <p>CCEW Mood Pencils (12/R3)</p>



www.acs.org/store

Upcoming Themes



Year	CCEW Theme	NCW Theme
2024	Batteries Theme: Get a Charge out of Chemistry En Español: Recárgate con la Química	Photography & Imaging Theme: Picture Perfect Chemistry En Español: Fotografía Perfecta de la Química
2025	Glaciers Theme: Hot Topic, Cool Chemistry! En Español: ¡Tema Candente, Química Refrescante!	TBD, Mar 2024

Questions



Contact



- Email: outreach@acs.org
- Facebook: [@ACS_Outreach](https://www.facebook.com/ACS_Outreach)



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OUT OF *CHEMISTRY*



April 21-27, 2024 | #CCEW



Thank you!

Please take our quick survey



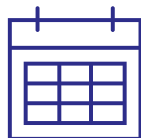
Registration Open



ACS Spring 2024: Many Flavors of Chemistry

March 17-21, 2024
New Orleans, LA





Next Month's Webinar: Social Media in your Local Section



- What: How to utilize social media to communicate and engage within your local section
- When: **Hosted virtually** on Wednesday March 27th, 2024 at 1pm
- Future Webinar Schedule:
<http://www.acs.org/localsectionwebinars>



THANK YOU!