

# Carolina Biological Supply Company

## *Inquiries in Science*®

### Amplify Your Genetics Teaching Skills

### Carolina Teaching Partner



# Focus Questions

- **Do you teach high school?**
- **Do you desire active learning experiences?**
- **Do you use an inquiry approach? What difficulties have you faced?**
- **Is inquiry addressed in your content standards?**

# What Is *Inquiries in Science*®?

**It's an innovative series of hands-on kits.**

- **Helps high school students understand abstract concepts**
- **Lab activities that engage students through guided inquiry**
- **Provides a solid science foundation for students, with far less work for teachers**



# Why *Inquiries in Science*®?

**It works!**

**It successfully teaches difficult concepts by using a simple learning cycle:**

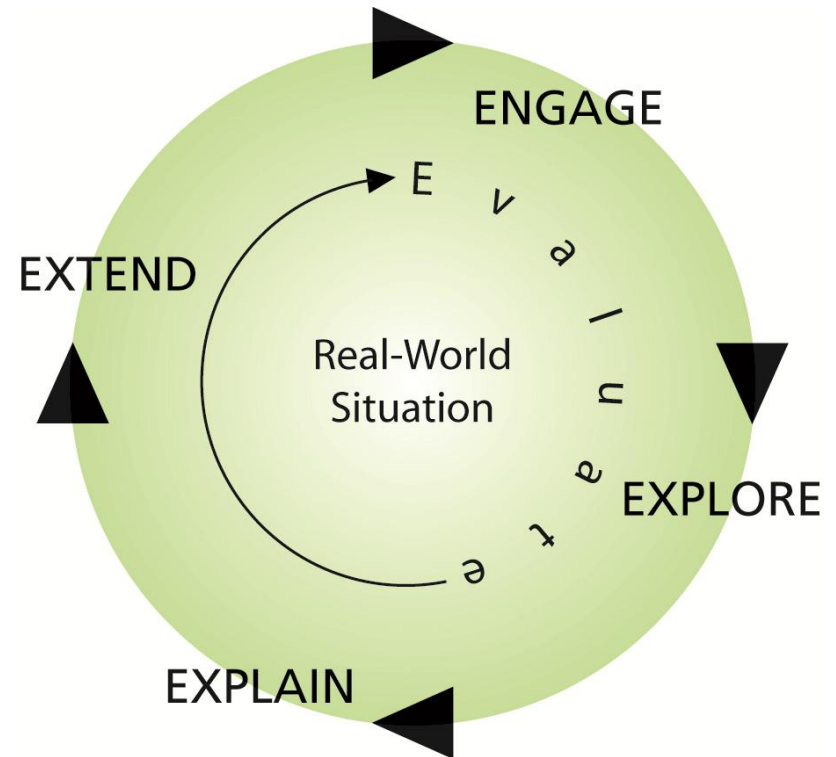
**ENGAGE**

**EXPLORE**

**EXPLAIN**

**EXTEND**

**EVALUATE\***



**\*NEW! FREE pre- and post-assessments are available for every kit in the Biology Series and Chemistry Series.**

# Why *Inquiries in Science*®?

**It's standards-based.**

***Inquiries in Science*® is based on national standards and those of most states. It's flexible, too, letting you choose single topics or complete strands.**

Carolina Biological - Inquiries in Science - Biology

Pennsylvania Academic Standards

Science

Grade 9

ACADEMIC STANDARD	PA.3.1.10.	Science and Technology: Unifying Themes: Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:
STANDARD STATEMENT	3.1.10.A.	Discriminate among the concepts of systems, subsystems, feedback and control in solving technological problems.
STANDARD DESCRIPTOR	3.1.10.A.1.	Identify the function of subsystems within a larger system (e.g., role of thermostat in an engine, pressure switch). <ul style="list-style-type: none"><li>Investigating Cell Types</li></ul>
STANDARD DESCRIPTOR	3.1.10.A.2.	Describe the interrelationships among inputs, processes, outputs, feedback and control in specific systems. <ul style="list-style-type: none"><li>Classifying Across the Kingdoms</li><li>Investigating Cell Types</li><li>Observing Form and Function</li></ul>

# ***Why Inquiries in Science®?***



**It saves time.**

- **Each kit includes supplies for a class of 30**
- **Well-developed, clear instructions for quick setup**
- **Saves time planning—no guesswork**
- **Most materials needed are included**

# ***Why Inquiries in Science®?***

## **It's easy to use.**

- **Just open the box and get started.**
- **All background information, easy-to-follow instructions, and teacher's manual are included.**
- **The activity is correlated to textbooks, so it is easy to fit in.**
- **And, the sturdy kit box makes storage easy.**



# Anatomy of the Teacher's Manual

## Guidance for teachers

- Learning goals
- Content standards
- Time requirements
- Materials review
- Safety information

### SAFETY

Ensure that students follow safe laboratory practices when performing any activity in the classroom or lab. Demonstrate the protocol for correctly using the instruments and equipment necessary to complete the activities, and emphasize the importance of proper usage. Use personal protective equipment such as safety glasses or goggles, gloves, and aprons when appropriate. Model proper laboratory safety practices for your students, and require them to adhere to all laboratory safety rules. Clean all laboratory equipment after each use. Appropriate MSDS (Material Safety Data Sheets) are included in the kit.

Avoid skin or clothing contact with any of the chemicals used in this lab. Be particularly careful with silver nitrate, which will stain skin and clothing.

### Disposal

Follow all local and state recommendations for chemical disposal. Metals can be cleaned (with steel wool, vinegar, or sandpaper) and reused.



### NOTES

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### LEARNING GOALS

Students use a guided-inquiry technique (explained fully in the "Instructional Approach" section) to discover how metals can vary in terms of chemical activity. This knowledge is used to test various combinations of metals to produce voltaic cells. The cell with the highest voltage is used to power various electrical devices and to power an electrolytic cell for extracting elements and plating metals. Finally, students design experiments for investigating variables that could affect the voltage and amperage output of their voltaic cell.

Students will

- develop the skills necessary to design and perform scientific investigations.
- develop an activity series for a given set of metals based upon their chemical activity.
- test various combinations of metals for voltaic cells to find the "best" cell, i.e., the one having the highest voltage and amperage output.
- use voltaic cells to power an LED lamp (and, if available, other electrical devices that use a AA 1.5 V battery, such as headphone radios and portable music players).
- connect in a series five or six voltaic cells to power a 9 V radio (or similar device) for a class demonstration.
- use their voltaic cell to power an electrolytic cell for extracting elements and plating metals.
- design an investigation to measure how voltage and amperage output are affected by specific variables.



### CONTENT STANDARDS

This kit is appropriate for high school students and addresses the following National Science Education Standards:

#### Grades 9–12

##### Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

##### Physical Science

- Structure and properties of matter
- Chemical reactions

# Anatomy of the Teacher's Manual

## Guidance for teachers

- Science content
- Preparation
- Implementation
- 5E step components
- Helpful hints

### HELPFUL HINTS

- To facilitate sharing and easy access, choose centrally located tables or counters for the Chemical Station (30-mL chemical dropping bottles, etc.) and the Measurement Station (voltmeters and amp meters, or multimeters).
- Another way to measure volume from the chemical dropping bottles is to use this rule of thumb: 20 standard drops = 1 mL.
- Oxidation on the metal strips can be cleaned with steel wool, with the exception of the magnesium strip. The best way to clean the magnesium is to fold it in half, place it in a jelly tray, and cover it with white vinegar for approximately two minutes.
- Remind your students to be extremely cautious with the silver nitrate solution, which will stain both skin and clothing.



#### IMPORTANT TERMS

anode  
cathode  
electrolytic cells  
oxidation reaction  
redox reaction  
reduction reaction  
voltaic cells

#### SCIENCE CONTENT

##### Electrochemistry

Imagine a world in which batteries are nonexistent. Our lives would be much more difficult if we could not rely on the energy supplied by batteries. Batteries belong to the area of science known as electrochemistry. The first battery in Western civilization, the "Voltaic pile," was invented by Alessandro Volta in 1800. It was a stack of alternating zinc and silver disks separated by pieces of saltwater-soaked cloth. Before the invention of the commercial electric generator in 1870, a "wet cell" known as a Daniell cell (or crow's foot cell), was used to power telegraphs, doorbells,

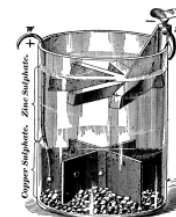


Figure 1. A Daniell cell.

and railway signaling systems. A Daniell cell consisted of a glass jar containing a star-shaped copper electrode at the bottom covered with dense copper sulfate solution, and a zinc crow's foot-shaped electrode located near the top covered with a solution of sulfuric acid or zinc sulfate (see Figure 1). This cell could be regenerated periodically by adding more copper sulfate crystals and sulfuric acid or zinc sulfate solution.

Two advantages of batteries are portability (particularly "dry cell" batteries) and lack of moving parts, traits not shared by electric generators powered by fossil fuels, moving water, or nuclear energy. There is only the quiet and efficient conversion of chemical energy into electrical energy. This electrical energy, known as direct current (DC), continues to be delivered until the chemicals and/or one of the electrodes are consumed.

##### Activity Series of Metals

The principle behind batteries or "voltaic cells" depends upon the relative chemical activity of two dissimilar metals. Every metal has a tendency to be oxidized, that is, to lose electrons. If these electrons are channeled through an external circuit, they can do useful work. The greater the tendency to be oxidized, the more reactive the metal (see Figure 2).

Oxidation is a common occurrence. We see iron and steel structures corrode as they lose electrons, creating  $\text{Fe}^{2+}$  ions that form compounds with oxygen known as iron(II) oxide ( $\text{Fe}_2\text{O}_3$ ), or rust. Coinage metals (copper, silver, and gold) were used early in ancient civilizations because they did not oxidize easily with other elements, and thus maintained their luster. Gold is prized for jewelry because of its relatively low chemical activity.

#### NOTES

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# Anatomy of the Teacher's Manual

## Guidance for teachers

- Student misconceptions
- Differentiated instruction
- Extension activities
- Additional resources

### RESOURCES

#### Web Sites

*At the time of this printing, the following Web sites were active. You may wish to perform an independent search for similar sites.*

How Batteries Work. ©HowStuffWorks, Inc.

This Web site covers the chemistry of batteries, the history of batteries, and the various types of batteries. It includes numerous illustrations and photos, related content, articles, and links.

<http://electronics.howstuffworks.com/battery.htm>

"Galvanic Cells and Electrodes." All About Electrochemistry. ©Stephen Lower. Simon Fraser University—Burnaby/Vancouver Canada.

This Web site explains the chemistry of half-cell reactions, charge transport, types of electrodes, and cell description conventions. It also provides a detailed concept map.

<http://www.chem1.com/acad/webtext/elchem/ec2.html>

### STUDENT MISCONCEPTIONS

- The larger the size of the electrodes, the more voltage a voltaic cell will produce.
- A battery or voltaic cell has a positive anode and a negative cathode. *This is only true for electrolytic cells.*
- All batteries can be recharged. *Only those that are designated as such are rechargeable.*
- Batteries produce AC current. *Batteries produce only DC current.*
- Batteries produce electricity. *Electricity is a process that occurs spontaneously when certain conditions are met. These conditions include a completed circuit of conductive material, and something to initiate a flow of electrons from atom to atom in the circuit, such as the potential difference a battery provides, or the movement of a wire in a magnetic field, as in a generator.*




### DIFFERENTIATED INSTRUCTION

- Have English Language Learners create flash cards of the Important Terms in the margin of the Science Content section. Have them write a word and draw a picture, graph, or diagram on one side of the card. Have them write the definition of the word on the other side of the card.
- If you have students who are poor readers, have them make concept maps listing all of the components and reactions of voltaic and electrolytic cells. Venn diagrams and graphic organizers are valuable learning tools for contrasting the similarities among and differences between voltaic and electrolytic cells.
- Assign tactile learners in student groups to be the lab "engineers" who assemble and monitor the voltaic and electrolytic cells.
- Create a PowerPoint® presentation of a working model of a voltaic and electrolytic cell showing the half-cell reactions, direction of current flow, charge on the electrodes, salt bridge, and voltage.
- Advanced learners can research the form and function of batteries of the future, cells that will be capable of recharging in minutes and be rechargeable as many as 20,000 times. Another possibility is the future production of flexible paper batteries that contain electrolytes with small, imbedded nanotubes serving as electrodes.



# Living Materials

- **Any kit containing living materials will not ship with the live specimens.**
  - **A prepaid coupon will be included with the kit to request the living materials later (no additional shipping charges apply).**
- 
- **Submit the coupon to Carolina at least 2 weeks prior to the requested delivery date.**
  - **Coupon request can be submitted by phone, fax, email, or mail.**

# Demonstration

## Introducing Biotechnology

Prior to today's demonstration:

- ***Engage***—By discussing the ethical issues surrounding biotechnology and its use
- ***Explore***—Extract DNA from cheek cells to visualize human genomic DNA

# Demonstration

## Introducing Biotechnology

Today we will:

- ***Explore***—Simulate DNA fingerprinting using dye samples run through a gel box
- ***Extend***—Observe the results of the gel and compare this simulation to a real DNA fingerprint

# Activity 1

## Understanding Reproduction and Chromosomes

Prior to today's activity:

- ***Engage***—By discussing sexual reproduction
- ***Explore***—View asexual reproduction using microscope slides

# Activity 1

## Understanding Reproduction and Chromosomes

Today you will:

- ***Explore***—Chromosomes and karyotyping
- ***Extend***—By determining gender and comparing karyotypes

# Activity 2

## Discovering Nucleic Acids

**Prior to today's activity:**

- ***Engage***—By discussing DNA and mutations
- ***Explore***—The steps of protein synthesis

# Activity 2

## Discovering Nucleic Acids

Today you will:

- ***Explore***—By “mutating” a sample DNA strand
- ***Explain***—The changes that took place in the protein synthesis

# Reporting Out

## Share:

- **Concepts investigated**
- **Usefulness of kit materials**
- **One positive experience**
- **Suggestions for classroom use**

# Kit Showcase

***Inquiries in Science***<sup>®</sup> Introducing Biotechnology Kit  
(catalog no. 251008)



# Kit Showcase

***Inquiries in Science***<sup>®</sup> Discovering Nucleic Acids Kit  
(catalog no. 251005)



# Kit Showcase

## ***Inquiries in Science***<sup>®</sup> Understanding Reproduction and Chromosomes Kit (catalog no. 251007)



# Purchasing Options

- **Purchase as:**
  - **Individual kits**
  - **Bundled lab packages**
  - **A complete lab course**
- **Refurbishment sets available**
- **[www.carolina.com/inquiries](http://www.carolina.com/inquiries)**
- **800.334.5551**

# Additional Resources

- **Exhibit booth staff**
- **Web site: [www.carolina.com/inquiries](http://www.carolina.com/inquiries)**
- ***Carolina*<sup>™</sup> Science catalog**
- **Contact Melissa Hodges:  
[Melissa.Hodges@carolina.com](mailto:Melissa.Hodges@carolina.com)  
or 800.227.1150, ext. 6355**

# Evaluations: Share Your Thoughts!

**Scale = 1 to 10**

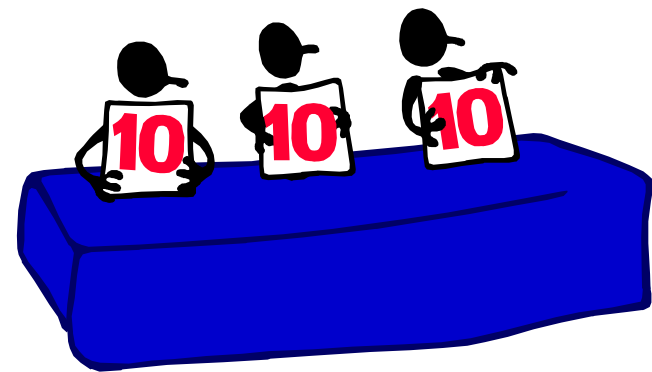
**10 = Outstanding**

**9 = Above Average**

**8, 7 = Average**

**6, 5, 4 = Below Average**

**3, 2, 1 = Well Below Average**

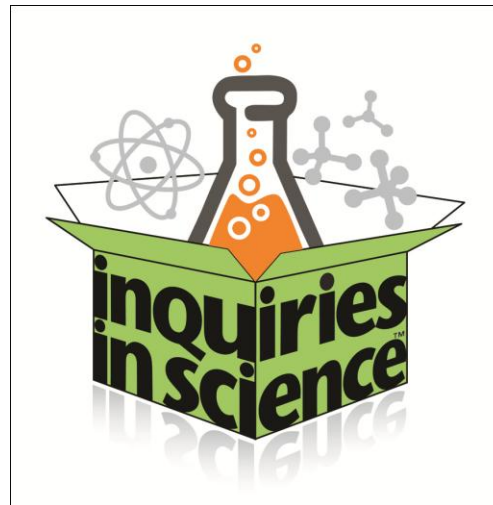


**Please provide comments!**

# Questions?



**Biology  
Series**



**Chemistry  
Series**



**Environmental  
Science Series**

# Carolina Free Resources



**Carolina offers many free resources to help support teachers.**

**CAROLINA®**  
**www.carolina.com**



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**www.carolina.com**

# **Carolina Biological Supply Company**

**Thank you for attending our *Inquiries in Science*<sup>®</sup> Amplify Your Genetics Teaching Skills workshop.**

**For all of your classroom needs, visit our Web site at [www.carolina.com](http://www.carolina.com).**

**Enjoy the rest of the conference!**