



**Reading Supports**

**Teacher’s Guide:**

**“The Shocking Chemistry of Electric Eels”**

*October/November 2018*

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



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of Electric Eels”***

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# Reading Supports

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 designed to help students prepare to read the article, and then locate and analyze information from the article.

* **Anticipation Guide (p. 5):** 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.

**Or** consider the following ideas to engage your students in reading:

**The Shocking Chemistry of Electric Eels**

* Before reading, ask students what they have heard about electric eels and if they have ever seen an electric eel.
* As they read the article, ask students to write at least three new things they learned about electric eels and how they produce electricity.
* **Graphic Organizer (p. 6):** 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. 7):** 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 Resources for More Information” section of the Teacher’s Guide: Tools and Resources provides sources for additional information that might help you answer these questions.

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

## Anticipation Guide

**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. Electric eels usually kill their prey by electrocution. |
|  |  | 1. Electric eels can use low voltages to locate their prey. |
|  |  | 1. Copper gives up electrons more easily than zinc. |
|  |  | 1. Alessandro Volta was inspired by electric eels to produce the world’s first human-made battery. |
|  |  | 1. The voltage in a battery is determined by how many cells are linked together. |
|  |  | 1. The shock from an electric eel is very painful, but does not have enough current to kill a person. |
|  |  | 1. Electric eels have special cells that can pump ions in or out of the cells, creating an electric potential. |
|  |  | 1. It takes more than a minute for a nerve impulse to travel through an electric eel’s body. |
|  |  | 1. The shock from an electric eel is delivered by its tail. |
|  |  | 1. Scientists are studying electric eels to design implantable batteries in people. |

## Graphic Organizer

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

**Directions**: As you read the article, complete the graphic organizer below to describe how electric eels produce and use electricity.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **What is it?** | **Voltage produced** | **How it works** |
| **Electrolocation** |  |  |  |
| **Electrocyte** |  |  |  |
| **Battery** |  |  |  |

**Summary:** In the space below, or on the back of this paper, write a short explanation of why a shock from an electric eel is painful but not lethal to humans.

## Student Reading Comprehension Questions

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

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

* 1. How did Alexander von Humboldt collect the live electric eels?
  2. Describe two ways electric eels capture their prey.
  3. What is a common misconception about the electric eel (*Electrophorus electricus*)?
  4. What is the difference between an electrolyte and an electrocyte?
  5. What chemical aspect of the eel’s electric organs is similar to Volta’s first battery?
  6. What property of metals makes them have “high electrical activity”?

**Student Reading Comprehension Questions, cont.**

* 1. What is the driving force in a battery?
  2. What is a person’s reaction when shocked with a current between 50 and 150 milliamps?
  3. How is an electric potential of about 150 millivolts created in the electrocytes of the electric eel?
  4. How long does it take for a nerve impulse to travel through all the electrocytes before an electric eel can deliver a shock?

**Critical-Thinking Questions**

***Write your answers on another piece of paper if needed.***

* + 1. Use the Activity Series in Figure 2 to explain the direction of electron flow in a lithium/copper battery.

1. Compare voltage and current as they relate to batteries.

## Answers to Reading Comprehension Questions

1. **How did Alexander von Humboldt collect the live electric eels?**

Alexander von Humboldt’s crew drove horses into the water causing the eels to come to the surface where they were easier to catch.

1. **Describe two ways electric eels capture their prey.**
2. Eels use a high-voltage jolt to stun their prey, causing all its muscles to contract at once. The eel can then capture the immobilized prey.
3. Eels send out rapid, low-voltage pulses of electricity that can cause neighboring fish to twitch. Sensing this movement in the water, the eel can locate the prey and go in for the kill.
4. **What** **is a common misconception about the electric eel (*Electrophorus electricus*)?**

A common misconception about the electric eel (*Electrophorus electricus*) is that because of its eel-like appearance and name, people think it **is** an eel when, really, it is a **fish** related to the catfish.

1. **What is the difference between an electrolyte and an electrocyte?**

An electrolyte is a compound that breaks down into ions in a solvent, creating an electrically conductive solution. An electrocyte is an electrically excitable cell.

1. **What chemical aspect of the eel’s electric organs is similar to Volta’s first battery?**

The electric organs of the electric eel contain metal ions dissolved in the fluid within and surrounding their cells to generate current, similar to the sodium and chloride ions that make up the electrically conductive solution in Volta’s first battery.

1. **What property of metals makes them have “high electrical activity”?**

The ability to lose electrons easily makes metals have high electrical activity.

1. **What is the driving force in a battery?**

The driving force in a battery is the difference in electrical potential energy, which is the battery’s voltage.

1. **What is a person’s reaction when shocked with a current between 50 and 150 milliamps?**

When someone is shocked using 50–150 milliamps of current, they feel extreme pain, respiratory arrest, severe muscular contractions and, possibly, death.

1. **How is an electric potential of about 150 millivolts created in the electrocytes of the electric eel?**

An electric potential of about 150 millivolts is created in the electrocytes of the electric eel when a nerve impulse is sent to the cells’ ion channels, causing sodium ions to rush in one side of the cells and potassium ions to rush out of the other side.

1. **How long does it take for a nerve impulse to travel through all the electrocytes before an electric eel can deliver a shock?**

It takes just 2 milliseconds for a nerve impulse to travel through all the electrocytes prior to an eel delivering a shock to its prey.

**Critical-Thinking Question(s)**

1. **Use the Activity Series in Figure 2 to explain the direction of electron flow in a lithium/copper battery.**

Since lithium is more active than copper, it will give up electrons more readily than copper does. Therefore, the electrons will flow away from lithium and toward the copper electrode when the two are connected by a wire. Thus, the lithium will be the anode and the copper will be the cathode.

1. **Compare voltage and current as they relate to batteries.**

Voltage is the difference in two electrical potential energies, while current is based on the number of electrons that pass a point in a given amount of time. Voltage is the force pushing the electrons, while current is the movement and streaming of those electrons.