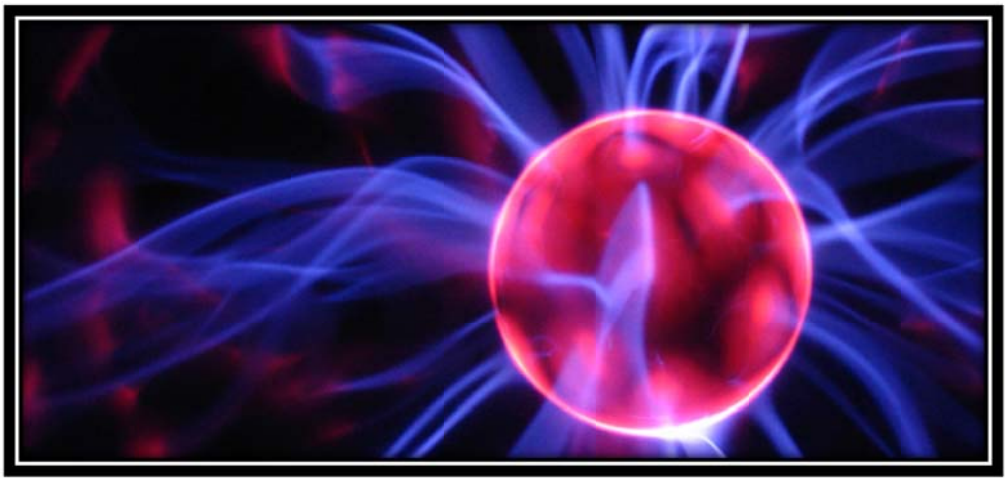
ELECTRICITY

GRADE 4

ASSESSMENT PACKET

An electrifying course that teaches the big ideas behind Faraday and Maxwell's ground-breaking work. You will discover how to design and test circuits, detect electric charge, learn about electrochemistry as you construct batteries, play with the static electric field, and uncover the mysterious forces that redefined the entire field of chemistry and physics when they were first discovered.



Created by Aurora Lipper, Supercharged Science

www.SuperchargedScience.com

This curriculum is aligned with the National Standards and STEM for Science.

Educational Goals

The scientific principles we're going to cover were first discovered by a host of scientists in the 19th century, each working on the ideas from each other, most prominently James Maxwell and Michael Faraday.

This is one of the most exciting areas of science, because it includes one of the most important scientific discoveries of all time: how electricity and magnetism are connected. Before this discovery, people thought of electricity and magnetism as two separate things. When scientists realized that not only were they linked together, but that one causes the other, the field of physics really took off.

Here are the scientific concepts:

Static Electricity

- The proton has a positive charge, the neutron has no charge, and the electron has a negative charge. These charges repel and attract one another kind of like magnets repel or attract. Like charges repel (push away) one another and unlike charges attract one another. Generally things are neutrally charged. They aren't very positive or negative, rather have a balance of both.
- Objects that are electrically charged can create a temporary charge on another object.
- The triboelectric series is a list that ranks different materials according to how they lose or gain electrons.

Electricity

- When electric current passes through a material, it does it by electrical conduction.
- Metals are conductors not because electricity passes through them, but because they contain electrons that can move.

Electrochemistry

- There are different kinds of conduction, such as metallic conduction, where electrons flow through a conductor (like metal) and electrolysis, where charged atoms (called ions) flow through liquids.

By the end of the labs in this unit, students will be able to:

- Design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.
- Know how to demonstrate that electrically charged objects attract or repel each other.
- Know electrical energy can be converted to heat, light, and motion.
- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the weight, length, or volume of objects.
- Formulate and justify predictions based on cause-and-effect relationships.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Construct and interpret graphs from measurements.
- Follow a set of written instructions for a scientific investigation.

NOTE: This assessment packet contains three sets of evaluations: one for static electricity, current electricity, and electrochemistry.

Static Electricity Grade 4 Evaluation

Teacher Section

Overview: Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time: 45-60 minutes

Objectives: Students will be tested on the key concepts of electricity:

1. The proton has a positive charge, the neutron has no charge, and the electron has a negative charge. These charges repel and attract one another kind of like magnets repel or attract. Like charges repel (push away) one another and unlike charges attract one another. Generally, things are neutrally charged. They aren't very positive or negative, but rather have a balance of both.
2. Objects that are electrically charged can create a temporary charge on another object.
3. The Triboelectric Series is a list that ranks different materials according to how they lose or gain electrons.

Students will also demonstrate these principles:

4. Design and build simple experiments that demonstrate the principles above.
5. Know how to demonstrate that electrically-charged objects attract or repel each other.

Materials (one set for entire class)

- balloon
- ping pong ball
- paper

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical

Students will demonstrate individually that they know electrically-charged objects attract or repel each other. While other kids are waiting for their turn, they have a choice of three different homework assignments to get started on. You choose whether they get to work together or individually.

Static Electricity Grade 4 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about electrical charges and how they interact with each other. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to choose which homework assignment you want to complete. The assignment is due tomorrow, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one:
    a. Write a short story or skit about static electricity from the perspective of the electron or proton. You'll read this aloud to your class.
    b. Make a poster that teaches the main concepts to static electricity. When you're finished, you'll use it to teach to a class in the younger grades and demonstrate each of the principles that you've learned.
    c. Write and perform a poem or song about static electricity. This will be performed to your class.

Static Electricity Grade 4 Quiz

Teacher's Answer Key

1. What charge do the proton, neutron, and electron have? *The proton has a positive charge, the neutron has no charge, and the electron has a negative charge.*
2. What happens when you bring two like charges together? Two opposite charges? *Like charges repel (push away) one another and unlike charges attract one another.*
3. What charge are most things? *Generally things are neutrally charged. They aren't very positive or negative, rather have a balance of both.*
4. How do I know if an object is positively or negatively charged? *The Triboelectric Series is a list that ranks different materials according to how they lose or gain electrons.*
5. Why does hair stick to a balloon when you rub it on your head? *If you rub a balloon on your head, the balloon is now filled up with extra electrons, and now has a negative charge, leaving a lot of positively-charged protons on your head. Opposite charges attract, so the hair sticks to the balloon.*
6. Can you see electrons? Why or why not? *Nope. The radius of an electron is approximately 0.000000000000002 meters. Way too small for the human eye to detect.*
7. If you bring a charged balloon near a stream of orange juice, what happens and why? *Orange juice is made out of water. The water molecule is a polar molecule, meaning that it acts like a tiny bar magnet in that it has a positive and negative end. Water is a liquid, which means that these little water molecules can rotate and move easily. The charged balloon influences the direction that the mini-magnets line up as they flow past.*
8. I have a foam plate, plastic bag, a bottle of rubbing alcohol, and a piece of wool. How can I generate a positive electrical charge? How will I really know it's positive? *A balloon takes on a negative charge when rubbed on hair. When a foam plate is rubbed with wool, the plate takes on electrons and creates a negative charge on the plate. To give the plate a positive charge, rub it with a plastic bag. The rubbing alcohol is not used.*
9. What does an electroscope detect? How do you know when it has detected it? *An electroscope detects electrons, or negative electric charges. The negative charge hits the foil ball, which conducts down the paperclip to the foil leaves. Since the foil is now the same negative charge, they move apart and deflect into a V-shape, indicating the presence of a negative charge region.*
10. Why does a neon bulb light up when brought close to a static source? *Fluorescent lights, or any tube of gas from the noble gases column on the periodic table, will light up in an electric field. A fluorescent tube is lined with white stuff called phosphor, which gives off light whenever it's struck by UV rays. The tube is filled with a gas that gives off UV rays when placed in an electrical field. When the bulb is brought close to a static charge, electrons rip through the tube and go out the other side. As they go through, they smack into the gas vapor which releases light rays (UV in a fluorescent tube) that hit the phosphor on the inside of the tube, which then emits light.*
11. Why do the leaves in the electroscope take on the same charge as the foil ball? *Because the foil ball, the paperclip, and the foil leaves all conduct electricity.*
12. Draw a diagram that shows the yardstick Electrostatic Motor experiment set, and the location of the positive and negative charges on the balloon and the yardstick. Your diagram should clearly explain what's going on and why. You can use another sheet of paper if needed. *Kids should draw something that resembles a stick with plus signs on the end and minus signs toward the middle. Nearby should be a circle that represents the balloon, which has minus signs all over it. The negative charge in the balloon repels the electrons in the yardstick, exposing those positive protons, which are attracted to the balloon. Since the stick is free to rotate, it chases the balloon around in a circle, indicated by an arrow.*

Static Electricity Grade 4 Quiz

Name_____

1. What charge do the proton, neutron, and electron have?

2. What happens when you bring two like charges together?

3. What charge are most things?

4. How do I know if an object is positively or negatively charged?

5. Why does hair stick to a balloon when you rub it on your head?

6. Can you see electrons? Why or why not?

7. If you bring a charged balloon near a stream of orange juice, what happens and why?

8. I have a foam plate, plastic bag, a bottle of rubbing alcohol, and a piece of wool. How can I generate a positive electrical charge? How will I really know it's positive?

9. What does an electroscope detect? How do you know when it has detected it?

10. Why does a neon bulb light up when brought close to a static source?

11. Why do the leaves in the electroscope take on the same charge as the foil ball?

12. Draw a diagram that shows the yardstick Electrostatic Motor experiment set, and the location of the positive and negative charges on the balloon and the yardstick. Your diagram should clearly explain what's going on and why. You can use another sheet of paper if needed.

Static Electricity Grade 4 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- balloon
- ping pong ball
- paper

Lab Practical: Ask the student *Note: Answers given in italics!*

- Design and build an experiment that shows how electrically-charged objects attract each other. *Rub a balloon on your head and lift it up six inches. The hair (positive charge) is attracted to the balloon (negative charge). Or bring it close to the ping pong ball and show how the positive charges in the ball are attracted to the balloon.*
- Design and build an experiment that shows how electrically-charged objects repel each other. *Rip the paper into tiny bits. Rub a balloon on your head and bring it close to the paper. The positive charge in the paper is attracted to the balloon (negative charge). The paper takes on the charge of the balloon and quickly jumps off.*
- Explain how objects that are electrically charged can create a temporary charge on another object. *The positive charges in the wall are attracted to the huge negative charge in the balloon, so the balloon sticks to the wall. The balloon also repels the negative charges in the wall, creating a temporary charge in the wall right around the balloon.*

Static Electricity Grade 4 Lab Practical

Student Worksheet

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a homework assignment as you do this test individually with a teacher.

Materials:

- balloon
- ping pong ball
- paper

Lab Practical:

- Design and build an experiment that shows how electrically-charged objects attract each other.

- Design and build an experiment that shows how electrically-charged objects repel each other.

- Explain how objects that are electrically charged can create a temporary charge on another object.

Electricity Grade 4 Evaluation

Teacher Section

Overview: Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time: 45-60 minutes

Objectives: Students will be tested on the key concepts of electricity:

1. When electric current passes through a material, it does so by electrical conduction.
2. Metals are conductors not because electricity passes through them, but because they contain electrons that can move.
3. There are different kinds of conduction, such as metallic conduction, where electrons flow through a conductor (like metal) and electrolysis, where charged atoms (called ions) flow through liquids.

Students will also demonstrate these principles:

4. Design and build simple series and parallel circuits by using components such as wires, batteries, switches, and LEDs.
5. Know electrical energy can be converted to heat, light, and motion.

Materials (one set for entire class)

- AA battery case
- 2 AA batteries
- 4 alligator wires
- switch
- LED
- 1.5-3VDC motor

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical

Students will demonstrate individually that they know how to wire up a circuit and explain how electrical energy can be converted to heat, light, and/or motion. While other kids are waiting for their turn, they have a choice of three different homework assignments to get started on.

Electricity Grade 4 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about electricity and how it works. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to choose which homework assignment you want to complete. The assignment is due tomorrow, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one that you didn't choose from the Static Electricity homework assignment last time:
    a. Write a short story or skit about electricity from the perspective of the wire or the electrical component. You'll read this aloud to your class.
    b. Make a poster that teaches the main concepts to electricity. When you're finished, you'll use it to teach to a class in the younger grades and demonstrate each of the principles that you've learned.
    c. Write and perform a poem or song about electricity. This will be performed to your class.

Electricity Grade 4 Quiz

Teacher's Answer Key

1. What is the difference between a bolt of lightning and the electricity in your circuit? *Quantity.*
2. How does electricity pass through a material? Name two different ways. *By conduction: metallic conduction, electrolysis.*
3. What kinds of materials are conductors and insulators? Name three of each.
   a. *Conductor: paperclip*
   b. *Conductor: key*
   c. *Conductor: metal unpainted zipper*
   d. *Insulator: paper*
   e. *Insulator: foam*
   f. *Insulator: glass*
4. What is an NC SPST switch? How does it work when placed in a circuit? *SPST stands for Single Pole Single Throw, which means that the switch turns on only one circuit at a time. When the switch is engaged, current flows. When it's not, the circuit is broken open and electricity stops. NC stands for Normally Closed, which means that the switch allows electricity to flow until it's activated. In a circuit, when this switch is pressed, the current stops.*
5. What's the difference between an incandescent light bulb, a fluorescent light, and an LED?
   a. *The incandescent light bulb uses a wire that glows when electric current runs through it. To keep the wire from burning itself up, the air is removed from the bulb and replaced with an inert gas. The wire is made from the element tungsten.*
   b. *A fluorescent tube is lined with white stuff called phosphor, which gives off light whenever it's struck by UV rays. The tube is filled with a gas that gives off UV rays when placed in an electrical field. When the bulb is brought close to a static charge, electrons rip through the tube and go out the other side. As they go through, they smack into the gas vapor which releases light rays (UV in a fluorescent tube) that hit the phosphor on the inside of the tube, which then emits light. Fluorescent lights, or any tube of gas from the noble gases column on the periodic table… like neon will also glow in an electrically charged field.*
   c. *LED stands for "Light Emitting Diode". They don't have a filament so they don't get hot.. They light up by the movement of electrons in a semiconductor material (more on this later), and they last a long time, like thousands of hours.*
6. If you measure 2.85 volts from your battery pack, do you need new batteries or will they work? *They will work, because 2.85÷2 = 1.4 Volts. Batteries between 1.3 – 1.5 will work in a circuit.*
7. Where have you used potentiometers in everyday life? *As a dimmer switch, radio control knob, motor speed control on appliances…_*
8. How is a CdS cell like a switch? How is it not like a switch? *The flow of current is controlled by the amount of light that falls on the detector. It's unlike a switch in that it never really stops the current completely.*
9. Is the trip wire an NO or NC switch without the paper inserted? *NC switch.*
10. What is a relay? *A relay is a switch you can turn on and off using electricity. It uses an electromagnet to active the switch inside it.*
11. Imagine your teacher just asked you to hook up a simple circuit to power a motor. Draw the circuit as a diagram below, and show how electricity flows through your circuit (indicate the direction with an arrow). Label every part of your diagram, including every component used. For bonus points, also show where you would put your DMM probes to measure how much voltage the motor is receiving. *DMM probes go one at each motor terminal with motor removed.*

Electricity Grade 4 Quiz

Name_____

1. What is the difference between a bolt of lightning and the electricity in your circuit?

2. How does electricity pass through a material?

3. What kinds of materials are conductors and insulators? Name three of each.
   a. Conductor:
   b. Conductor:
   c. Conductor:
   d. Insulator:
   e. Insulator:
   f. Insulator:

4. What is an NC SPST switch? How does it work when placed in a circuit?

5. What's the difference between an incandescent light bulb, a fluorescent light, and the LED?

6. If you measure 2.85 volts from your battery pack, do you need new batteries or will they work?

7. Where have you used potentiometers in everyday life?

8. How is a CdS cell like a switch? How is it not like a switch?

9. Is the trip wire an NO or NC switch without the paper inserted?

10. What is a relay?

11. Imagine your teacher just asked you to hook up a simple circuit to power a motor. Draw the circuit as a diagram below, and show how electricity flows through your circuit (indicate the direction with an arrow). Label every part of your diagram, including every component used. For bonus points, also show where you would put your DMM probes to measure how much voltage the motor is receiving.

Electricity Grade 4 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- AA battery case
- 2 AA batteries
- 4 alligator wires
- switch
- LED
- 1.5-3VDC motor

Lab Practical: Ask the student *Note: Answers given in italics!*

- Design and build a simple series circuit which lights up an LED and includes a switch. *Battery connects to the LED, which connects to the switch, which connects back to the battery pack. When switch is thrown, LED lights up.*
- Design and build a simple parallel circuit which powers both LED and motor at the same time. *Battery connects to the motor which connects back to the battery pack. Also LED connects to both terminals on the back of the motor. When batteries are in the case, both LED and motor should work.*
- Explain how electrical energy can be converted to light or motion. *Any electrical circuit that involves turning a motor on or lighting up an LED.*

Electricity Grade 4 Lab Practical

Student Worksheet

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a homework assignment as you do this test individually with a teacher.

Materials:

- AA battery case
- 2 AA batteries
- 4 alligator wires
- switch
- LED
- 1.5-3VDC motor

Lab Practical:

- Design and build a simple series circuit which lights up an LED and includes a switch.

- Design and build a simple parallel circuit which powers both LED and motor at the same time.

- Explain how electrical energy can be converted to light or motion.

Electrochemistry Grade 4 Evaluation

Teacher Section

Overview: Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time: 45-60 minutes

Objectives: Students will be tested on the key concepts of electrochemistry:

1. There are different kinds of conduction, such as metallic conduction, where electrons flow through a conductor (like metal) and electrolysis, where charged atoms (called ions) flow through liquids.
2. Electrolytes are a substance (like salt) that becomes a conductor of electricity when dissolved in a solvent (like water).
3. This type of conductor is called an ”ionic conductor” because once the salt is in the water, it helps along the flow of electrons from one clip lead terminal to the other so that there is a continuous flow of electricity.
4. Metals are conductors not because electricity passes through them, but because they contain electrons that can move.
5. Batteries need electrodes made of two dissimilar conductive materials, like metal.

Students will also demonstrate these principles:

6. Design and build a simple battery.
7. Know chemical energy can be converted into electrical energy.

Materials (one set for entire class)

- AA battery case
- 2 AA batteries
- 2 alligator wires
- Distilled white vinegar
- Disposable cup
- Salt
- Sugar
- 2 Pennies
- 2 Nails
- 2 Pieces of plastic
- 2 Popsicle sticks
- Digital Multimeter

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical

Students will demonstrate individually that they know how to build a battery and explain how chemical energy can be converted to electrical energy. While other kids are waiting for their turn, they will get started on their homework assignment. You get to decide whether they do their assignment individually or as a group.

Homework Assignment

Your classroom is going to be converted into an interactive science museum next week by your students. You can invite parents, teachers, lower grade levels, and a camera crew. This is fun, informative, and really gives the kids the credit they deserve for working so hard to learn this science stuff. And they get to do all the work. You're just the consultant. It's really the icing on the teacher's cake.

Here's their assignment: Students will be in charge of one of the stations. Their audience knows nothing about electricity. Their job is to design and build an experiment that teaches the students in lower levels an important concept in one of the following areas: static electricity, electricity, or electrochemistry. They'll get to explain what's going on as they demonstrate their experiment. Your students can have the audience just watch or actively do something at their station. Grade your students based on content and creativity (50-50 split), so really encourage their minds to go wild and try something new mixed with what they already have mastered.

Electrochemistry Grade 4 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's is where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about electrochemistry and how it works. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to get started on your homework assignment. The assignment is due next week, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it.

   Here it is: Your classroom is going to be converted into an interactive science museum next week. You will be in charge of one of the stations. Your audience knows nothing about electricity. Your job is to design and build an experiment that teaches the students in lower levels an important concept in one of the following areas: static electricity, electricity, or electrochemistry. You will get to explain to your students what's going on as you demonstrate your experiment. You can have them watch or actively do something at your station. You will be graded based on content and creativity, so really let your mind go wild. (Hint: If you were the audience, what would *you* want to learn about most?)

Electrochemistry Grade 4 Quiz

Teacher's Answer Key

1. Name three kinds of electrolytes we've used in our electrochemistry experiments. *(Salt water, lemon juice, vinegar and salt.)*
2. Where would you place your DMM probes to measure the generated voltage? *(The black probe on the foil and the red probe on the silverware.)*
3. What happens if you use two strips of the same material? *(You won't have a difference. These copper ions interact with the zinc electrode to form zinc ions. The copper electrons are chemically reacting with the lemon juice to form copper ions. The difference in electrical charge (potential) on these two plates causes a voltage.)* What would happen if we used non-metal strips? *(They don't break into ions, and don't work.)*
4. What kinds of fruit make the best batteries and why? *(Citrus, because of the acid.)*
5. What happens if you put one electrode in one fruit and one electrode in another? *(The ions are not able to be attracted to the different electrodes, so there's no current flowing.)*
6. Where did the copper on your key come from? *(The copper ions in the solution.)*
7. What kind of bubbles formed when we split the water molecule? *(As the water molecule breaks apart into smaller pieces: hydrogen ions (positively charged hydrogen) and oxygen ions (negatively charged oxygen)., they bubble up into the test tube.)*
8. Does plain water conduct electricity? *(You need the electrolytes to carry the current through the water and separate the water molecule into its ions. Without salt, the water acts like a weak insulator and no bubbles will form.)*
9. Why does electricity flow through some solutions but not all of them? *(Salt mixes with water and separates into positively (Na+) and negatively (Cl-) charged particles (ions). If you pass a current through the solution of salt and water, opposites attract: the positive ions are attracted to the negative pole and the negative ions go toward the positive pole. These migrations ions allow electricity to flow, which is why "salt" solutions conduct electricity.)*
10. What is a salt? *(When a substance mixes with water and separates into its positive and negative parts, it's called a "salt.")*

Electrochemistry Grade 4 Quiz

Name_____

1. Name three kinds of electrolytes we've used in our electrochemistry experiments.

2. Where would you place your DMM probes to measure the generated voltage?

3. What happens if you use two strips of the same material? What would happen if we used non-metal strips?

4. What kinds of fruit make the best batteries and why?

5. What happens if you put one electrode in one fruit and one electrode in another?

6. Where did the copper on your key come from?

7. What kind of bubbles formed when we split the water molecule?

8. Does plain water conduct electricity?

9. Why does electricity flow through some solutions but not all of them?

10. What is a salt?

Electrochemistry Grade 4 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- AA battery case
- 2 AA batteries
- 2 alligator wires
- Disposable cup
- popsicle stick
- Digital Multimeter

Electrolyte Options:

- Distilled white vinegar
- Salt
- Sugar

Electrode options:

- 2 pennies
- 2 nails
- 2 piece of plastic
- popsicle stick

Lab Practical: Ask the student *Note: Answers given in italics!*

- Design and build a battery and show how much voltage it produces. *Student will pour vinegar and salt into a cup, stir, and connect the alligator clips to two dissimilar metals (take away points if they use two of the same materials for electrodes). Students will measure voltage by connecting up the alligator clips to the DMM probes and setting it to 20 VDC and reading the voltage. Expect 0.5 to 1 volt.*
- Explain from your experiment above how chemical energy can be converted into electrical energy. *The basic idea of electrochemistry is that charged atoms (ions) can be electrically directed from one place to the other. The NaCl (salt) molecule dissociates in the vinegar into the ions Na+ and Cl-. Na+ is attracted over to the negative electrode and Cl- zips over to the positive. The ions are attracted (directed) to the opposite electrode and there is current in the solution.*

Electrochemistry Lab Practical

Student Worksheet

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a homework assignment as you do this test individually with a teacher.

Materials:

- AA battery case
- 2 AA batteries
- 2 alligator wires
- Disposable cup
- popsicle stick
- Digital Multimeter

Electrolyte Options:

- Distilled white vinegar
- Salt
- Sugar

Electrode options:

- 2 pennies
- 2 nails
- 2 piece of plastic
- popsicle stick

Lab Practical:

- Design and build a battery and show how much voltage it produces.

- Explain from your experiment above how chemical energy can be converted into electrical energy.