Electricity and Magnetism

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Purpose of this unit:

The purpose of this unit is to allow students to learn about electricity and magnetism through discussions, exploring activities, and group and independent learning. Students will also be able to work with making and testing predictions, making inferences, and making and recording observations.

What standards does this unit address?

Standards taken from Hawaii Content and Performance Standards III:

Grade 4: Standard 6: Physical, Earth, and Space Sciences: NATURE OF MATTER AND ENERGY: Understand the nature of matter and energy, forms of energy (including waves) and energy transformations, and their significance in understanding the structure of the universe

Benchmark SC.4.6.2 Explain what is needed for electricity to flow in a circuit to create light and sound

Grade 4: Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process

Benchmark SC.4.1.1 (Scientific Inquiry) Describe a testable hypothesis and an experimental procedure

Benchmark SC.4.1.2 (Scientific Knowledge) Differentiate between an observation and an inference

Stage 1: Classroom Community Profile

***Prompt 1*: *What are the physical factors of the school and classroom*?**

I am in a Title 1, public school in the Central District of Oahu. I teach fourth grade with 16 students that will be in my science class, eight boys and eight girls. The students are seated in groups of four, with two boys and two girls at each table. I teach all general education subjects and have the afternoon block that runs from 12:30 to 1:45 that I can use for science. There is no set pace to the science curriculum. I just need to cover the quarterly state standards each quarter for science, as well as the other subjects. Overall, the students get along well with one another and have all been together in classes for several years. I have a variety of science resources that I am able to obtain from the other grade level teachers. In my own classroom I have a basic science kit, enough that each student could have one, which comes with basic tools such as measuring tape, goggles, magnifying glasses, and tweezers. Once a week I have an EA that comes in to help with my Special Education students in the afternoon. These two students are seated at the same table so that I can provide assistance to them.

Prompt 2: What are the intellectual and academic development levels of this class?

The majority of my students lack analytical and creative thinking skills. They are pretty good at practical thinking but often need much support and assistance to complete assignments. Hands-on activities are extremely important for this class. They also need a lot of examples and explanation and have an endless amount of questions for everything we do. We have to move at a slower pace than the other fourth grade classes to really build understanding and proficiency in skills.

I have two students in a pull out special education class for language arts and math. They are with me for science and struggle mostly when we need to write answers or find answers in a reading and with critical thinking activities. These two students will most likely struggle with learning new concepts and applying them correctly in science, as most of the other students will also. I have several students that show signs of having some form of attention deficit disorder, but have not been formally identified. I have two other students who were retained in previous grades and one girl who never talks when called on. The student who does not talk does not qualify for special education because she has the ability to do grade level work and has also undergone speech observations and testing that have found nothing unusual.

My 14 regular education students are below grade in math. I also have the below grade level reading class when we switch classes for language arts and I have all of my regular ed students then, except for six who are at grade level or above in reading. I have a few students that catch on quickly to new material and are able to assist others. For science, the majority of the class will most likely struggle throughout the unit.

Prompt 3: What are the collective language development characteristics of this class?

There are three English Language Learners, but two do not show signs of being ELL students and do well in speaking, writing, and comprehension. The third has a thick accent and is definitely not proficient in English in all communication areas and in comprehension, whether it is based on reading or verbal questions/instructions from me. All three do go to ESL classes twice a week for 30 minutes in the morning.

For the rest of the class, most students lack the ability to write in ways that are grammatically correct and have a difficult time writing their ideas with complete thoughts. Verbally, the majority of my students also struggle to find words that help others to know exactly what they are trying to say or explain. Descriptions are often vague or unrelated to what is being discussed. I work on this by asking questions to help the students get their ideas out with better explanations. In science, we work on vocabulary and concept development a lot in order to build understanding and use of the correct science terms. For this unit vocabulary will be a major part of developing understanding by using the correct terminology in presenting activities, as well as when having the students explain ideas.

Prompt 4: What are the social dynamics of this class?

As a class, my students are very vocal. Talking never seems to stop. With my one student that does not speak when called on, she does socialize with her peers during class and at lunch and recess. For the most part, all of my students get along with one another and help each other when needed. I have two boys who often say each is being mean to the other, but this varies from day to day. One day they will be friends and the next day will avoid each other. I do not have any major behavior problems or students that act out in class. If problems do arise, most tend to work themselves out. It is rare that I have to step in when there is a conflict between students. Other students that are not involved in the conflict itself tend to be the mediators to help resolve the problem.

Working in groups works well. I do have some problems with socializing preventing work from being done. It often takes several reminders to stay on task to complete assignments in groups. There are a few students who will assume the role of group leaders and help to keep the others on task. I think this definitely helps because it is a peer taking charge rather than a teacher always giving directions. When working in group for science, which the students have not done much, I do foresee a need to delegate tasks and roles within each group so that activities will be completed with little argument, hopefully.

As mentioned before, most lack analytical and creative thinking skills. Practical thinking abilities are pretty good, and for those that are weak in this area, other students are able to help clarify instructions and help with assignments. Overall, I think the students will need a lot of support in science. For some reason, most of the students dislike science greatly. I want to change this mindset through fun activities and hope the students will see that science is just more than a textbook.

Prompt 5: What socio-economic and cultural factors characterize this class?

As stated before, I am in a Title I school with most of my own students receiving reduced or free lunch. Most come from low income families. I think that because all the students come from homes where money and material things are scarce, they can relate to one anther and don't single out a child for not having something. I know there are two students whose families are slightly better off than the others, but they do not use this to put down students and do not show off what they have.

All of my students are local kids, except three- one from the mainland, one from Samoa, and one from the Philippines. Although three students are not from Hawaii, they have been her for several years and seem well adjusted to the culture here. I think that because Hawaii is as diverse as it is, the other students are very accepting to those who are not from here. I don't see students teasing those who are not from Hawaii. It is interesting to hear the students who did not grow up here talk about how they lived in their hometowns and their culture. There are always things we do in class that allows for them to share their perspectives and how life differed in the mainland, Samoa, or the Philippines.

All the students live in Wahiawa and live near the school. Several have divorced parents who are now single parent families or remarried. A few of my students have parents who are of no help or support to their student. Aside from these, overall, my students' parents are helpful and care about their child's learning.

Stage 2: Enduring Outcomes

Prompt 1: What Standards will this Unit Address?

Grade 4: Standard 6: Physical, Earth, and Space Sciences: NATURE OF MATTER AND ENERGY: Understand the nature of matter and energy, forms of energy (including waves) and energy transformations, and their significance in understanding the structure of the universe

Benchmark SC.4.6.2 Explain what is needed for electricity to flow in a circuit to create light and sound

Grade 4: Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process

Benchmark SC.4.1.1 (Scientific Inquiry) Describe a testable hypothesis and an experimental procedure

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Prompt 2: What Big Ideas Characterize This Unit?

- Objects have a positive and negative charge; Most things are electrically neutral (equal number of positive and negative charges)
- Opposite charges attract, while like charges repel (i.e. a magnets south pole is attracted to the north pole, while like poles repel)
- Something with an excess number of one charge will attract the opposite until the numbers are equal
- Electrical forces are stronger when closer and get weaker with distance
- When electricity flows through a wire, a magnetic field forms around it.
- A hypothesis or prediction can be tested by using an experiment.
- An inference makes assertions/draws conclusion about what happened; An observation notes an occurrence.

Prompt 3: What Enduring Outcomes will Students Acquire?

Students will be able to:

- Define the following terms: induced charge, electrically neutral, static electricity, and current electricity
- Make predictions and state observations and inferences
- Retell that opposite charges attract and like charges repel one another
- Recall that electricity will always flow from one thing to another
- Use a wire and battery to light a flashlight bulb

- Create a series and parallel circuit
- Compare and contrast a series circuit and a parallel circuit
- Predict what will happen to the light bulbs in a parallel circuit
- Build a simple compass to detect magnetic fields
- Demonstrate that when an electric current passes through a wire, a magnetic field forms
- Sort magnetic and non-magnetic items by testing items with an electromagnet
- Apply knowledge of electrically charged items or items with an induced charge to explain static electricity experiments

Stage 3: Evidence

Prompt 1: What evidence and applicable tasks will indicate the outcomes have been met?

Enduring Outcomes	Appropriate Evidence	Applicable Tasks	Type of Assessment
Memory: Retell that opposite charges attract and like charges repel.	Accurate description of: opposite charges attract and like charges repel through demonstrations using items such as magnets or accurate drawings with labels.	Drawing pictures with labels or being able to label a given picture; demonstrations of the above outcome and talk with students to check for understanding.	Formative
Recall that electricity will always flow from one thing to another.	Correctly connect a battery, wire, and light bulb to allow the light bulb to light.	Use a light bulb, wire, and battery to discover how a proper connection is needed to create a flow of energy to light the light bulb.	Diagnostic
Analytical: Compare and contrast a series circuit and a parallel circuit.	Detailed explanation of how a series circuit and a parallel circuit are similar and different.	Short response answer to follow a hands-on activity where series circuits and parallel circuits are created.	Diagnostic
Sort magnetic and non-magnetic items by testing items with an electromagnet.	Logical and organized sorting of different objects that are magnetic and non-magnetic.	Use an electromagnet to detect what objects are magnetic and non-magnetic.	Summative
Creative: Create a series circuit and a parallel circuit; Predict what will happen to the light bulbs in a parallel circuit.	Correctly builds and discusses a series circuit and parallel circuit; makes a prediction of what will happen to the light bulbs in a parallel circuit.	Use light bulbs, wires, and batteries to build a series circuit and parallel circuit. Draw and label a picture in a journal with a brief explanation, including a support or correction to the prediction made.	Formative and Summative
Build a simple compass to detect magnetic fields by applying knowledge of induced charges.	Creates a compass that works correctly by detecting the Northern direction (use an actual compass to check).	Uses various materials, including a nail that will be magnetically induced, to create a compass to detect the Northern direction.	Summative
Make predictions and state observations and inferences	Makes predictions that can be tested/observed and observations are recorded. Support for or against prediction is included	Example: In activity where students need to light a light bulb with a wire and battery, a prediction is made on how the set-up will look. Set-up is tested and observations are made. Notes include whether prediction was correct or was not observed.	Diagnostic
Practical: Demonstrate that when an electric current passes through a wire, a magnetic field forms.	Able to create an electromagnet and explain that when the wires are connected to a source of electricity, a magnetic field forms.	Use a battery, iron nail, and insulated copper wire to show that when an electric current flows through a wire, it will become magnetic and have the ability to attract other magnetic items (goes with analytical outcome of sorting items).	Formative
Apply knowledge of electrically charged items to explain static electricity experiments.	Accurately explain how a balloon that has an induced charge will attract pieces of paper, packing peanuts, and repel a stream of water and another charged balloon.	Four science stations where students are able to investigate static electricity. Stations will include using a charged balloon to discover what happens with pieces of paper, packing peanuts, a stream of water, and another charged balloon.	

***Prompt 2: Identify diagnostic, formative, and summative assessments.* (Attach actual assessments)**

***Prompt 3: By what criteria should the assessment product be evaluated; and what levels of mastery should be used to determine quality, proficiency, performance, or understanding? (*Attach rubrics and/or other applicable evaluation criteria)**

- See below for a sample assessment and rubric. (Use for electromagnets)

Sample Assessment for Memory Outcome:
Recall that electricity will always flow from one thing to another.

**Assessment is done to see if students are able to correctly connect a wire, light bulb, and battery to make the light bulb work and to see if they can explain why the light bulb works.*

You will receive a light bulb, wire, and battery. Your job is to use these three items to get the light bulb to turn on. When you get the light bulb to turn on, draw a picture of what you did in your science journal. Be sure to label each part of your diagram. In sentences, explain what you did with your items and tell why the light bulb works.

Rubric:

Meets with Excellence (ME)	All three items are used to light the light bulb. Picture is drawn neatly and labeled correctly. A thorough, detailed explanation is provided on what was done with the three items, as well as why the light bulb works. Explanation includes the battery is the energy source and electricity will always flow from one thing (battery) to another (light bulb). Student works independently to complete task.
Meets with Proficiency (MP)	All three items are used to light the light bulb. Picture is draw and labeled correctly. An explanation is provided to tell what was done with the three items and why the light bulb works. Student needs little to no help to complete task.
Approaching (N)	Student works with the three items, but needs a great amount of assistance to achieve goal. A picture is drawn and labeled. An explanation is included to tell how the three items were used. Explanation of why the light bulb works is missing or incorrect.
Well Below (U)	Student is unable to complete task without assistance. An accurate drawing with labels is not included. Student is unable to tell what to do in order to light the light bulb.

Stage 4: Instructional Blueprint

Lessons	Student Learning Objectives- By the end of this lesson, students should be able to…	Essential Questions	Instructional Strategies/Tasks to Support Differentiation	Formative Assessments
KWL-H, Part 1 (What I Know, What I Wonder, and How Can I Learn It?)	State what they know about electricity & magnetism, what they want to know, and how they can find the answers to their questions	What do I know about electricity and magnetism? What do I want to learn about electricity and magnetism? How can I find this information?	**Independent Work/Class Discussion**: Students fill in their own KWL-H chart, only the KWH columns. After this, we will combine all our ideas to create a class KWL-H chart that will be completed at the end of the unit.	The students complete the KW and H columns of a KWL-H chart.
What is Electricity?	Brainstorm ideas on what electricity is, how it helps us, where it comes from, & what needs electricity to work	What is electricity? How does electricity help us? What needs electricity to work?	**Independent Work/Class Discussion:** Create an idea web as a class. If questions arise, the will be added to the KWL-H chart.	Class discussion about electricity. Each student writes two to three ideas that they will then share with the class.
How Do Magnets Stick?	Describe how magnets attract and repel one another by applying knowledge of north and south magnetic poles.	What happens when two magnets are put together?	**Exploration/Concept Teaching:** Students will be given a variety of magnets (circular, magnetic marbles, bar magnets). Explore to see if they are attracted to one another or if they repel. Class discussion where the concept of north hand south magnetic poles/positive and negative will be introduced. Discuss why magnets repel and when they are attracted to one another.	Drawing pictures with labels to show that like poles repel and opposite poles attract. Demonstrate the above outcome using magnets with an explanation of north and south magnetic poles.
The Magic of Static!	Demonstrate how static electricity allows for objects to attract and repel one another with an induced charge. Define induced charge, electrically neutral, and static electricity.	What is static electricity? What is an induced charge?	**Demonstration/Cooperative Learning/Work Stations/Concept Teaching:** A demonstration is first done by rubbing a balloon on a student's hair to see that when the balloon is lifted, the hair will stand. Concepts to be introduced: induced charge, electrically neutral, and static electricity. Review that like charges repel and opposites attract. There will be four stations to work through with static electricity: activities. Students will make predictions about what will happen and have questions to answer at each station. They will also need to draw pictures of what occurred at each station.	Perform each activity accurately. Questions are answered thoroughly and correctly. Predictions are made and observations recorded. Accurate drawing of what happened with each activity with labels showing if there was an attraction or repulsion.
Suspension with Magnets	Explain how a suspended magnet will always point in the same direction (north magnetic pole towards the north and south magnetic pole towards the south) Compare how this attraction differs from the attraction between two magnets.	What happens when a magnet is suspended? What happens when a magnet is spun when suspended?	**Demonstration/Cooperative Learning:** Begin with a demonstration of a suspended magnet and point out its direction. Spin magnet and notice where it ends. Split into small groups. Students go outside and tie circular magnets to a tree and spin magnet. Compare all magnets. Repeat to see if same results occur. Explain that they have just found the north-seeking pole on the magnet. Use a globe in the classroom to locate north and south direction.	Students complete activity accurately. Create a diagram of a globe with north and south labeled. Draw a magnet to show how a magnet would stop if it were spun around.

Making a Compass	Create a compass by applying knowledge of inducing charges. Use the compass to find the Northern direction	Why does a compass always point to the north? How can a non-magnetic item become magnetic?	**Apply Knowledge/Work in Pairs:** Create a compass with a nail and Styrofoam, using a bar magnet to magnetize the nail. Use a second magnetized nail to check that the nail to be used in the compass is magnetized. Once compass is made, place compass in a tray of water. Watch how compass moves and where it ends. Compare to suspended magnet.	Compass is made correctly. The nail used repels and attracts a second magnetized nail. Students are able to explain which direction the compass ends up facing and compare this activity to the suspended magnets activity. A paragraph is written in a science journal.
Electricity makes a Magnet!?	Compare electricity and magnetism. Describe how a magnet affects a compass. Tell how an electric current affects a compass.	Can electricity make a magnet? How are electricity and magnetism related?	**Explore/Work in Pairs:** Use a bar magnet to see its effect on a compass. Record observations. Tape a wire to a battery and observe what happens when compass is placed near the other end of the wire. Compare electricity and magnetism.	Accurately describe the effect of the magnet and electric current on the compass. Accurate comparison of electricity and magnetism.
Electromagnets	Create an electromagnet. Demonstrate that when an electric current passes through a wire, a magnetic field forms.	What is an electromagnet and how is it formed? What happens when an electric current passes through a wire?	**Explore/Extend/Work in Pairs:** Students create an electromagnet with a partner. Use the electromagnet to sort magnetic and non-magnetic items. Sort these items and record what is found.	Able to create an electromagnet and explain why/how it can be used to sort magnetic and non-magnetic items. Logical/organized sorting of items.
And Then There Was Light…	Light a flashlight bulb with a wire, D battery, and masking tape. Explain that electricity will always flow from one thing to another. Define current electricity and how it differs from static electricity.	How can a battery light a light bulb? What is the difference between an electrical current and static electricity?	**Work Independently/Class Discussion/Concept Teaching:** Students are given materials: D battery, flashlight bulb, masking tape, and wire that has ends stripped. A prediction is made about what the set-up will look like. They work independently to test their prediction and record the results. If students are not able to light the bulb, we move on to a discussion and work together to connect the materials to allow the light bulb to light. Talk about current electricity. Compare to static electricity.	Students correctly connect the flashlight bulb, wire, and D battery to light the bulb. A picture is draw with an explanation and labels to tell what steps were taken to get the light bulb to light. An accurate comparison of static and current electricity is written.
Simple Circuits	Build a simple circuit with a light bulb & holder, battery & battery holder, wire, and alligator clips. Tell why a light bulb goes out when it is disconnected from the battery. Recall that electricity will always flow from one thing to another.	How does a simple circuit work? Why does a light bulb go out when one of the connections is taken apart in a simple circuit?	**Class Discussion/Work in Pairs/Concept Teaching:** Discuss circuits. Students work in pairs to create a simple circuit. A diagram is drawn and labeled to show circuit. Students then explain to other groups what was done to compare and contrast if any step was done differently.	Students correctly define a circuit. An accurate diagram is drawn and labeled. Students are able to explain what was done to build the simple circuit and why the light bulb goes off if a wire is disconnected.
Series and Parallel Circuits (most likely a two-day activity)	Create and explain a series circuit and a parallel circuit. Predict what will happen to the light bulbs in a parallel circuit when one bulb is removed. Compare and contrast a series and parallel circuit. Recall that electricity will always flow from one thing to another.	What is the difference between a series and parallel circuit? Why does a disconnection cause the light to go out in the series circuit and not the parallel circuit?	**Concept Teaching/Cooperative Learning to Extend Ideas Learned:** Discuss series and parallel circuits. Students first build a series circuit with two other students. Predictions are made and recorded about what will happen if a bulb is unscrewed or part of the circuit does not work properly. Their predictions are tested and observations recorded. A parallel circuit is created. Once the circuit is working, students are instructed to remove one of the light bulbs. Inferences are made as to why the other bulb is still lit. Students compare and contrast series and parallel circuits.	Correct definition of series and parallel circuits. Use materials provided to build a series and parallel circuit. Draw and label a picture with a brief explanation of circuits, including the prediction(s) made and what was observed. Accurate comparison of series and parallel circuits in a science journal.

KWL-H, Part 2 (What Did I Learn?)	Fill in the "L" column on the KWL-H chart with the information that was learned from the unit.	What did you learn about electricity and magnetism?	**Evaluate:** Students will complete their own KWL-H charts and then we will combine our ideas in order to complete our class chart. This will indicate what students have learned over the unit.	The questions/ideas that were in the "What Do I Wonder?" column were answered individually and the class chart was completed. Students would be able to state what was learned during the unit.

References

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