7-2012

Circuits [4th grade]

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UNDERSTANDING BY DESIGN

Unit Cover Page

Unit Title: Circuits

Grade Level: Fourth Grade

Subject/Topic Area(s): Science/ Circuits

Designed By: Carrie Sites and Melissa Cole

Time Frame: 2 weeks

School District: East Central ISD

School: Salado Intermediate

School Address and Phone: 3602 South WW White Road, San Antonio TX 78222

Brief Summary of Unit (Including curricular context and unit goals):

Students will understand that electricity flows through a circuit which must be closed for the energy to travel, that different materials can allow energy to flow or prevent it from travelling and that the energy source must be properly connected for energy to flow. At the end of this unit students will be able to independently identify complete and incomplete circuits, offer ways to fix incomplete circuits, identify parts of a circuit, and create a circuit that is a part of a lighthouse.

UbD - Circuits

Stage 1 – Desired Results

Established Goals (e.g., standards)

4.2 C (2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations. The student is expected to: (C) construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data

4.6 BC (6) Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems. The student is expected to: (B) differentiate between conductors and insulators; (C) demonstrate that electricity travels in a closed path, creating an electrical circuit, and explore an electromagnetic field

Transfer

Students will independently use their learning to…

identify complete and incomplete circuits, offer ways to fix incomplete circuits, identify parts of a circuit, and create a circuit that is a part of a lighthouse.

Meaning

Understandings

Students will understand that….

Electricity flows through a circuit which must be closed for the energy to travel.

Different materials can allow energy to flow or prevent it from travelling.

The energy source must be properly connected for energy to flow.

Essential Questions

1. How does electricity work?

2. How would your life be different if we did not have insulators?

3. Where does energy go when a circuit is broken?

Acquisition

Knowledge

Students will know…

Key Terms:

Insulator- Object that slows down the flow of energy

Conductor- Object that easily allows the flow of energy

Circuit- Pathway that starts and finishes at the same place

Energy Source- Where energy comes from

Current- Movement (flow) of electricity in a certain path.

Different forms of energy- specifically electricity.

Skills

Students will be able to…

- Create complete and incomplete circuits.
- Identify and explain the purpose of insulators and conductors.
- Explore electromagnets

Stage 2 – Evidence

CODE (M or	**Evaluative Criteria**	

T)	(for rubric)	
T M M A	Time frame given. Lighthouse structure. Identification and description of insulator, conductor, switch, and energy source. Plan of lighthouse. Creation of complete circuit. Use of switch. Complete circuit identification Presentation	Performance Task(s) *Students will demonstrate meaning-making and transfer by…* Pretending to be an electrician of an older lighthouse in Texas, the Lydia Ann. The lighthouse will have problems with the wiring and will hire students to figure it out. They will decide which circuit to use to complete the flow of electricity. Students will identify complete and incomplete circuits. Once identified, students will fix the incomplete circuits. Then they will choose one complete circuit to use to create their own lighthouse. They will plan and construct a lighthouse with a complete circuit and a switch. Additionally, they will identify in their plans the conductors, insulators, and energy source of the light house. A rubric will be provided. --- Other Evidence (e.g., formative) Curriculum based test Pre and Post Assessment Conductor and Insulator Quiz

Stage 3 – Learning Plan

CODE (A, M, T)	Pre-Assessment *How will you check students' prior knowledge, skill levels, and potential misconceptions?* Please give pre-assessment a week before you begin unit to familiarize yourself with student ability.	
A	**Learning Activities** **Day 1**- **Intro and Vocabulary** As a class review the forms of energy previously discussed- light, thermal, sound, heat, and electricity. Give students one minute to brainstorm everywhere they see or use electricity in a day. After a minute, give them 1 minute to share with a partner and add to their own list. Then have them repeat with another partner for an additional minute, continuing to add to their list. Afterwards, share as a class everywhere they see electricity. Pose the EQ "How does electricity work"? Students will do a quick write in response. They can draw a picture or use words but they need to respond for 3 minutes. Share as a class, showing pictures if they wish. Students will then do the Vocabulary Magic activity with cards provided. Directions on card page. Show powerpoint afterwards and go over to be sure students have correct matches.	Progress Monitoring (e.g., formative data) Observation and quick write

A	**Day 2- Open and Closed Circuits** Review vocabulary of circuits, open and closed circuits that they worked with yesterday. Discuss the components that a circuits needs to work- Energy source, load (or the light bulb), and where the current travels on. Discuss safety of wires, talking about the metal getting hot and not touching that. Put students into groups of 3, they will be creating different circuits in these groups. Before students begin creating different circuits on their own, have them take out their science notebooks. They will make a T-chart- successful circuits, unsuccessful circuits. Then give students 5 minutes to start creating a circuit with wires, 1 bulb, and 1 battery. After 5 minutes, bring students together, put materials in the middle of desk, and ask one group (who you saw was successful), to show their circuit to the whole class. Once they do that, draw the circuit as a class in the successful column. Point out what you expect to see on the drawing. Then give students another 15-20 minutes to create as many successful circuits as they can and draw the pictures. They need to also draw the unsuccessful circuits. Afterwards have students make conclusions by answering these questions- what do all your successful circuits have in common? What do you unsuccessful circuits have in common? Discuss together by having students show their pictures. Talk about how the successful has a full loop of some sort, wires touching the metal part of the bulb or bulb holder, etc. Afterwards give vocabulary of closed circuit for successful and open for unsuccessful. Pose question for them to ponder- how does a switch work in a circuit? Like a light switch, what does it do? Students answer on a sticky note before they leave the room or are finished with the subject.	Observations, notes
A	**Day 3- Parallel and Series Circuits** Review the circuits they created yesterday and talk about the switch that they had yesterday. What answers you saw and tell them to look for the answer in the BrainPop video next Afterwards have students watch a BrainPop on Electric Circuits, take the quiz and see what knowledge they gained. After the video, have students test out a switch with one light bulb. If no switch is there, ask kids how they could solve the problem- simply remove the wire from the power source. Put all materials in the middle of the table and pose the question, could you have more than one light bulb and still have a working circuit? In groups of 3 give students same materials (review vocabulary), plus an extra light bulb. Have them create as many different complete circuits using multiple light bulbs. They will still be drawing the pictures in their science notebook. Students will work for roughly 20 minutes. After you pick up materials, discuss with students what they saw when they	Observation and experiment notes

	added extra light bulbs. How did your circuit change? How did it stay the same? If you would like, bring in vocabulary of a series, versus parallel circuits. This can be an extension for some students to identify them.	
A	**Day 4**- **Insulator and Conductors** Have you ever been outside when it's really hot and touched the metal handrail? How did it feel? What about when you went to the slide, did it feel the same? Why do you think that is? Give students a chance to think about it then discuss as a class. Discuss with students how insulators and conductors are used in circuits, it's what makes them work. Sometimes they are used in the middle of circuits. Remind them about the vocabulary of insulator and conductor and let them know that today they are going to predict and test out (on the computer) different materials to determine if they are an insulator and conductor. Pass out sheet. This can either be done whole class if there are not enough computers, individually at computers, or in partners. Whichever is best for you class and with your resources. Students will predict what each object is. Then test them out using http://www.andythelwell.com/blobz/guide.html click on section 2: Insulators and Conductors After all students have tested and have their results, discuss as a class what all their conductors have in common, go over answers. Be sure to go back to website and talk about knife- has plastic and metal and the pencil- lead and wood. Relate it back to their work with circuits. What were the insulators in their work? Conductors? Talk about the purpose of them. Wire with rubber, plastic and metal on the light bulb holders, etc.	Observation and experiment notes
A, M	**Day 5- Insulator and Conductors** Review the insulator and conductors from the day before and the work that they did. Create a T-chart in your science notebook of good insulators and good conductors. Put these in their places as a class: insulators- rubber, wood, plastic, glass, fabric. Conductor- metal. Share a personal story where insulators have failed you- When I was in college my dog chewed my laptop cord, I didn't realize. I plugged it in, did a bunch of work, but when I was done I went to unplug it to save energy. I grabbed the cord on the part where she chewed it (I didn't know it was chewed), and I was shocked! Literally. I felt a jolt of electricity through my hand. The rubber around the cord was the insulator, without it, the wire, a conductor, transferred the energy to me. Can you think of times you've used insulators, or where you needed one? Write a list of them. Give 1 minute to create the list, share out. Bring up the kitchen, where do you use insulators in the kitchen like oven mitts, handles on a pot, towels, etc. A lot of people have talked about insulating themselves from the heat, but what about the cold. Do you use insulators to protect yourselves from the cold? Jackets, blankets, hats, ear muffs, bring up Arctic/Antarctic animals and their blubber. Have students read the article from National Geographic http://education.nationalgeographic.com/education/encyclopedia/blubber/?a	Observation, discussion, quiz

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<tr>
<td></td>
<td>r_a=1&ar_r=3

The last paragraph is about people eating blubber, be sure to decide whether you want to tackle that topic with students or not.

After reading, have students put their science journal on their desk. Go over questions on the board that students will answer AFTER the activity. 1. Which hand was colder? 2. Why was that hand colder? 3. How is the Crisco like blubber on animals? Then have students join you in a circle for the blubber experiment. Afterwards discuss as a class how blubber in an insulator and how it helps the animals survive the cold climates.

After the blubber experiment have students take the insulator and conductor quiz.</td>
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<tr>
<td>A, M</td>
<td>Day 6- Electromagnet
Discuss with students how they've been creating circuits that produce electricity. Sometimes circuits can create other things, like magnets. Today we are going to create an electromagnet. Watch video on BrainPop on Electromagnets. The questions are difficult for the test, but it shows what happens and offers good ideas of how to use electromagnets. Discuss what an electromagnet is and let students know they will be creating an electromagnet. However it will be in groups. Before getting started, in their science notebooks have students create a table. Explain how the experiment will work. Students will create a table of a 3x5 (3 columns, 5 rows). It should look like this:
<table>
<tr><td>Number of coils</td><td>Prediction number</td><td>Actual number</td></tr>
<tr><td>1</td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td></tr>
<tr><td>10</td><td></td><td></td></tr>
<tr><td>15</td><td></td><td></td></tr>
</table>
Have students predict how many paper clips they will attract with 1 coil, 5 coils, 10 coils, and 15 coils.

Then hand out the worksheet, Magnetic Attraction, found at

http://www.k12reader.com/reading-comprehension/Gr4_Wk23_Magnetic_Attraction.pdf

Place students in groups of 4 or 5. Students will come to you in groups and you will do the electromagnet with those students. All other students will read and answer questions on their own. When they come to you, they need to bring their science notebook to fill in their actual number of paper clips it attracts. If students finish the sheet early, they read.

After all groups go, pick one group's results and create a line graph of the data. Students will need to do the same. They can do it with their data, if you've</td>
<td>Observation, worksheet, participation</td>
</tr>
</table>

	done enough line graphs and you feel confident they can handle it. Or you can have the whole class use that group's data. Afterwards, ask the group what trend they see. Or overall what happens to the paperclips as you coil the wire more.	
A, T	**Day 7- Read about lighthouses, hand out rubric** Many students will never have seen lighthouses. Start out with a read aloud of one of these books about lighthouses. Little Red Lighthouse and the Great Gray Bridge by: Hildegarde Swift Beacons of Light Lighthouses by: Gail Gibbons Birdie's Lighthouse by: Deborah Hopkinson Watch powerpoint about light houses. If you have acess to United Streaming, have students watch the video "Tour a Lighthouse", if not you can watch a similar video. Discuss things they have in common and how they work. Students draw in their notebooks what lighthouses have in common, discuss what they're used for, where they're found (coasts). Then talk about how circuits are incorporated into current lighthouses. After students understand what a lighthouse is, where they're found and why. Pass out the rubric/directions for their assignment. Go through the directions first and be sure students understand what they will be doing. Then take a look at the rubric together. Answer any questions. Pair students up, if time have them start the circuit sheet and identify whether the circuits are complete/incomplete and offer ways to fix the circuits. If not wait till tomorrow. Students cannot start planning their lighthouse creation until after they do the first sheet.	Observation
T	**Day 8- Work on lighthouses** Students either do electrician sheet, or they start the plans for their lighthouse. By the end of today, students should be either starting to create their lighthouse, or already be started. Walk around offering ideas for the lighthouses. Have paint, paint brushes, construction paper, paper towel rolls, toilet paper rolls, etc. Any extra materials they include on their plans you can give tomorrow.	Observation, plans, electrician notes
T	**Day 9- Work on lighthouses** Students work on lighthouses the whole time. Teacher walks around offering suggestions.	Observation, plans, electrician notes, lighthouse
M, T	**Day 10- Present lighthouses, Post test** Give students maybe 10 minutes to finish their lighthouse specifically being	Observation, plans,

	sure to practice their light, then groups present them and show their lighthouse working with the switch. As groups get up to present, collect the rubric that was given to students at the beginning of this. After all groups go, give the post test, which is the exact same test as the pre test.	electrician notes, lighthouse, post test
	Extension Ideas for Performance Task Students need to name their lighthouse and write a history of the lighthouse. When it was built, why it was built, where it was built, and what happened to it to become so deteriorated. **Modification Ideas for Performance Task** Fewer circuits to identify as complete or incomplete. Scaffolding and ideas to create the lighthouse. Talk them through the complete circuit they create. No switch	

Pre/Post Assessment:

Name:_____ Date:_____

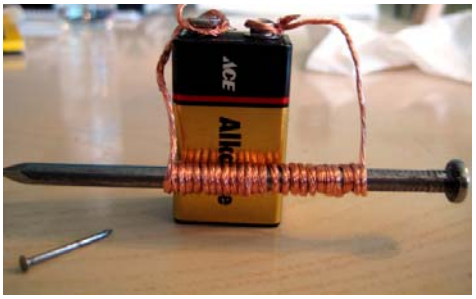
1. Fill in the missing pieces to make this a complete circuit.

2. Classify these objects as either insulators or conductors.

- Cardboard
- Cooking pot
- Glass
- Metal spoon
- Paper clip
- Plastic spoon
- Screwdriver
- Styrofoam
- T-shirt
- Wooden spoon

Insulator	**Conductor**

3. What happens when a wire is wrapped around a nail? What happens when you continue to wrap the wire around the nail additional times?



4. Your family just bought a new lamp for their house, but it doesn't work. What could be wrong with the lamp?

    a. There is a scratch on the bulb.
    b. The wire is twisted.
    c. The light bulb is not screwed in.
    d. The lamp shade is cracked.

5. It is a chilly winter day outside and you want a cup of hot chocolate. Which cup would insulate your drink the best?

    a. Plastic
    b. Metal
    c. Styrofoam
    d. Glass

Magic Card Vocabulary Directions

Teacher Use

Students will be in groups of 3. This is best, but you can change the number of students in each group

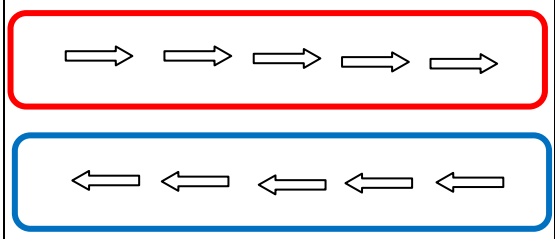
Materials:

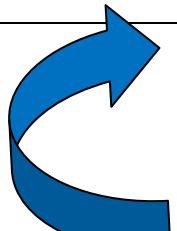
Set of cards cut up in a ziplock bag for each group of students

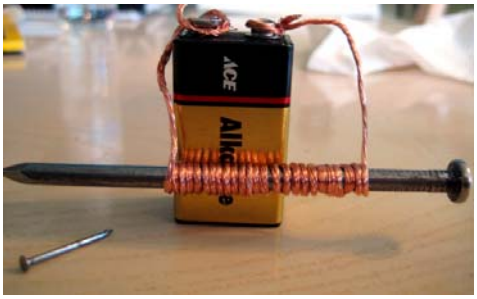
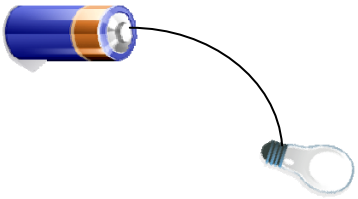
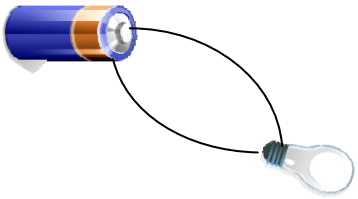
Directions:

1. Students take cards out of bag and put them into piles of pictures, word, and definitions.
2. Students put all the word cards out face up in front of them so everyone can read the word.
3. Slowly teacher reads one word at a time, students must point to the word and repeat the word out loud. If they repeat incorrectly, teacher says the same word again. Go through all the words.
4. Then one at a time, students pick a picture from the picture pile and describe what they see. They use the term "I think this might be this word because this reason." They place the picture with the vocabulary word they believe matches it. Students cannot correct each other. If 2 students believe their picture goes with the same word, then they can have 2 pictures next to one word. Students continue going through all of the picture cards doing this.
5. At the end, students can choose to move pictures to different words, but everyone must agree.
6. Then one student at a time takes a definition card and reads it aloud. Then says "I think this might be this word because this reason." They put the card next to the picture and word. All students go through the cards, students cannot correct another student, 2 definitions can go with 1 word.
7. At the end, students may all agree to switch definitions to another word.
8. After all groups are finished, teacher will show the powerpoint and students can make corrections at this time to their pictures, words, and definitions.
9. After the video the teacher goes through with the class the picture with the word and definition.

EXT- For students who finish early, have them use the word in a sentence, without restating the definition. They can use a sentence strip to write and underline the word.

insulator		Object that slows down the flow of energy.
conductor		Object that easily allows the flow of energy.
energy source		Where energy comes from
switch		A piece that allows you to stop and start the energy flow by either breaking or connecting a circuit.
current		The movement or flow of electricity in a certain path.



circuit		Pathway that starts and finishes at the same place
electromagnet	 http://commons.wikimedia.org/wiki/File:Homemade_Electromagnet.jpg	A magnet that is powered by electricity.
open circuit		An open connection path where energy does not flow continuously.
closed circuit		A closed connection path for energy to flow.

Name_____ Date_____

Insulators and Conductors

Directions Predict whether you think each object is a conductor or insulator. After you predicted all of the objects, go to the website http://www.andythelwell.com/blobz/guide.html and click on section 2: Insulators and Conductors, which is at the bottom of the screen in the purple row. Test out each object and label it in your chart.

Object	Prediction- Put C for Conductor, I for Insulator	Results- Put C for Conductor, I for Insulator
Ruler		
Key		
Coin		
Chalk		
Knife		
Nail		
Eraser		
CD		
Pencil		
Fork		

Conclusion:

1. What did you notice about all of the conductors? Do they have anything in common?

2. What did you notice about the insulators? Do they have anything in common?

Conductor/Insulator Quiz:

Name:_____ Date:_____

Categorize the objects that you would find in your kitchen drawer as either insulators or conductors.

1) Metal key- _____

2) Plastic pen - _____

3) Metal fork - _____

4) Pencil –_____

5) Coins - _____

6) Screwdriver - _____

7) Eraser - _____

8) Nail - _____

9) Rubber band - _____

10) Napkin - _____

11) How would your life be different if we did not have insulators?

_____

_____

_____

_____

_____

Blubber Experiment Directions

Teacher Use

Materials:

2 rubber gloves per student

Container of Crisco

Bucket of ice

Directions:

*Every student will need to have a buddy for this activity

1. Each student puts on one glove.
2. Teacher goes around and puts Crisco on the gloves hand ONLY. Put Crisco all over the hand, but keep it on the glove.
3. Students' buddy will take the 2nd glove and place it on the hand with the Crisco. By the end, everyone should have 1 hand with 2 gloves on it (with Crisco in between the gloves), and one hand free.
4. Teacher walks around to each student and has them place both hands in the bucket of water.
5. When a student is finished with the experiment, they go to their desk and do a quick write in their science journal using the questions that are on the board.
6. Go around so each student can test out the blubber.

Electromagnet Experiment

Teacher use

Materials:

Copper wire- cannot have rubber around it

A bunch of paper clips

Nail

1 battery- it works better to have a larger battery, however it works fine with a D battery

Directions:

1. Teacher wears rubber gloves. Discuss with students why you should wear rubber gloves with this- they're an insulator against the conductor or the wire
2. Hold one end of the wire to one end of the battery.
3. Wrap the wire around the nail one time (like in the middle).
4. Connect the other end of the wire to the other end of the battery.
5. Try to pick up paper clips. Students record results.
6. When you let go of one end of the wire to the battery, it loses its magnetic field and paper clips would drop.
7. Repeat steps 2-6 coiling the wire 5 times, then 10 times, then 15 times.

The wire will still feel hot under the gloves. Discuss with student why they are not a great insulator for this (how thin they are). If you use a D battery, the longer you hold the wire, the more energy you lose. So don't hold it for too long, otherwise you won't have enough energy to do all coils.

Name _____ Date_____

Lighthouse Creation

Purpose: You're the electrician of an older lighthouse in Texas, the Lydia Ann. They're having problems with the wiring and have hired you to figure it out. You will need to decide which circuit to use to complete the flow of electricity. Once you decide which circuit to use, you will need to create a working lighthouse using that circuit.

Instructions:

1. Using this set of electrical plans, decide which circuit to use. But first, you must say whether the circuit would light the bulb AND why, or whether it would not light the bulb AND why. If the bulb will not light up, you need to offer a suggestion for how to complete the circuit and solve the electrical problem.

2. Plan with a partner how to create a lighthouse with a switch that can light up the night. You must use the circuit you chose from the plans above. On your plans identify the **insulators**, **conductors**, and **energy source** and explain what they will do for the lighthouse. Create a list of items you will need to construct your lighthouse.

3. Create the lighthouse using your rubric.

4. Test your lighthouse using the switch to show there is a complete circuit.

Due Date _____

Grading Criteria	Approaching Expectations	Meeting Expectations	Exceeding Expectations

Complete Circuit Identification (20 points)	You were unable to correctly identify the closed circuits and fix the problems for the open circuits.	You were able to identify most of the closed circuits, but you did not make the necessary corrections for all of the open circuits to light up.	You were able to identify all closed circuits and correct the problems of all of the open circuits, so all the lights are on!
Lighthouse Structure (10 points)	The lighthouse has little to no resemblance of lighthouses seen on the Eastern coast of the US	The lighthouse has all physical structures present. You know it's a lighthouse!	The lighthouse has all physical structures present, and includes other features that are seen near or on lighthouses. You'd want to see this lighthouse if you were lost!
Identification and description of vocabulary (20 points)	You identified OR described some vocabulary. All of your descriptions OR identifications may not be correct.	You identified AND described 2 out of the 3 vocabulary correctly.	You identified AND described ALL vocabulary correctly.
Plan of lighthouse (15 points)	Plan is non-existing or lacking. You forgot to include the materials needed.	Your plan contains the basic information and materials needed to complete your lighthouse.	Your plan is extremely detailed and has all the information and materials you need, and then some. I can see your lighthouse now!
Complete circuit (10 points)	Your light bulb did not help guide ships to shore.		Your light bulb guided ships to shore!
Use of the switch (10 points)	Your switch did not turn on or off the light bulb.		Your switch flashed the light to sailors at sea. They found their way!
Presentation (15 points)	This was not your best work. It is incomplete and still a work in progress.	The lighthouse looks good. It is painted/colored to represent a lighthouse and it is neat.	Your lighthouse looks FANTASTIC! It is detailed, the painting/coloring is precise, and it looks good enough for a museum!

Notes