

ELECTRIC CIRCUITS

STEM ENHANCEMENT

2012

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Educator Directions and Resources

Overview and Objectives

Science, technology, engineering, and math (**STEM**) are critical components of a student's education. This **STEM** enhancement is intended to provide additional opportunities for your students to become more engaged in learning and gain a better understanding of what **STEM** is and its application in the world around us.

This **STEM** enhancement will provide the opportunity for students to understand:

- Energy has many forms such as heat, light, motion, and electricity. (PS3A)
- Energy can be transferred from one place to another. (PS3B)
- Heat energy can be generated a number of ways and can move (transfer) from one place to another. Heat energy is transferred from warmer things to colder things. (PS3C)
- Electrical energy in circuits can be changed to other forms of energy, including light, heat, sound, and motion. Electric circuits require a complete loop through conducting materials in which an electric current can pass. (PS3E)
- Problems of moderate complexity can be solved using the technological design process. This process begins by defining and researching the problem to be solved. (APPC)
- Possible solutions should be tested to see if they solve the problem. Building a model or prototype is one way to test a possible solution. (APPE)
- Solutions to problems must be communicated, if the problem is to be solved. (APPF)

*This enhancement does not have a *sound energy* component*

Included with this enhancement are several opportunities for you and your students to experience the excitement generated through the use of “engaging scenarios”. An engaging scenario is when an event or story is fabricated to engage the students thereby making them want to be a part of solving whatever problem has been presented in the scenario.

Lesson 12 – Learning about Switches, presents a scenario in which the students are asked to use what they have learned so far about switches to see if they can create different kinds of switches. Some examples may be momentary switches or single-pole double-throw switches. As students create and test their switches, continue to challenge them by seeing how switches



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can manipulate bulbs in a series. As the number of bulbs increase, can your students design switches to turn certain bulbs off and on at different times?

Lesson 13 – Constructing a Flashlight has been replaced with the **Illumination Device**

Challenge. This challenge is a culminating project whereby students will be presented with another engaging scenario, engineer a design, test their design, cost and present their designs for the challenge. While you are actively involved with your students, it is imperative they be required to use all of the skills they have gained during this unit. Please take advantage of the time you are monitoring your students and use it as a formative assessment to see where they may have gaps in their learning and may need additional support or instruction.

Our goal for this enhancement is to provide you with easy to use, highly engaging learning opportunities for both you and your students. Enjoy!



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True Value Hardware

123 California

Anytown, Washington 90000



Dear Mrs. _____,

I understand that the 4th Grade students at your elementary school have been learning about Electric Circuits. Our customers are looking for new types of switches. I was wondering if your students would like to put their knowledge to work and help us come up with some new switches.

Some ideas would be switches to use inside and also switches that would be “green”, by that I mean the switches would work by a green method. Please submit your prototypes within the next week.

I thank you for your time and hope to hear you and your students soon with great new switch ideas!

Sincerely,

Mr. Value



Lesson 13 – Illumination Device Challenge

Dear Teacher,

The following directions are intended to give you a general outline for how to execute **Lesson 13** in your classroom. Although this lesson was designed through trial and error of several teachers and classrooms, you are obviously encouraged to put your own spin on it! Please understand that this lesson has been intentionally designed as a culminating project. This process will take several days, but in order for the students to reap the full benefits of the process, you are encouraged not to rush them. Be sure to take the time and enjoy this process with your students!

Preparation:

Please prepare in advance a copy of the following for each student:

- Illumination Device Parent Letter
- Illumination Device Cost Sheet
- Illumination Device Check list/Rubric

Front load:

A few days prior to you actually wanting to begin the lesson in class, you will need to front load the students with the following information:

Present students with the engaging scenario by reading aloud the **Wilderness Ventures Summer Camp Letter**.

Give each of the students a copy of **the Illumination Device Parent Letter, Illumination Device Cost Sheet and the Illumination Device Check list/Rubric**. Please be sure to give your students a “deadline” of when all materials should be brought to school.

Execution:

Day 1

Students will begin the process of engineering their illumination device. This means they will be drawing a scientific diagram, fully labeled, of their proposed device. It is up to you whether or not they do this drawing in their science notebook or on a separate piece of paper.

This diagram should clearly illustrate all parts of the device including: the complete circuit, the encasement, the bulb cover and how they propose to decorate their device. Again, all parts must be clearly labeled.

Please check each students design and question them if it appears their design may not work. Once a student has received a “check” from you on their Illumination Device Check List paper, they may begin the construction process.



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Lesson 13 – Illumination Device Challenge

Day 2 - 5 (not all students will move at the same pace, so the “days” are a guideline)

****Before any students begin the process of constructing their device, please have the class come together as a group so you can reiterate to them the importance of revising their illumination device diagram as they make changes in their construction process.**

For example, if a student discovers that the placement of his/her circuit within the encasement isn't going to work and he/she changes the design of the device, he/she must make that change on their labeled diagram as well. It is extremely important all students understand that this step is a vital part of an engineer's job.

Remind students that if their device is to be mass-produced, the company needs an accurate diagram of how to produce the device.

Frequently check in with students *without* giving advice or suggestions as much as possible.

Students will share their ideas and check in with the teacher throughout the process to make sure they are following guidelines and that their device actually works.

Students will come to you and ask you to figure out why their device is not functioning properly. Please do not give them the answers, instead remind them of the *troubleshooting* skills they acquired in Lesson 6 – What's Wrong with the Circuit?

Utilizing the Illumination Device Cost Sheet – The cost sheet is an extremely important component of this design challenge as it represents the math component of the STEM process.

Students must keep track of the materials they use and record the materials on their cost sheet. As changes are made to the design of the device, those changes should be reflected on the cost sheet.

At the conclusion of the process, during their presentations, they will share out with the class how much their device costs. This amount should be as accurate as possible.

Day 6

Students will finish their devices at different times. It is important you remind them they will be presenting their devices to the class.

Encourage students to come up with a slogan, jingle or sales pitch to make the class want to “buy” their product.

Students will present their devices and share their process.

Students will be scored based on a scoring guide or rubric based on how you want that to look in your classroom.



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Lesson 13 – Illumination Device Challenge



Dear School Family:

We've been having a blast in our Electrical Circuits unit in Science! We've been studying energy, the transfer of energy and how a complete circuit is a system, dependent on all parts working together.

It is time for us to complete our culminating project and would appreciate any supplies you can send from home. Our culminating project is a design challenge where the students will be creating their own illumination devices. Students will be designing, testing, troubleshooting, costing and presenting their inventions. All of the work must be done in the classroom as this is part of their final grade in Science this trimester. A list of appropriate household items follows~

All students need to bring:

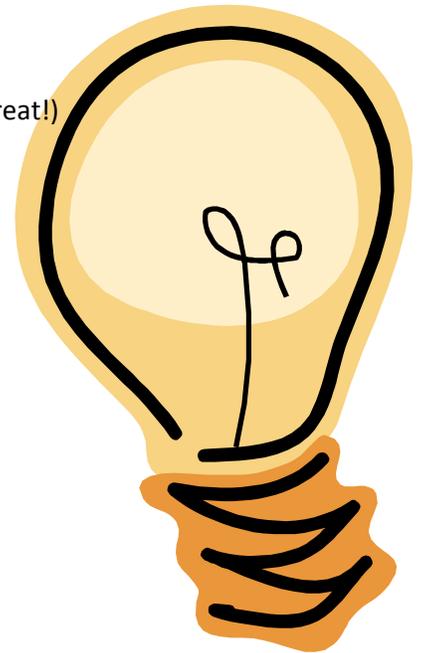
- (2) new batteries: AAA, AA or D size batteries are appropriate
- a bulb cover/protector (the bottom of a plastic water bottle works great!)

Students can donate the following to our class:

- cardboard toilet paper rolls
- cardboard paper towel rolls
- shoe boxes
- wrapping paper or tissue paper remnants
- plastic water bottles

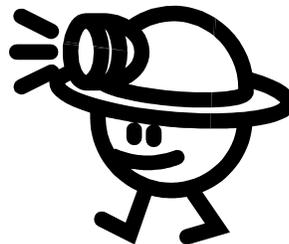
The teacher will provide:

- a light source
- wires
- construction paper
- masking tape
- a switch



Please encourage your child to share his/her ideas about their project with you. But remember, all work must be completed in the classroom. Any part of the project assembled at home will not qualify to receive a grade. If you have any question, please e-mail me at: _____.

Thanks for your help!



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Lesson 13 – Illumination Device Challenge

Wilderness Ventures Summer Camp
509 Hiking Trail Blvd.
Mt. St. Helens, WA 98611

Tuesday, November 11, 2014

{Insert Teacher Name}

{Insert School Name}

{Insert School Address}



Dear {Teacher Name},

I have heard through many cohorts that your 4th graders are becoming extremely knowledgeable about electric circuits. My camp is thrilled to hear of this news. We are making plans for our summer camp, but need some devices to make our ideas work. My camp counselors and I were wondering if your 4th graders would be up to the challenge to help us at Wilderness Ventures Summer Camp with our excursion into Ape Cave by Mt. St. Helens.

Our camp is looking for a portable illumination device that campers can use when they go cave dwelling. Ape Cave is 12,810 feet long; very dark as you can imagine. It is the longest lava tube in North and South America.

We also have some criteria for the device that we would like your students to follow (see next page). We would like to know how much the device costs and what materials were used. Devices that are practical and have some individuality would be fantastic. Please send your students samples A.S.A.P.

Thank you for your time and effort into this project. We cannot wait to see what the 4th graders can come up with!!

Sincerely,

Your friends at Wilderness Ventures Summer Camp



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Illumination Device Rubric/Check list

Name: _____

Skill		Notes:
Scientific diagram with labels		Teacher check off
Working circuit, prior to encasement		Teacher check off
Working circuit in encasement		Teacher check off
Decorative elements added		Student check off
Cost Analysis sheet completed		Student check off
Presentation <ul style="list-style-type: none"> • jingle, slogan, sales pitch 		Student check off

Illumination Device Rubric/Check list

Name: _____

Skill		Notes:
Scientific diagram with labels		Teacher check off
Working circuit, prior to encasement		Teacher check off
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Decorative elements added		Student check off
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Presentation <ul style="list-style-type: none"> • jingle, slogan, sales pitch 		Student check off



Name: _____

Cost Analysis of Illumination Device

Material	Cost		Number of Items Used		Total
Bulb	\$1	x		=	
Battery	\$2	x		=	
Switch	\$3	x		=	
Wire	\$3	x		=	
Bulb Protection	\$1	x		=	
Container	\$5	x		=	
Decorations (see below)					
			Total	=	

Decorative Item	Cost		Number of Items Used		Total
Designer Fee	\$5	x	(one time decorative fee)	=	\$5.00
Wrapping Paper	\$2	x		=	
Construction Paper	\$1	x		=	
Stickers	\$1	x		=	
Ribbon	\$1	x		=	
		x		=	
			Total	=	

Remember: You need to make sure you have accounted for all parts of your illumination device so your cost sheet is accurate. Your goal is to create the most effective and attractive device for the least amount of money. Keep in mind your audience and purpose! Good luck!

