Asia Society | Center for Global Education

Project Planning Template
Solar Phone Charger

COURSE: Advanced Manufacturing	DURATION: 4 weeks	TEACHER:	

GLOBAL ISSUE OVERVIEW

In the U.S., electricity to run equipment and recharge tools is available and relatively inexpensive. This is not the case worldwide. In many regions of the world, access to electrical power is sporadic at best and non-existent at the worst. This lack of reliable power impacts everything from the potential for industry and economic development to agricultural production to family life to the ability to communicate over long distances. From a design and manufacturing perspective, this scenario provides the opportunity for designing and manufacturing tools and equipment to help people address power needs on both the large and small scale.

STANDARDS ADDRESSED

Career/Technical Knowledge and Skills	Academic Knowledge and Skills	21st Century Skills
STCO.04.05.a – Identify changes in society and the creation of new needs and wants to the process of invention and innovation. STCO.06.03.a – Demonstrate the design process by defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, and exploring possibilities. STCO.06.03.b – Select an approach, develop a	CCSS.ELA-LITERACY.RI.9-10.4 – Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper). CCSS.ELA-LITERACY.W.9-10.1 – Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.	**Learning and Innovation Skills:** • Critical Thinking and Problem Solving • Communication and Collaboration **Life and Career Skills:** • Flexibility and Adaptability • Initiative and Self-Direction • Productivity and Accountability

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design proposal, make a model or prototype, test and evaluate the design using specifications, refine the design, create or make it, and communicate processes and results. STCO.06.03.c – Understand that the design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. MPRP.02 Understand the manufacturing process and systems common to the machine tools and materials forming industries. PSTS.04.03 Utilize computer aided design programs in designing a project. PSTS.06 Understand electrical principles, circuit theory, and apply them in practical settings.	CCSS.ELA-LITERACY.SL.9-10.1 – Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. CCSS.MATH.PRACTICE.MP6 – Attend to precision. CCSS.MATH.PRACTICE.MP5 – Use appropriate tools strategically.	• Leadership and Responsibility **Sample State Standards:** **Colorado Postsecondary and Workforce Readiness** PWR.02.01.a – Apply logical reasoning and analytical skills. PWR.02.07.d – Take responsibility for actions. PWR.02.06.a – Plan and prioritize goals. PWR.02.06.b – Manage time effectively. PWR.02.06.d – Learn from instruction and criticism. PWR.02.06.e – Take responsibility for completion of work.

PROJECT DEFINITION & GOALS/OBJECTIVES

In the U.S., we have come to rely on cell phones as a staple of daily life for work, school, and everyday living. Your phone is often either in your pocket or in your hands. This is true in many regions of the world: cell phones can be found pretty much everywhere. You also know this: the more your phone is in use, the sooner you will need to plug it in to recharge. If you lived in other areas of the world, for example areas of West Africa or Central Asia, finding a way to charge a phone often becomes a bigger issue than obtaining a phone. One resource that is in abundance, however, is sunshine. Adding that to the fact that solar panel costs are dropping rapidly and readily available in sizes that are appropriate for recharging cell phones, you may have a potential solution waiting to be developed.

Students will …

- Research regions of the world to identify areas with limited electrical power availability and high minutes of sunshine
- Discover how solar panels convert light energy into electrical energy
- Learn how electrical circuits work
- Use a CAD program to model an electrical circuit for the solar panel
- Research the correct size solar panel needed for this application
- Use CAD to design an enclosure for the wires and the panel appropriate for a given region of the world
- Construct a prototype of the product to test for feasibility for a given region of the world
- Build final product

SCENARIO OR PROBLEM: What scenario or problem will you use to engage students in this project?

You have a cell phone, your friends have cell phones, your teammates on the soccer team have cell phones, even the exchange student from (Kenya) on the team has a cell phone. When you left practice, which ran late today, you realize that you forgot to plug in your phone last night; now it is completely dead.

Now you can hear your mom's warning when she gave you the phone: "If you are going to be late, call me or you will be grounded. That's why we are giving you a phone." You know if you don't reach them, your parents will be furious. Fortunately for you, your teammate has a fully charged phone, so you can call home. You reach your mom (whew!), and as you drive your friends home, they give you a hard time about having a dead phone. The exchange student says that running out of power happens all the time back in (Kenya); they don't even have power all the time if they do remember to plug the phone in.

Wouldn't it be great if we didn't have to rely on electricity to charge cell phones? Most places, you have access to another free and widely available energy source, namely sunshine. How can this energy source be harnessed to charge cell phones, especially in areas of the world like (Kenya), where your teammate comes from, that don't have reliable electricity?

Essential Questions	Grade Level Adaptations
What are all the possible solutions to this problem? How can solar energy meet our energy demands? Could we create a small solar charger for a cell phone that can be made available in different regions of the world?	Size and scope of project can be modified to suit various grade levels. For example, younger grade levels might not actually build the final product. Older students might add a cost sheet to their final product.

ASSESSMENT: How will you determine what students have learned? (Check all that apply)			
FORMATIVE		**SUMMATIVE**	
Quizzes/Tests		Multiple Choice/Short Answer Test	
Notes/Graphic Representations	**X**	Essay Test	
Rough Draft		Written Product with Rubric	
Practice Presentation	**X**	Oral Presentation with Rubric	
Preliminary Plans/Goals/Checklists of Progress		Other Product or Performance with Rubric	**X**
Journal/Learning Log	**X**	Self-Evaluation or Reflection	**X**
Other:		Evaluation by Authentic Audience	**X**
		Other: 3D model	

MATERIALS, RESOURCES, or CONSTRAINTS: What materials and resources will be needed? Are there any perceived challenges?

MATERIALS

Plastic for 3D printer and laser cutter
Wire
Solar panels
LEDs
Copper tape
Batteries
Solder
Electrical tape

RESOURCES

Khan Academy, "Introduction to Circuits and Ohm's Law":
https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/v/circuits-part-1

Paper Circuit Activity:
"The Great Big Guide to Paper Circuits", on Sparkfun.com: https://learn.sparkfun.com/tutorials/the-great-big-guide-to-paper-circuits

Solar Cell Resources:
Khan Academy, "Solar Power": https://www.khanacademy.org/partner-content/nova/energy/v/solarpower
How Stuff Works, "How Solar Cells Work": http://science.howstuffworks.com/environmental/energy/solar-cell.htm

SUPPORT, MODIFICATIONS, AND EXTENSIONS: What is needed to provide support for students who have difficulty learning the content, modify for students with special learning needs, or to provide enrichment for advanced students?

Size and scope of project can be modified to suit individual accommodations. Individual supports such as mini lessons and additional tutorials can be added as needed.

CALENDAR OF MAJOR LEARNING ACTIVITIES—What are the learning activities or tasks for each day? Are there any project milestones? When will formal assessment activities occur?

Week 1				
Monday	Tuesday	Wednesday	Thursday	Friday
Present scenario, and students conduct research and brainstorm possible solutions to the problem, considering the region you are targeting. Zero in on solar charger. Students sketch solutions in engineering notebooks.	Identify what we need to know in order to build a solar circuit. Students watch Khan Academy video about how electricity works. Students add to engineering notebook with sketches of circuits. Begin building knowledge about electrical circuits by constructing a paper circuit.	Research and build knowledge about how solar cells work. Use power meter and sample solar cells to measure electrical output in different settings. Add to engineering notebook diagram of solar cell function.	Determine electrical charging needs of cell phones. Research solar cell types that are available on the market that would be appropriate for charging a cell phone; determine the feasibility of each for the region you are targeting.	Use dimensions of electrical components to design enclosure solutions suitable for the users and the regions you are targeting, so that the end user does not hurt themselves and also so the components do not get damaged.
Week 2				
Build prototypes of enclosures using cardboard and tape.	Build prototypes of enclosures using cardboard and tape. Use feedback to decide on final design.	Use calipers and prototype to begin designing enclosure in Solidworks.	Use calipers and prototype to continue designing enclosure in Solidworks.	Use feedback from peers and instructor to finalize Solidworks model.

Week 3				
Make a plan for what machines you need to use to produce your design. In engineering notebook create visual plan for fabrication of charger.	Begin fabricating solar circuit and enclosure for charger. Adjust fabrication as needed.	Continue fabricating solar circuit and enclosure for charger. Adjust fabrication as needed.	Continue fabricating solar circuit and enclosure for charger. Adjust fabrication as needed.	Continue fabricating solar circuit and enclosure for charger. Adjust fabrication as needed.
Week 4				
Continue fabricating solar circuit and enclosure for charger. Adjust fabrication as needed.	Solicit feedback on product from students and community members outside of class.	Write reflection on project in engineering notebook. What are the strengths and weaknesses of your design? Include feedback from peers.	Prepare for final presentation.	Final presentations.
STUDENT REFLECTION ACTIVITIES—How will students reflect on their work? Add reflection questions and/or activities here.				
Write reflection on project in engineering notebook. What are the strengths and weaknesses of your design? Include feedback from peers.				

Adapted from: Southern Regional Education Board, Unit Planning Template, 592 10th St. N.W., Atlanta, GA 30318-5776