**Energy Playground to Build Healthy Communities**

Target Grade Level(s): Middle School (6th, 7th, 8th)

Subject(s): Physical Science (Energy)

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**Problem Statement:**

The City of \_\_\_\_\_\_\_\_\_\_\_ is advertising a Request for Proposal (RFP) to develop the area of land near \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ School to encourage physical activity and outdoor fitness, as well accessibility for all in the community.The RFP’s scope would include additional energy resources to supplement the community’s energy needs and/or redirect energy back into the playground. The RFP would require the developed land to provide the community with sustainable attractions for multiple ages and abilities. There is an open space next to \_\_\_\_\_\_\_\_\_\_\_\_\_ Park that has opportunities for potential energy. Proposals for the project are being solicited.

The Request For Proposals criteria set out by the City of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is as follows:

* Space for the park is limited.
* The space must be accessible to all members of the community.
* The proposal must provide its own energy requirements.
* Proposals addressing health and fitness needs of the community will be given special consideration.
* Proposals addressing social needs of the community (2 or more people to operate the attraction) will be given priority.

Our class is going to submit a proposal to design and build a sustainable, human-fueled energy park - an Energy Playground. Each group in our class will be responsible for a portion of the park.

As middle-schoolers, we love to move! Using our understanding of science and working together in engineering groups, how can we channel our energy to have fun, stay healthy, build friendships, and serve our community?

**Unit Overview and Table of Contents**

Before beginning the unit, students should have the following prior knowledge:

* Students can identify & define different types of potential & kinetic energy
* Students can describe energy transformations & transfers
* Students describe and apply the steps of the engineering process

Lesson 1: Introduction of and close reading of the problem statement

* Form Groups
* Introduce the problem
* Brainstorm Know/Need to Know
* Rewrite problem statement in own words

Lesson 2: Introduce site map and brainstorm ideas

* Introduce map of site
* Students brainstorm ideas of how they might use various features of the site in energy playground attractions
* Students brainstorm energy transformations that they could use in attractions

Lesson 3: Research the Problem

* Review Redefined Problems
* Introduce final proposal assignment
* Assign specific plots of land to groups
* Research examples of playgrounds
* Research energy types and energy storage options
* Research how to give energy back to community

Lesson 4: Prototype Sketch/Build/write proposal

* Review engineering design cycle
* Establish group norms
* Brainstorm & determine Best Fit Solution
* Construct model of attraction
* Students use template to write formal proposal for their design

Lesson 5: Design/Test Evaluation Matrix - Peer Review with Pugh Chart and Gallery Walk

* Students share their models in a gallery walk
* Students use a Pugh Matrix to evaluate their own and other groups’ models
* Students reflect on their group process during the project
* Teacher evaluates proposal and models

**Provide the following items for the entire unit:**

**Standards (NGSS, CCSS, CTE): Shelley (CTE), Meghan (NGSS), Kathleen (CCSS)**

What standards (content and practices) are you addressing in this unit/lesson(s)?

Next Generation Science Standards (NGSS) Middle School

**NGSS MS PS3-2** Develop a model to describe that when the arrangement of the objects interacting at distance different amounts of potential energy are stored in the system.

**NGSS MS PS3-3** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

**NGSS MS PS3-5** Construct, use, and present arguments to support the claims that when the kinetic energy of an object changes, energy is transferred to or from the object.

**NGSS MS ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solutions, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**NGSS MS ETS1.C:** Optimizing the Design Solution  
Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)  
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

**NGSS MS ETS1-2** Evaluate completing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**NGSS MS ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.

**Common Core State Standards**

ELA:

#### *Craft and Structure:*

[CCSS.ELA-LITERACY.RST.6-8.4](http://www.corestandards.org/ELA-Literacy/RST/6-8/4/) Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.

#### *Integration of Knowledge and Ideas:*

[CCSS.ELA-LITERACY.RST.6-8.7](http://www.corestandards.org/ELA-Literacy/RST/6-8/7/) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

#### *Text Types and Purposes:*

[CCSS.ELA-LITERACY.W.7.2](http://www.corestandards.org/ELA-Literacy/W/7/2/) Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

[CCSS.ELA-LITERACY.W.7.2.D](http://www.corestandards.org/ELA-Literacy/W/7/2/d/) Use precise language and domain-specific vocabulary to inform about or explain the topic.

#### *Research to Build and Present Knowledge:*

[CCSS.ELA-LITERACY.W.7.7](http://www.corestandards.org/ELA-Literacy/W/7/7/) Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

#### SPEAKING AND LISTENING

#### *Comprehension and Collaboration:*

[CCSS.ELA-LITERACY.SL.7.1](http://www.corestandards.org/ELA-Literacy/SL/7/1/) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

[CCSS.ELA-LITERACY.SL.7.1.B](http://www.corestandards.org/ELA-Literacy/SL/7/1/b/) Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.

MATH: (extension)

*Geometry*

#### *Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.*

[CCSS.MATH.CONTENT.7.G.B.6](http://www.corestandards.org/Math/Content/7/G/B/6/)

Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

*Mathematical Practices*

#### [CCSS.MATH.PRACTICE.MP1](http://www.corestandards.org/Math/Practice/MP1/) Make sense of problems and persevere in solving them.

**Soft Skills:**

Think creatively - Students will brainstorm, evaluate and refine ideas as part of the engineering cycle.

Work creatively with others - Students will work in small, assigned groups where they will need to practice being open to others’ ideas and willing to compromise.

Solve problems - Students will need to ask questions & identify multiple ways to solve the problem

Communicate clearly - Students will need to communicate with one another in order to collaborate, which will include persuading, instructing, motivating, & listening. They will also need to communicate with their final audience (the City government) to inform & persuade the government of the value of their project.

Collaborate with others - Students will need to work with a small, diverse team where they compromise, and contribute and value the contributions of others.

Produce results - The project will need to result in a high quality product, a result of students working respectfully, being accountable, cooperating, and participating actively. Their project design must reflect the needs & desires of the clients (for example, being accessible to all and environmentally sustainable).

**Locally and/or Personally Relevant for Students:**

How do students build on their understanding of their school community or on what matters to students? Are there ways to make a strong connection to women or underrepresented minorities in STEM fields – to increase proportionate representation of those groups in STEM?

Ideally, the park siting should be tailored to fit the location of the students (local or neighborhood space), but it could also be sited somewhere in the region with a focus on helping students in need. The park is to be designed for access by all, so students will need to look at how to provide for kids with special needs or disabilities.

**Connections to career and educational pathways:**

How will students learn about connections to career and educational pathways into the unit/lessons?

The design of equipment with interconnecting components ties directly to a mechanical or civil engineering education and career path. The focus on energy harvesting, use, transfer, and storage connects to the civil engineering sub discipline of power generation with a focus on green energy. Developing these features within a specified space with geographic and cost constraints ties to educational and career paths in architecture and civic/urban planning.