**Lesson 2: Evaluate Map & Brainstorm**

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.

In this lesson, student groups will evaluate different features of the park site. They will evaluate different sections of the site in order to determine what useful features it possesses. They will then brainstorm some ways to generate or transform energy based on the different features in the park.

**Learning objectives:**

* Students will evaluate features on a map.
* Students will brainstorm design types of energy to transform using the land features.

**Lesson standards (NGSS, CCSS, CTE):**

MS-ETS1-1.

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

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| **MS-PS3** | **-5.** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. |
| **MS-PS3** | **-2.** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. |

[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.

[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).

**Soft skills:**

Work creatively with others, solve problems

**Locally and/or personally relevant for students:**

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:**

In this lesson, students review a map of the area where the park will be and brainstorm ways to make use of the land. This connects to career pathways in architecture, civic/urban planning, mechanical and civil engineering, power generation, and green energy.

Resources for teaching students about careers:

<https://www.planning.org/kidsandcommunity/> (planning)

<https://climatekids.nasa.gov/career-wind-energy/> (green energy)

**Materials:**

For each group: copy of site map

For each student - Handout for land analysis/research notes

**Lesson preparation:** Teacher should make copies ahead. Teacher should also have thought about possible ideas for the energy potentials of each plot of land to give groups hints to kick start their brainstorming (for example, the land with the stream - could suggest the ideas of waterwheels or dams if students are having trouble getting started).

**Time required:** 55 minutes

**Grouping of students for instruction:**

Describe how students will be divided into groups, if applicable (random, ability, interest, social purposes, etc.) Will students have roles? If so, how will roles be assigned? How will students learn their roles?

Students will be in teacher-assigned small groups of 3-5. Groups should contain a mix of ability levels. Teacher may assign group roles if desired (for example, facilitator, questioner, recorder, summarizer).

**What is the instruction? Consider the PBL Procedure that is being addressed here:** See the PBL procedure on page 2. Are the students understanding, exploring, or resolving the problem? Or, are they doing all 3 in this lesson? Explain what the teacher is doing and what the students are doing. This section should be written as if you were writing very detailed substitute plans. Teachers should be able to teach this lesson from all the information you provide without having to ask the author questions

**Exploring the Problem**

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| **Teacher** | **Student** |
| Do Now: What do you think are the most important goals or requirements of the energy playground we were discussing yesterday?  Assign & analyse map of site  Review the project goals & requirements. Have students reread their rewritten project statements from the previous lesson, then lead a class discussion where students share out & review important points of the problem statement (possible points to review: number of energy transformations required, accessibility, attraction needs to involve 2 people working together to operate, involve physical activity of children, attraction should store &/or return energy to the community power grid, space is limited).  Review group work expectations. For example, model what it looks like for one student to encourage another to return focus to the task. Model how to disagree politely (“I disagree with your idea because . . .”, “That’s an interesting point, but did you consider . . .”). If you have established norms, refer to them.  Pass out handout 1 (or have students write the What do you see?/What do you think?/What do you wonder? chart in their notebook). Teacher will pass out maps to groups. (Or use image on power point) Groups do not yet know which plot is theirs. Teacher will ask: What do you see? What do you think? What do you wonder?  Teacher models Brainstorming possible solutions  Guide students through a brainstorming example. Ask them to imagine a plot of land with a geothermal hot spring (which is NOT actually on the site). What energy would be available? What energy transformations could help you generate energy from the hot spring? (Use image prompt of geothermal spring on powerpoint slide). Teacher fills out a “bubble” on the concept map for the geothermal hot spring, and records ideas for energy types and changes coming off that bubble. Other possible examples the teacher might use for modeling this process include ocean wave energy or sound waves from Seahawks stadium. | Students record answers individually, then share out. This should lead into the discussion of the project goals and requirements.  Students will reread their rewritten project statements from the previous lesson, and share out important points to remember through class discussion.    Students discuss and record ideas in table groups, then share out ideas with whole class.  In groups, students generate/brainstorm ideas of how to use geothermal energy (for instance, to make electricity). Students will share out ideas - teacher can prompt them to think about thermal energy, using the steam, etc. **Be sure to guide students to consider the idea of using an electrical generator**. They don’t necessarily need to know all the details, but the idea of kinetic energy being used to move parts in a generator to make electricity will be very useful to them later. |
| Pass out handout 2 (concept map).  Generate possible solutions  1.Ask students to select 3 x 3 group of squares.  2.Students then brainstorm ideas for that area, ask them to record their idea on their concept map. They could fill out the concept map individually, or the could have one per group on larger paper in the center of the group table.  3.After 5 minutes ask students to move to another section of their choice.  4. Complete this cycle 3-4 times so students select a variety of places to brainstorm (hills, river, forest, lake, flat land)  If time allows, students could do a gallery walk around the room to look at ideas on the concept map generated by different groups.  This might be a place to talk about urban planning as a career and use resource above.  Pass out handout 3 (energy changes). Return to the geothermal energy example. Use the geothermal energy example to model how to fill out the energy transformation tool. For example, thermal energy in the steam could be transformed into kinetic energy in the generator. The where/how could be the steam rising and moving parts (magnets) of the generator. A second example could be the mechanical energy in the generator could transform into electrical energy in wires. The where/how would be the magnets spinning to create electric current. These examples are filled out on the attached powerpoint slides.  Direct groups to fill out the second part of the handout, where they brainstorm specific energy transformations they might be able to use, based on the sites’s features. This will will require them to connect the different types of energy to the actual physical features of the site.  This might be a place to talk about green energy careers using the above resource.  Exit ticket: What challenges do you anticipate so far? What are you excites you about this challenge?  If time: Share out Exit Ticket  Next steps (or if pacing is too slow etc) - have students begin research using websites (from Lesson 3) | Student groups select an area to brainstorm.  Students discuss with each other ideas that could generate energy in that area.  Students switch to new 3 x 3 and begin new discussion and recording new ideas.  Students rotate around the room with their team, reading ideas on other groups’ concept maps. Students could record warm feedback and non-judgemental questions in their journals.  Students fill in the example on their handout as the teacher models.  Students complete energy transformation sheets for areas that they are most comfortable with or excited about.  Students write response to exit ticket in Science Journal, or on scrap paper to be collected by teacher. |

**Accommodations:**

Provided completed energy transfer sheet of geothermal energy for students who read below grade level standard.

Use simple map for some class as needed, or assign simpler plots of land to students as necessary.

**Extensions:** Describe possible ways to extend the lessons, if time allows. Students could be challenged to add extra types of energy & extra transformations beyond what is required into their design ideas. Students could also be challenged to consider the aesthetics of the design in more detail. When considering energy storage capability of the design, students could be encouraged to consider ways to reduce energy lost through friction and increase efficiency.

**Assessment:**

How will you assess student learning during the problem? Will there be a final product? Will the final product criteria be clear for students from the beginning? Will there be both whole group elements and individual accountability? Attach appropriate rubrics

This lesson will involve in-the-moment formative assessment. As groups are working on the second part of the handout, make sure that they are including a reasonable way of storing energy. Watch for energy transformation ideas that are nonsensical, and guide students to correct those ideas. At this stage, you don’t want to discourage ideas, but you do want to help students generate correct ideas about energy. Handouts can be collected to monitor individual accountability.

**References/Resources:**

Attach any materials students will use during the lesson; e.g., handouts, questions to answer, and worksheets.Acknowledge your sources. Give credit to the person who created the idea for the instructional plan, including yourself. You might use language such as "Instructional Plan adapted from \_\_\_\_\_”; “Instructional Plan Consultants (not responsible for the content of this instructional plan): \_\_\_\_\_\_\_”; and/or “Instructional Plan Created by \_\_\_\_\_” Cite scripted materials/curriculum if appropriate.

See attached PowerPoint

See attached student handouts (1, 2, & 3)

See attached map(s)