**Lesson 1 - Brainstorm Know/Need to Know**

**Problem statement:** The City of \_\_\_\_\_\_\_\_\_ is advertising a Request for Proposal (RFP) to develop the area of land next to \_\_\_\_\_\_\_\_\_\_\_\_\_ 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 as well as provide energy back into the development. The RFP would require the developed land to provide the community with sustainable attractions for all ages and abilities. There is an open space next to the \_\_\_\_\_\_\_\_\_\_\_\_ Middle School that has opportunities for potential energy (see attached topography map). Bids for the project are being solicited.

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

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| --- |
| * Space for the park is limited * The space must be accessible to all members of community. * The proposal must provide its own energy requirements.   + Energy is stored or returned/redirected to park   + Multiple energy transformations * Proposals addressing health and fitness needs of the community will be given special consideration.   + Involves 1 or more people to operate   + Promotes Physical activity/health |

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

This lesson fits into the Problem Statement as an introductory lesson to get students hooked and help them begin to process and understand the problem in order to plan how to solve it. They will receive further information regarding the RFP in a later lesson.

**Learning objectives:**

* Students will identify general criteria and constraints for the problem.
* Students will write out the problem in their own words.

**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.

[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.

**Soft skills:**

Collaboration, Creativity

**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 (in their school or in their community).

**Connections to career and educational pathways:**

In this lesson, students are exploring energy use and transformation which connects to careers in mechanical engineering. They are also thinking about making use of that information in a specific constrained space for the good of the community which connects to careers in architecture and civic/urban planning.

Resource for videos about engineering careers: <http://www.boeing.com/principles/education/explore-by-theme.page#/career-runway>

**Materials:**

Videos: <https://www.youtube.com/watch?v=7bREFtjFqDA> (~3 min); (<https://www.youtube.com/watch?v=ts-zt2UtTAk> (~3 min)

Problem Statement; poster or chart paper to record Know/Need to Know results; markers, sticky notes, projector, computer. Students need access to this list throughout the PBL.

**Lesson preparation:**

Teacher should prepare a possible Know/Need to Know list and questions to help students move through the task. This poster should be posted at all times during the unit.

|  |  |
| --- | --- |
| **KNOW - Sample - partial list** | **NEED TO KNOW - Sample - partial list** |
| **Needs to promote physical activity**  **Attractions must be sustainable**  **Accessible for all ages and abilities**  **Limited space in \_\_\_\_\_\_\_ park**  **Attractions must provide own energy**  **Attractions may produce additional energy for the community** | **What types of energy should be included?**  **How many attractions will fit in the space?**  **What does the space look like?**  **How big is the space?**  **How is energy stored?**  **How is energy transferred to power something else?**  **Who will be able to “make” energy? Can people in the community/school access it?** |

**Time required:**

45 - 60 minutes (1 period)

**Grouping of students for instruction:**

Students can be grouped whole-group or random small groups, but the final list will be generated whole-group.

**What is the instruction? Consider the PBL Procedure that is being addressed here:**

Students are understanding the problem presented in the lesson (Meet the Problem, Know/Need to Know, Define the Problem Statement).

**Understanding the Problem**

|  |  |
| --- | --- |
| **Teacher** | **Student** |
| We all know that middle-schoolers have lots of energy. You love to move! But many of you don’t! You spend your free time in front of a screen.  What if there was a way to get you moving, playing games, and helping our planet - all at the same time? As we watch these videos, using your science notebooks, write down one interesting idea, one question, and one new idea from what you see.  Show both videos.  <https://www.youtube.com/watch?v=7bREFtjFqDA> <https://www.youtube.com/watch?v=ts-zt2UtTAk>  Reflection questions:   1. What interested you? 2. What questions did you have? 3. What new ideas occurred to you?   Discuss in your small groups or with a partner.  Share out briefly whole group.  Explain that our class has an opportunity to work with some of these ideas.  Read Problem Statement aloud and show map. Students reread independently and underline or highlight key ideas and details.  Using a Know/Need to Know T-chart, ask students to help you generate a class list of concepts under each heading. See sample below.  Questions to keep the discussion moving:   1. What is actually in the text that we can list as something we understand about this problem? 2. What are some questions we might need to find answers to? 3. What might we need to research? 4. What vocabulary or science concepts do we already know? Need to learn? 5. How might we categorize some of these ideas?   Introduce the vocabulary of **criteria** and **constraints**.  **Criteria are rules or directions that must be followed; they are the requirements that must be met.**  **A constraint is a limitation or condition that must be satisfied by a design.**  Teachers asks groups to read over the problem statement and identify need to knows vs knows in a T-Chart  Teacher models categorizing by highlighting 1-2 criteria or constraints from the problem. Have students continue the process by rereading and identifying possible criteria and constraints.  Possible intervention if group is trying to solve problem rather than identify knows vs need to knows: Hand out hard copy of problem statement. Ask 1 student in group to highlight what they “know”, then after group discusses, as another member to highlight in a different color - what they need to know or is unclear. Then ask them to copy these in their Science Journal.  On another poster paper/butcher paper (or highlight/circle items on original poster, or ask students to highlight (with different colors) their current list of knows and need to knows in their Science journal), teacher begins to categorize the ideas into:   1. Constraints 2. Criteria 3. Possible future research topics for groups and/or teaching points.   Independently, in your science notebooks, write in your own words, what the problem is, including criteria and constraints.  Share out a few examples whole group.  Exit Card: Ask students to write out the problem in their own words in their Science Journal or Exit slip  This might be a good time to show the videos on careers in engineering: <http://www.boeing.com/principles/education/explore-by-theme.page#/career-runway>  Next steps: We will look at the map and begin brainstorming possible uses of plots on the map.  Alternative next step: If students are lacking in background for energy concepts, use the Energy Toy Stations PowerPoint and mini - lesson to provide additional background before moving on to the map. | Students watch videos and record three different reflections in science notebooks. (I, ?, \*)  ~10 minutes  Students discuss notes with partner or small group.  Students share out whole group (call on students or take volunteers to share).  ~ 5 mins.  Hand out PBL statement. Students read closely for key ideas and details, highlighting or underlining.  ~5 mins.  Students share out whole group (call on students or take volunteers to share).  Students record information in their science journals as teacher records on poster.  ~10 minutes  Students record these vocabulary words and definitions in their science notebooks.  Student identify criteria and constraints from the sample slide about building a boat.  Students set up “T-chart” in Science Journal.  Students reread problem statement and discuss with group what they know and what they needs to know.  Students close read to mark constraints and criteria.  ~5 mins.  Students share out whole group to identify possible constraints and criteria.  ~5 mins.  Students record problem statement in their science notebooks. Share out with a partner, then whole group.  ~5 mins.  Students write in their science journal, reflecting on the problem in their own words. |

**Accommodations:**

No special accommodations, although strategies appropriate for ELL students should be considered during the brainstorm (SIOP, GLAD). For example, students can be provided with sentence stems and visual cue cards for the vocabulary.

**Extensions:**

Students could begin to sort and add detail to each Know/Need to Know category in preparation for researching.

Energy Toy Stations could include toys such as: spinning top, parachute figure, pull back car, wind-up figure, paper fan, jumping frog, etc.

**Assessment:**

Assessment will be through the rewrite of the problem in the students’ own words in the science notebooks. (Formative)

Formative assessment will also occur during the brainstorm as the teacher becomes aware of the students’ background (or lack of) in terms of the content (energy) or process (inquiry - based learning). This will allow the teacher to create future lessons based on Need to Knows.

**References/Resources:**

Video sources: ACE SAATCHI & SAATCHI; Global Inheritance

Energy Information for student background: <https://www.eia.gov/Kids/energy.cfm?page=about_forms_of_energy-basics>

Vocabulary List in Resources

Instructional Plan Created by: Kathleen DuCharme, Meghan Palmer