MOSA MACK SCIENCE

Renewable Resources Lesson 3: *The Engineer*

Educator's Resource Guide

Objective

In *The Engineer*, students will:

1. Design a plan to conserve a natural resource.
   (or)
2. Design a plan to mitigate the uneven distribution of a natural resource.

Time Required: 185 minutes

Materials Required	Safety/Other Considerations	Science & Engineering Practices
• Computers for research • Paper • Colored pencils/markers • Extension Materials: Various types of paper, tape, glue	None	• Designing Solutions • Communicating Findings/Design (Oral Presentation)

Inquiry Scale: Leveling Information

Level 1: (most teacher-driven) (*recommended for grades 4–5)*
Show examples of different natural resource types, with conservation and mitigation ideas (ideas located in the Appendix at the end of this document). Remind students of their research in *The Make* and how they can use what they discovered to help inform their solution. Lead students as a class through the Student Guide Planning Organizer and all aspects of *The Engineer*.

Level 2 (*recommended for grades 5–6)*
Show examples of different natural resource types, with conservation and mitigation ideas (ideas located in the Appendix at the end of this document). Remind students of their research in *The Make* and how they can use what they discovered to help inform their solution. As a class, lead students through the first parts of the Student Guide Planning Organizer and collaborative brainstorming about solution ideas for conservation or mitigation. Students decide individually what solution they will engineer.

Level 3 (*recommended for grades 6–7)*
Students are given information about example conservation or mitigation ideas only (ideas located in the Appendix at the end of this document). Support students in initiating the Student Guide Planning Organizer, as needed. Students complete *The Engineer* process independently.

Level 4: (most student-driven) (*recommended for grades 7–8)*

Students independently complete all aspects of *The Engineer*, designing their own solutions for conservation or mitigation, and explaining how their solution benefits the environment or society.

Agenda

I. Show PowerPoint to introduce *The Engineer* Activity (10–15 minutes)

The PowerPoint will review essential concepts learned in *The Make* and provide context for students' upcoming *Engineer* challenge.

II. *The Engineer* Activity (150 minutes)

In the presentation and in the Student Guide, students are presented with a challenge:

> Your Challenge: The town of Resourceville is unique. The town's residents have access to every resource you studied in *The Make*. It seems their options for energy are endless! This has been a huge draw for the town, and as a result, its population has tripled in the past five years! Town council is thrilled with the boom in population, but behind closed doors, they're facing a problem.
>
> The town's resources are in trouble. There are two problems: conserving natural resources and mitigating the uneven distribution of resources. They heard about the great work you did in *The Make* and have hired you as an engineer to solve one of their resource problems.
>
> **Your Task:**
>
> 1. Choose **one** of the two resources you chose to study in *The Make.* This can be either the renewable or nonrenewable resource.
> 2. Recall how that resource is distributed throughout the world and how it has an impact on the environment and society.
> 3. Go through the engineering design process to determine how you plan to:
>   - conserve the natural resource
>
>   **OR**
>   - mitigate* the uneven distribution of a natural resource.
> 4. Present your final solution to the town through a model or technical drawing.
>
> *The word "mitigate" means to make a problem less serious or less severe. For example, if your sibling is blasting music, putting in earplugs would mitigate the problem. It doesn't fix the problem completely; it just makes it easier to deal with.

As guided by the Student Guide Planning Organizer, students will:

1. Identify the resource they will focus on.
2. Brainstorm a solution to an issue.
3. Plan and design a diagram of their design solution.
4. Present their solution with either a 3D model **OR** a technical drawing. Their presentation will include information about how their solution addresses either the conservation of resources or mitigation of uneven distribution of resources.

If students need suggestions or ideas on places to get started on their engineering challenge, give them suggestions from the Engineering Suggestions document in the Appendix below the Assessment Rubric.

III. Presentation and Assessment (10 minutes)

Presentation/Assessment

Students present their final design solutions as if they are presenting to an audience of their peers or community members; assessment parameters are suggested below.

***The Engineer* Assessment:** Project Grade and Rubric Score Sheet – Renewable Resources

Project Submitted by _____

Renewable Resource Engineer Checklist: Content Concepts and Practices

Your Challenge: Design a plan to conserve a natural resource or to mitigate the uneven distribution of a natural resource.

Project Completeness:

- ❑ Technical drawing or model is detailed
- ❑ Functioning parts are labeled for clarity
- ❑ Technical drawing has the name of the design as the heading
- ❑ Equipment design drawing is well-organized, neat, and in color

DCI Standards Checklist:

- ❑ Includes annotations describing how the design solution works
- ❑ Includes annotations about the location of the design solution
- ❑ Includes a caption explaining how the solution conserves or mitigates natural resources
- ❑ Includes a caption explaining impacts of the natural resource
  - ❑ Uses research from *The Make* to create a caption that explains how the natural resource is distributed throughout the world and
  - ❑ How this impacts environment and society, specifically describing uses of the resource

Science & Engineering Practices Rubric

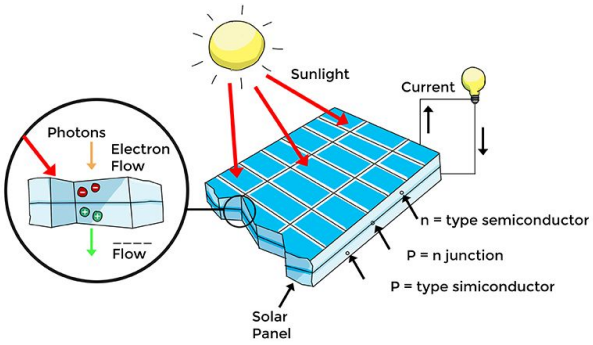
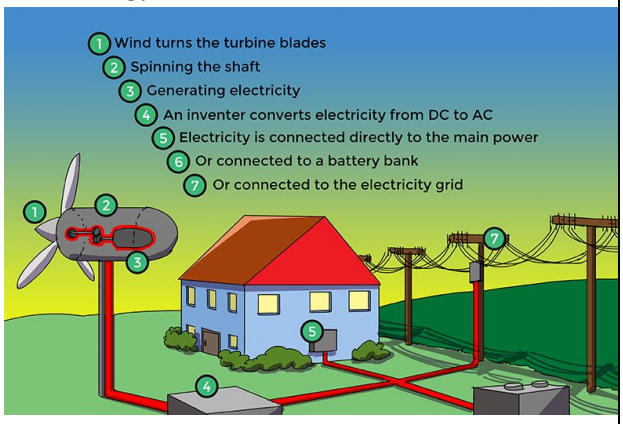
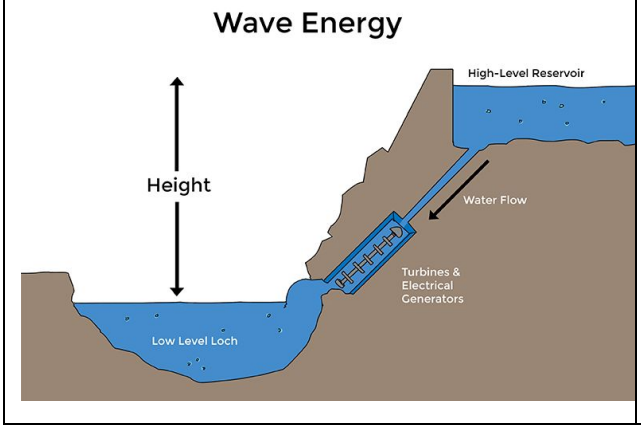
	Emerging (1)	**Developing (2)**	**Proficient (3)**	**Advanced (4)**
Constructing Explanations and Designing Solutions	Constructs an explanation with no clear sources of evidence.	Uses scientific principles and/or data from at least one source to construct or evaluate an explanation, but explanation contains minor misconceptions.	Uses accurate but incomplete scientific principles and/or data from multiple sources to construct or evaluate an explanation.	Uses accurate and complete scientific principles and/or data from multiple sources to construct or evaluate an explanation.

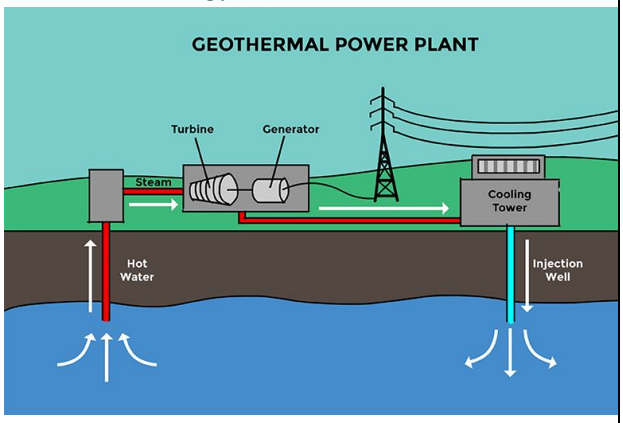
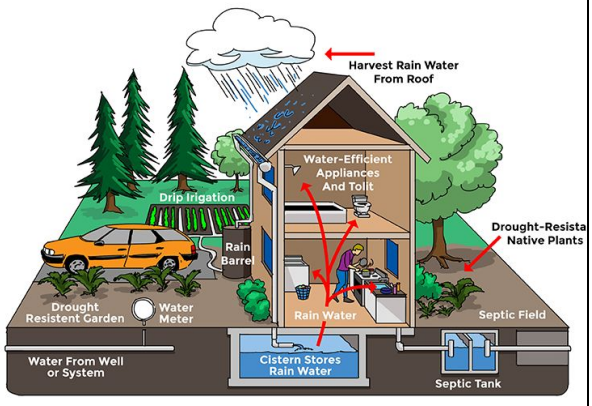
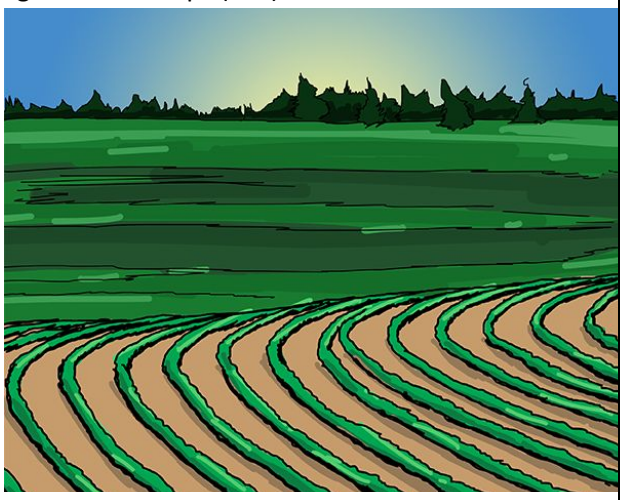
Teacher Comments:

Final Score: Final Grade:

Appendix: Engineering Suggestions to Spark Student Ideas

*Ideas provided for learner inspiration to improve upon and create scenarios to apply existing solutions

Example Natural Resource **(R=Renewable; LTR= Long Time to Renew; NR=Nonrenewable)**	
Sunlight (R) 	**Example Conservation Idea:** solar cells to replace fossil fuels **Example Distribution Mitigation Idea:** mirrors reflecting sunlight around the earth from space
Wind Energy (R) 	**Example Conservation Idea:** wind turbines to replace fossil fuels **Example Distribution Mitigation Idea:** huge deflectors that funnel wind to areas where there is none, then install wind turbines; transport energy created from wind turbine sources to areas where there is no wind
Wave Energy (R) 	**Example Conservation Idea:** water turbines to replace fossil fuels **Example Distribution Mitigation Idea:** underwater turbines that harness the energy of waves and currents; transport energy created from wave turbine sources to areas where there is no ocean

Geothermal Energy (R) 	**Example Conservation Idea:** harness hot water and hot rock from Earth to replace fossil fuels **Example Distribution Mitigation Idea:** drill into the earth to reach hot spots
Fresh Water (LTR) 	**Example Conservation Idea:** home-appliance accessories; behavioral adjustments; capture rainwater **Example Distribution Mitigation Idea:** innovative water capture and filter technologies; desalination; transport fresh water to places where there is none
Agricultural Crops (LTR) 	**Example Conservation Idea:** Crop rotation, runoff control, contour farming **Example Distribution Mitigation Idea:** Grow crops native to the ecosystem; passive/active solar greenhouses; permaculture; intercropping to improve plant and ecosystem resiliency; can, freeze, dry, preserve and transport crops to places they can't grow

Forest Products (LTR)	**Example Conservation Idea:** recycle, use composites made from wood scrap, limits to forest clearing **Example Distribution Mitigation Idea:** forestation and reforestation planning
Soils (LTR) 	**Example Conservation Idea:** compost, plant bare surfaces **Example Distribution Mitigation Idea:** compost programs; remediation of toxic or depleted soils.
Crude Oil (NR) Natural Gas (NR) Coal (NR)	**Example Conservation Idea:** gas-free transportation, recycling, use of renewable energy sources **Example Distribution Mitigation Idea:** plans for limits to import fossil fuels and their derivatives
Metals (NR) 	**Example Conservation Idea:** increase recycling **Example Distribution Mitigation Idea:**plans to limit extraction and make distribution equitable