

Cells Lesson 3: “The Engineer” Educator’s Resource Guide

Objective:

In the Engineer, students will:

1. Design a unique, never-before-seen cell that does a specific job, focusing on the theme that structure helps support function.

Time Required: 120 minutes

Materials Required	Safety/Other Considerations	Science & Engineering Practices
<ul style="list-style-type: none"> ● Materials Needed: ● Blank printer paper (design brainstorming sketches) ● Poster Paper (final cell prototype) ● Markers or Colored Pencils ● Cells Design Student Handout ● Engineer Powerpoint 	None	<ul style="list-style-type: none"> ● Constructing Explanations or Arguments From Evidence ● Designing Solutions

Inquiry Scale: Leveling Information

Level 1 (most teacher-driven): *(recommended for grades 4-5)*

Provide the table of potential cell services to be performed by a never-before-seen cell for learners to choose from. Lead the design process on the board as learners follow along with their own choice of one of the possible cell services. For the cell that you are modeling, ask for learner input and apply to create your representative never-before-seen cell.

Level 2: *(recommended for grades 5-6)*

Provide the table of potential cell services to be performed by a never-before-seen cell for learners to choose from (see Level 1). Initiate and lead the design process on the board for the “Brainstorm” and “Prototype” steps of the design process. Allow learners to elaborate upon and finalize their final cell independently.

Level 3: *(recommended for grades 6-7)*

Learners choose a specific service to be provided by their never-before-seen cell. Table provided at Level 1 is an optional source for ideas. Lead the “Brainstorm” step of the design process while helping learner refine their ideas of structure and function.

Level 4: *(recommended for grades 7-8)*

Learners create cell design as instructed, completing all aspects of the design process independently, with scaffolding as necessary.

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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 their upcoming “Engineer” challenge.

PowerPoint Slide Guide

Slide 2: Review: What did we learn about cells in our Make activity?

1. Think-pair-share
 2. Learners share out answers
 3. Make a chart on the board that reports out on students’ learned knowledge of cells
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Slide 3: We have learned that cells are made up of different parts.

1. Ask learners where the cells parts shown are located in a cell. What is the specific job of each cell part shown here? Do you think that the cell could function well if one of the parts was not able to do their job?
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Slide 4: We have also learned that the different cell parts have very specific functions.

1. What is the specific job of each cell part shown here? Do you think that the cell could function well if one of the parts was not able to do their job?
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Slide 5: The Design

Slide 6: The Design

1. Break down the process of the Design for learner.
2. Collectively with class, brainstorm a list of services that a never-before-seen cell could provide for an organism. Extend the thinking (orally) of a few of the services listed.
3. Emphasize that this is an individual project, though they will be working next to their peers and collaborating to the extent that they can share what they are thinking with a neighbor.

To spark student ideas, see suggestions in Appendix A below the assessment rubric.

Slide 7:

1. Emphasize the fun and challenge of ideating a unique cell design.
 2. Remind learners that they will present their final designs to the class.
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II. Engineer Activity (150 minutes)

As guided by the organizer, students will:

1. Brainstorm unique cell ideas and drawings on blank printer paper.
2. Create a prototype drawing of their unique cell and identify the function of the specialized parts with labels. Parts and functions must also include how molecules (such as food, energy, and “products”) travel in, out, and through the unique cell.
3. Elaborate on their design and add any further details that enhance the design and function of their unique cell and its parts.
4. Transfer the final design to the poster paper and complete with details in color.

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.

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Engineer Assessment: Project Grade and Rubric Score Sheet - Cells

Project Submitted by _____

Cells Engineer Checklist: Content Concepts and Practices

- Poster title reflects the unique name or type of cell created
- Cell design is unique (never-before seen) and performs a specific service needed by an organism
- Shows how the parts (organelles) of the unique cell work together to help the cell survive and do its job
 - Labels each cell part and accurately connects its form to its function
 - Describes how other molecules, such as food, energy, and “products” are connected with these cell parts

Science & Engineering Practices Rubric:

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Designing Solutions	Applies no scientific principles and/or data to design, construct, and/or test a design of an object, tool, process or system.	Applies minimal scientific principles and/or data to design, construct, and/or test a design of an object, tool, process or system.	Applies adequate scientific principles and/or data to design, construct, and/or test a design of an object, tool, process or system.	Applies complete scientific principles and/or data to design, construct, and/or test a design of an object, tool, process or system.
Communicating Findings/Design (Oral Presentation)	Findings/Design are incompletely and inaccurately communicated. Or no evidence of using appropriate eye contact, adequate volume, or clear pronunciation.	Findings/Design are completely communicated with some misconceptions. Or Uses minimal eye contact, inappropriate volume, or inconsistent pronunciation.	Findings/Design are completely communicated but lacking depth and complexity. Or often uses eye contact and engaging and appropriate volume and pronunciation, but is inconsistent.	Findings/Design are completely communicated with depth and complexity. Or mostly uses eye contact and engaging and appropriate volume and pronunciation.

Teacher Comments:

Final Score:

Final Grade:

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Appendix A: Suggestions to spark student ideas

Potential Cell Services	Cell Parts/Functions	Cell Type to Innovate*
Cell types that interact and can camouflage within any surrounding	<p>Cell membrane can stretch out very flat or grow very long and change color/pattern</p> <p>Special particles in the cell membrane absorb the surrounding light and trigger a change in the cell membrane to match surroundings</p>	<p>Skin Cell</p> <p>Hair Cell</p>
Cell types that interact and are able to transform and create an exact copy of an organism it encounters as friend or foe	<p>Cell nucleus has a special organelle that can direct activities within the cell and also communicate across cells when to initiate the mimicry process as benefit (i.e. competing for food, surviving a predator attack, etc.)</p>	<p>Bone Cell</p> <p>Muscle Cell</p> <p>Blood Cell</p> <p>Skin Cell</p>
Cell types that can create energy bursts to support rapid growth, fast movement, or high endurance in an organism.	<p>Mitochondria are super-power generators that create energy for various cell/cell group functions</p>	<p>Nerve Cell</p> <p>Muscle Cell</p> <p>Blood Cell</p> <p>Stomach Cell</p>

*Students need not know the actual morphology of these cells. Offer to students the option to use these cell names/functions to inspire the form and function of their own never-before-seen cell.