States of Matter Lesson 3: "The Engineer"

Student Handout

Your Challenge: The City has a ton of problems: too many potholes, not enough fresh water, and an out-of-breath balloon artist! Luckily, it's only your first day as Chief Chemical Engineer, so you don't have to fix everything at once. Pick **one** of the problems and use what you've learned in the "Solve" and "Make" to design a solution.

Problem	Necessary Information
Potholes	The city is suffering from excessive potholes, but they just can't figure out what best to fill them with! They need a smooth surface for cars to drive on, despite whatever weather (or temperature) hits.
Demand for Fresh Water	City residents need a new source of fresh drinking water, and they're hoping to pipe in saltwater from the nearby ocean. But for that to work, they need a system that distills and filters the water before they can drink it.

Directions:

Using your planning guide below:

1. Choose which problem you want to solve to help the city.
2. Brainstorm requirements and constraints to consider when designing your solution.
3. Reflect on the mystery in the "Solve" and the experiments from the "Make." Discuss with your group what state or states of matter your problem deals with and thus what properties (including particle motion,) to consider when designing your solution.
4. Brainstorm ideas based on both your questions and your prior knowledge of states of matter.

5. Finalize your solution design and create your technical sketch.

Planning Organizer:


Plan

Understand the Problem: Restate the problem you are addressing in your own words. *What is the challenge you are focusing on?*
Looking back on the "Solve" and "Make," what did you learn about different states of matter (their properties, how particles move) that you should consider in your design?

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What are your design requirements? What are some possible constraints to consider?
A requirement is a rule you must follow. For example, if the product must be a certain size or able to hold a certain weight, then size and weight capacity are considered requirements. A constraint is a limitation. For example, if you only have a certain amount of money or space to work with, then money and space are considered constraints.

Requirements	Constraints

Ideate/Brainstorm: Brainstorm some ideas for product designs based upon your answers to the questions above.
Put any and all ideas here. They can be notes, sentences, or sketches. Keep your mind open to as many ideas as possible!

From your brainstorm ideas, choose the idea that you think will work best to develop further as a technical sketch.
5. Create your technical sketch of your solution on a separate sheet of paper. Make sure you following these guidelines: ● Use a ruler for straight lines. ● Include measurements for your design (How tall/wide/long would your design be? Will your measurements be done in centimeters, meters, kilometers?) ● Include labels of all parts. ● Include annotations of how the design works. ● Optional: Include sketches showing multiple views. What would your design look like from the front, side and top?
6. Present your solution. Presentation must: ● Explain and demonstrate how the device works. ● Explain how the device helps to obtain usable water. ● Include information on your design solution and your researched state statistical data. Refer to the rubric below for presentation requirements!

Assessment: Final Presentation to City Council and The Public

You have helped the City to develop a solution to one of its biggest problems! In a poster or powerpoint presentation, give an overview of your solution, showing a detailed sketch and citing all relevant scientific information about states of matter to justify your design.

Use the "States of Matter *The Engineer* Checklist" and "Cognitive Skills Assessment" below to make sure you have done your best possible work.

States of Matter Engineer Checklist:

Your Challenge: Design a solution to one of the City's problems.

Project Completeness:

- ❏ Title: Name of design as heading
- ❏ Problem and its importance to the City identified
- ❏ Brief overview provided, including questions/limitations considered when designing the solution
- ❏ Use a ruler for straight lines.
- ❏ Use of full color
- ❏ Include measurements for your design (How tall/wide/long would your design be? Will your measurements be done in centimeters, meters, kilometers?)
- ❏ Include labels of all parts.
- ❏ Include annotations of how the design works.

- ❏ Optional: Include sketches showing multiple views. What would your design look like from the front, side and top?
- ❏ Final presentation of design solutions in written and verbal format as if presenting/pitching device to an audience of peers.

Cognitive Skills Assessment

	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.