Short Performance Assessment: **MS-ETS1-1-3**

Grade Level: **Middle School**

Title	**Redeveloping "The Dirtiest Street in All of the City"**		
Designed By	**Tabby McLain**	Course(s)	**NGSS Middle School/ Indiana 6th-8th Science**

Standards
MS-ETS1: Engineering Design *https://www.nextgenscience.org/topic-arrangement/msengineering-design*

Performance Expectations
The materials and activities outlined in this lesson are just one step toward reaching the performance expectations listed below.
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.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Dimension	**Name or NGSS code/ citation**
Science and Engineering Practices	**SEP.1: Asking Questions and Defining Problems** ● Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
	SEP.4: Analyzing and Interpreting Data ● Analyze and interpret data to determine similarities and differences in findings**.**
	SEP.7: Engaging in Argument from Evidence ● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.
Disciplinary Core Ideas	**ETS1.A: Defining and Delimiting Engineering Problems** ● The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.
	ETS1.B: Developing Possible Solutions ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
	ETS1.C: Optimizing the Design Solution ● Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.

Crosscutting Concepts	**Influence of Science, Engineering, and Technology on Society and the Natural World** ● All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. ● The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.
Student Performance Expectation	1. Identifying the problem to be solved 2. Defining the process or system boundaries, and the components of the process or system 3. Defining the criteria and constraints 4. Organizing data 5. Identifying relationships 6. Interpreting data 7. Identifying the given claims or design solutions 8. Identifying scientific evidence 9. Evaluating and critiquing evidence 10. Reasoning/ synthesis

Short Performance Assessment format adapted from the template available at Stanford NGSS Assessment Project https://scienceeducation.stanford.edu/ngss-assessment-design-and-analysis-resources.

Name _____

Redeveloping "The Dirtiest Street in All of the City"

Background:
Greater Indianapolis' Arab community is extensive and well established today. You are probably personally acquainted with at least one Arab family who has immigrated to the area from another country in the last year or two. These newest members not only have access to modern shelter, infrastructure, and services, but also to the network of fellow Arabs already established here. Even with a community helping newcomers to adapt and feel welcome, adjusting to life in a new country is a challenge. Have you ever thought about what it might have been like in the early 1900s for the first Arabs arriving in Indianapolis, without access to either 21st century developments or to the support of others linked with them through shared experiences and language? In this lesson, you will learn that Indianapolis' first Arab population lived in crowded and humble housing, surrounded by contaminated environmental conditions.

Design Problem:
Congratulations on your new position! You have just been onboarded as the youngest engineer ever to be hired by cutting-edge tech firm PriorCorp. Because of your specialized knowledge of the Arab community, you have been appointed to the design team working on an extraordinary project. Your team has been granted access to the company's YesterBot, which makes use of proprietary technology to enable time travel. You are tasked with traveling back to Indianapolis' Willard Street of 1903 to improve the living conditions for residents of the newly-established Syrian Quarter. Remember that this is your first assignment at your new firm, so you'll want to come up with your best ideas to impress your supervisor; below are some reminders to help you come out on top. Good luck!

- You are not limited to housing improvements- your department can choose to address any living conditions that you see as problematic.
- Your YesterBot access is strictly limited to this one task only, so don't get any wild ideas.
- As always, follow all the usual time travel rules:
    - Avoid paradoxes (for example, don't startle your great-great-great grandfather into falling into the White River which would result in you not being here in the first place).
    - Don't do anything that will alter a significant event in world history.
    - Don't get yourself caught in an endless loop.
- Some additional rules for your department today:
    - Do not introduce any technology, materials, knowledge, or scientific discoveries to 1903 that would not already have existed at that time.
    - You can, however, be as creative as you like in the way you use any of those resources (for example, you might choose to use chewing gum in place of mortar); on the other hand, be careful that your usage of resources doesn't create any new problems for your residents (refer again to the chewing gum example- those buildings would be unsound).
    - You can employ "new" scientific knowledge if it existed in 1903 (for example, in folk medicine), even if it has only more recently been accepted by science.
    - You should avoid incorporating resources that your residents would not have been able to access (for example, building a filter for the river out of fine gold mesh). If access might seem doubtful to anyone else on the project, be sure to include a plausible explanation for how that resource might have been obtained.
    - Respect the law insofar as you are aware of it, and respect ethical boundaries (for example, you should not steal materials for your residents).

Part 1: Learn about some of the housing and environmental issues that residents of the Syrian Quarter are living with (*whole class*)

- Watch the portion from time 2:40-11:33 of Dr. Edward Curtis' *Arab Indianapolis* documentary (available at https://arabindianapolis.com/the-documentary/).
    - During the video, take note of any issues you think your department should address in this project.
    - Also take note of any evidence of bias against your residents.
- After the video, discuss:
    - Scientists work with quantifiable measurements whenever possible. This type of data is not always available, especially when dealing with historical situations. When this sort of situation occurs, it is important to evaluate the data at hand for biases. What evidence of bias did you see in the clip? Which parts of the clip contained information that can be taken as objective scientific evidence? The clip indicated some clear bias in the way the data was reported at the time- to what extent do you think that affects our project? Do you think we can still rely on the historical observations such that we can assume that Willard Street actually was dirty and that the residents would benefit in terms of their psychological and/ or physical health from the area being cleaned up?

Notes:

Part 2: Define the criteria and constraints you'll need to consider in your redevelopment plan (*whole class*)

- Brainstorm your observations from the clip of issues in need of improvement on Willard Street in 1903.
- Outline the project's **constraints (materials and resources)** in general terms, referring to the project reminders listed under the Design Problem section.
- Set the project's **criteria (desired features)**. Be specific and prioritize the importance of each criteria.
    - Make sure you decide exactly what issues your team will address in the project. Examples might include the size or material of housing, services, water or air quality, etc- this is completely up to your design team.
- Be sure to discuss and take into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- Set up the decision matrix that your team will use to evaluate competing solutions with respect to how well they meet the criteria and constraints of your problem.
    - Make sure that everyone has access to a copy of the decision matrix, either by writing it on the whiteboard or by creating and sharing a Google Doc.
- Use your decision matrix to score and evaluate 1903's Willard Street as it was presented in the clip.

Notes:

Part 3: Come up with your redevelopment plan (*small groups*)

- Use Google and/ or reference books to individually research the technology, materials, knowledge, and scientific discoveries available in 1903- remember to be creative and think outside the box.
    - After collecting this information, share it- but only with the other members of your small team.
- How will you specifically address the issues the full design team agreed to focus on?
    - As part of your plan, describe the materials and processes you will use for each criteria chosen as a project focus by the design team.
    - Take into account how other variables might need to be managed in order for your plan to succeed.
    - Support your plan with data, prior knowledge, logic, and reasoning.

Notes:

Part 4: Present your redevelopment plans (w*hole class*)

- Each small team should present their plan to the full design team.
    - After presenting, small teams should answer any questions from other members of the design team.
- After each presentation, score that solution according to the decision making matrix.
- Decide which plan is best.

Notes:

Part 5: Create a hybrid plan *(whole class)*

- Use what you learned from your research and from each other to create a class plan with a higher score than any individual plan.
- Combine the best pieces from your team plans and add any new ideas that were inspired by the plan presentations and discussions.
- Score this final solution according to the decision making matrix.

Notes:

Part 6: Reasoning/ synthesis; written reflection (*individual*)

Write a reflection piece over what you learned in this activity. Address the following:

- Compare the decision design matrix scores from 1903 Willard Street, the highest-scoring small group solution, the lowest-scoring small group solution, and the final hybridized solution.
- How feasible (aside from the time machine) would it have been to actually implement the changes from the hybrid design in 1903? What barriers to implementation can you think of? What could have helped reduce those barriers? In what ways would it have been simpler to implement these changes in 1903 versus today?
- If your 2 biggest barriers weren't in place, how feasible would implementation have been?
- What differences could these changes have made for the residents?
- How could these changes have improved life for the residents?
- If these changes had actually been implemented in 1903, how might life be different today for descendants of these residents? How might things be better? In what ways might those changes in 1903 have made things worse for the descendants of these residents today?
- What sorts of things (services, resources) are today's Arab immigrants to the Indianapolis area missing?

Notes:

Teacher Info (Observations from video to help if students stall in Part 1 or 2 brainstorming session):

1903 WIllard Street, Indianapolis
Lacking access to resources: fuel for wood stove
Houses 15 feet wide, up to 10 people
Dusty streets

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Indianapolis Journal, 1903
Not everyone perceived the people in the light that we do today (visitor “doomed to meet with disappointment”)
2 rambling rows of old broken down 1-story frame houses bordering a half block of the dirtiest street in all of the city
People started with very little

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Historian interview
Indianapolis perceived as mostly white- populations of diverse groups but relatively models
“Racist ideological rhetoric”- different skin color, immigrants, religious minorities
Rubble and debris in streets
Fair amount of heavy industry very close by
Lacking: paved streetways, modern sewer service, utilities
Smells like (typical of downtown Indy): coal ash + wood ash from coal- and wood-burning stoves; “all of the odors from industry”: odors from “riverside industry” (infer that water source itself is polluted), one of the largest pork packing plants on planet, metal factories, grain factories, auto plant