Unit Title	Solving Real-World Grand Design Challenges	Unit Length	23 days

DESIRED RESULTS: STAGE ONE

Core Curriculum Content Standards
(The NJSLS., including the pertinent Technology and 21st Century standards, that inform the curriculum)

NJSLS:
8.1.A - Technology Operations & Concepts
8.1.B - Creativity and Innovation
8.1.E - Research and Information Fluency
8.1.F - Critical Thinking, Problem Solving, and Decision Making
8.2.A - The Nature of Technology: Creativity and Innovation
8.2.B - Technology and Society
8.2.C - Design
8.2.D - Abilities for a Technological World
9.3.ST-ET.1-6 - Engineering & Technology Career Pathway
ELA Standards for Science & Technical Subjects: RST6.1—10

Understanding(s) *(The big idea(s) students should take from the lesson)*	Essential Question(s) *(The open-ended, provocative question(s) that help frame inquiry)*
- Engineering, design, and technology are created and utilized as a response to specific circumstances and must account for the specific needs of populations, individual and collectives issues and concerns, as well as specific situational criteria and constraints - Meaningful engineering design for real world problem solving must optimize available resources and account for social, environmental, and economic impacts - Criteria and constraints represent requirements and limitations that must be considered in developing problem solutions, and they form the basis for how an individual approaches developing and executing a solution to a problem - Engineering, both as a profession and an action, can serve to change the world for the better through improving quality of life and access to fundamental necessities - Criteria and constraints can come in many forms and include monetary, material, ethical, and scaling concerns	- How do teams efficiently and effectively solve problems that exist in an increasingly complex world? - Why is it important to clearly document their process and communicate their work to others?
Knowledge *(Students will know . . .)*	**Skills** *(Students will be able to . . .)*
Students will know the difference between a problem and a	Students will be able to identify a school-wide or local problem,

question	delineate criteria and constraints, and propose and prototype solutions for the problem
● Students will know how utilizing the engineering design process helps engineers solve a problem	● Students will be able to compile, arrange, format, present and defend information in an engineer's notebook or design portfolio
● Students will know how important documenting their progress in an organized and detailed manner is in order to stay organized	
● Students will know the difference between a requirement and a constraint	

ASSESSMENT EVIDENCE: STAGE TWO

Performance Task(s)	Other Evidence
● Identify the problem ● Identify the design statement ● Identify the requirements and constraints ● Ask scientific research questions ● Compile information about the science behind the challenge ● Explain who benefits from the solution ● Brainstorm multiple solutions using a variety of techniques ● Sketch ideas for solutions ● Collaborate with others to choose final solution ● Create a technical drawing of project ● Explain why this solution will solve the problem ● List the steps to create the product ● Note the changes made while building ● Provide feedback to peers ● Utilize feedback to improve design ● Reflect on experience and redesign project in multiple ways ● Follow safety rules while building ● Use varies tools in classroom to create prototype	● Engineering Design Process Documentation ○ Document, Presentation, Website, etc. ● Physical Prototype ● Individual Participation in Group Projects

LEARNING PLAN: STAGE THREE

Sequence of Learning Activities	Materials and Resources

Day 1-20: Student-Designed Final Project
- Day 1: Introduce Final Project.
  - Lesson about identifying problem statement, defining design statement, and setting constraints.
  - Give examples of topics that students in the past have done in order to potentially inspire students.
- Day 2:
  - Mini lesson on using the design process as a way to bounce around between the steps to further develop ideas (design thinking)
  - Students do not have to complete this in the chronological order
- Day 3-6:
  - Ask through Plan due on Day 6
- Day 7-16:
  - Mini Lesson on common tools needed for students' plans (coping saws, exacto knives, hot glue guns, hot wire cutters, etc.
  - First phase of Create & Prototype due by Day 16.
- Day 17:
  - Feedback Day
    - Students share their projects with the class to get feedback on their projects so far. They will document their feedback to use throughout the rest of the building process.
- Day 18:
  - Finish building prototype by Day 20.
- Day 21:
  - Feedback Day 2
    - Students share their final projects with class to get feedback for their improve step. Document feedback.
- Day 22-23:
  - Improve
    - Students complete the documentation for the improve step, reflecting on the entire experience of the project and redeveloping or redesigning possible solutions for their problem.

- Access to basic hand tools and fabrication equipment
- Materials for design challenges (foam, wood, wire, acrylic etc.)
- Access to computer lab and LCD projector
- CAD/CAM software and technologies
- Video conferencing capability for work with mentors

Notes/Reflections

Group Members: Class:

Pet Accessory Design Challenge
Grand Design Challenge - Design Brief

Problem Statement: The purpose of this class is to provide an opportunity for you to utilize your knowledge and skills to solve problems present in our world and day-to-day lives. Some of the solutions to these problems may necessitate the use certain new materials in this room, and at this point in your education, you have had minimal exposure to them. This project will help you to become familiar with using multiple materials together, while allowing you to develop the skills necessary to succeed in this class.

Design Statement: The House A guidance counselor at CMS, Mrs. Montefinese, recently got a guinea pig for her office. It needs more accessories for inside its cage, and to play in outside of the cage. Your challenge is to develop a pet friendly object for the guinea pig.

Requirements:
- Must be constructed with animal safe materials only

Constraints:
- Time Frame: Approximately 1.5 weeks

Documentation & Evaluation

Ask

- What is the goal of this project? (the <u>problem</u> you are solving)
    - ○
- What is the task that you are faced with?
    - ○
- What are some problems you may face during the project?
    - ○

Research Questions (questions that will help you build your project-think about the materials you have available and your audience)	Answers

Interview with Vinny/Mrs. Montefinese

Questions to ask Vinny/Mrs. Montefinese to help gain knowledge about his needs/personal information	Answers

Ask - Design Idea

- What type of object will your be designing for this project?
  - ○
- Does this product already exist?
  - ○
- If yes, how will yours be different? (if no, leave this blank)
  - ○

Imagine

Fill out the paper morphology chart to brainstorm possible components of your design. Get it scanned at the library and insert it in below.

Imagine

Create a rough sketch of each group member's 3 best ideas and insert it below as a link to the PDF. You should hand draw this and get it scanned at the library.

Plan

Fill out the chart below with the specifications for your final design

	Final Idea Specifications
What is the object?	
Materials Needed	
Materials Brought in from Home (optional)	
Tools Needed	
How will Vinny use the product?	
Image from Google that is similar to your design	

| Image from Google that is similar to your design	
Image from Google that is similar to your design	

Plan

In complete sentences, explain why this is your best idea. Reference your research and why this would be the best product for the animal.

Plan

List the steps you will take to create your project. Steps must be detailed. Anyone with your drawing and list of steps should be able to create your product.
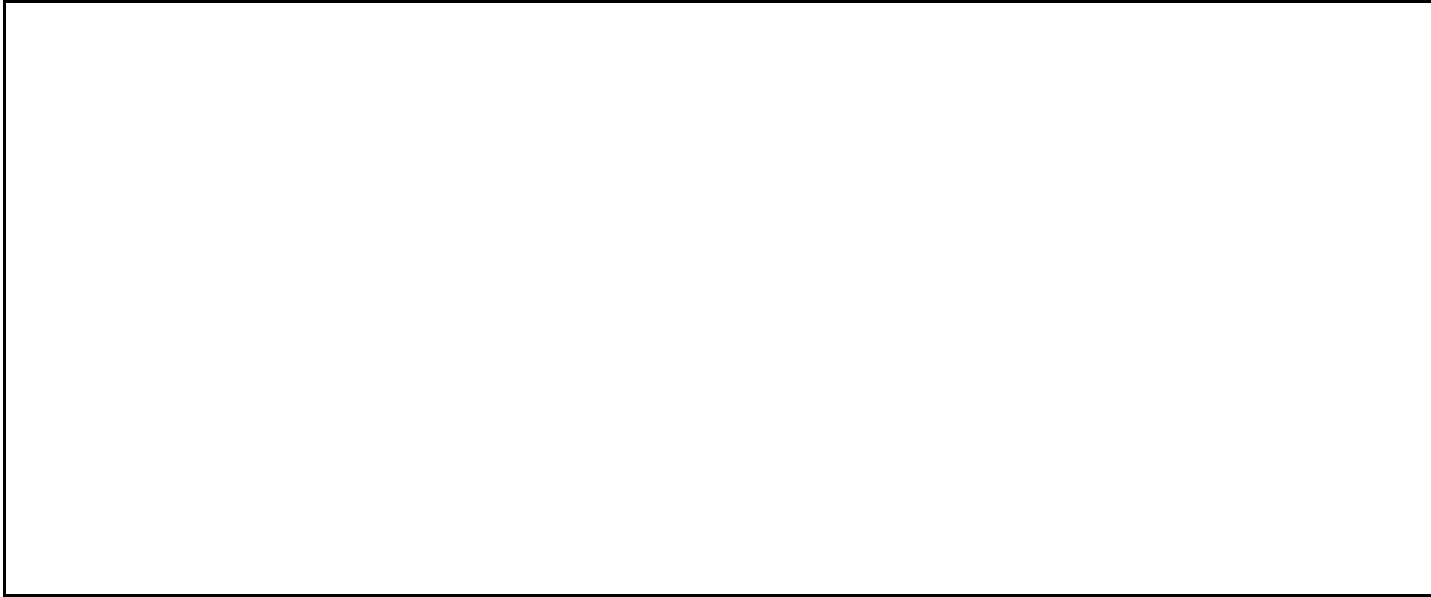
Plan - Drawing

Each group needs one drawing of your final design.

This needs be hand drawn with 3 views and scanned in.

The drawing must use a ruler when appropriate, and include labels for materials and parts, and dimensions.

Insert Link to PDF here:

Create Daily log of activities	
Date	Tasks Accomplished by Each Group Member (Change Member to group member's name)
	Member 1: Member 2: Member 3: Member 4:
	Member 1: Member 2: Member 3: Member 4:
	Member 1: Member 2: Member 3: Member 4:
	Member 1: Member 2: Member 3: Member 4:
	Member 1: Member 2: Member 3: Member 4:
	Member 1: Member 2: Member 3: Member 4:
	Member 1: Member 2: Member 3: Member 4:

Create
Log of Changes Made (Add more rows if needed)

Date	Changes made from original plan & explain why
Ex. 5/12	Removed the top cover - made it easier to access the inside

Interview/Test with Vinny

Questions to ask Vinny to help make final changes before the final test	Answers/Observations

Feedback
As your classmates give you feedback, record it below

Classmate's Name	Comments Provided

Improve Reflection Questions
Answer the questions below to reflect on your project

What worked well during the project?	

What could have gone better?

Improve - Redesigned Idea
Make references to your changes you made to your project as well as your feedback from peers to answer these questions

If you were to make more changes to your project, what is one thing that would you change?

How would this change make your product better for the user? Be specific!

If you were to make another change to your project, what another thing that would you change?	
How would this change make your product better for the user? Be specific!	