Design a Shipping Container

Submitted by: Christopher Tolliver, Science
Kissimmee Middle School, Kissimmee, Florida

Target Grade: 6-8 Science or Technology

Time Required: 60 minutes

Standards:

- 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.

Lesson Objectives:

Students will:

- Design and create three afford homes out of a shipping container.
- Present these homes to a client (the class), and break down why the home is deigned the way it is.

Central Focus:

Students will design and create affordable homes for families that have been hit by a natural disaster. These homes are made for families less than 4. These homes need to be easily built for a quick reaction time to the disaster. With this assignment students will be able to practice engineering skills while gaining understand of events that are happening in the everyday world.

Background Information:

Students need to have background knowledge over natural disasters that occur and history if disasters that have happen in the past and how the containers could be beneficial for housing in the event of a natural disaster.
They also need to see examples of real life shipping container homes.

Materials

- Engineering notebook
- Pencil
- ¼" Graph paper
- Tape
- Glue stick
- Architectural scale
- Architectural templates
- Computer with SketchUp 2017
- Design Brief, Decision Matrix, Design Process Solution Templates
- 3D Printer
- Project Rubric (see below)

Instruction

Introduction:

Safe, secure, affordable housing is needed in many parts of the country. In the wake of a hurricane, tsunami, or forest fire, many affordable homes are needed quickly. Shipping containers were originally invented to carry cargo across oceans. Cargo shipping containers make great housing because they are strong, durable, waterproof, resistant to mold, fire, and termites, as well as being affordable, easy to assemble, stackable, and readily available. Shipping containers are in abundant supply and many are ready for recycling; housing is the ideal solution.

Shipping-container housing has gained increasing recognition in the wake of the tragic natural disasters in New Orleans and Haiti where low-cost, emergency housing continues to be an urgent need. Innovative architects and green designers are taking this simple idea one step further and turning shipping containers into housing that is not only functional and affordable, but also sustainable.

In this problem you will design a one-story home from four reclaimed shipping containers using your knowledge from this unit, consider factors like room sizes and relationships, kitchen working triangle, and plumbing configurations.

Procedure:

Your challenge is to design and print a home from four or fewer, reclaimed shipping containers. The containers are 8'x20' and must be made into a one-story, one-family, two-bedroom, and 1 or 1½ bathroom home. Using their 3D Printed models, each student in the class will have 5 minutes to present their designs to the client and classmates. Presentations will occur on _____.

1. Complete the Design Brief as you listen to the client interested in purchasing your shipping container home design.

2. Review the Shipping Container Home Grading Rubric so that you are familiar with the grading criteria.
3. Rearrange your 4 laminated rectangles, each 8 x 20 blocks (1/4" graph so ¼" = 1' scale) to represent the four cargo containers. You will create three potential solutions, each with a maximum of four shipping containers.
4. Arrange your graph paper rectangles into the design layout that you will use for your home solutions.
5. Trace the graph paper rectangles onto graph paper for each of your three home designs.
6. Sketch in room walls, window and door openings. Label rooms and sizes.
7. Use the Decision Matrix to determine which of the three shipping container home designs you will continue to use for this project.
8. Use the architectural templates to sketch doors, furniture, fixtures and appliances in your final design.
9. Use colored pencils to lightly and neatly color each of the following areas.

a. Service area – green

b. Sleeping area – blue

c. Living area – red

10. Use the SketchUp software to draw your container home. Include doors, windows, furniture, fixtures, and appliances.
11. Dimension the floor plan and print a copy with dimensions, room labels, furniture, and appliances using the dimensional anchor tool.
12. Create and print a 3-D view without a roof.
13. Assemble a PowerPoint document using exported images of your 3D design from SketchUp, and with your 3D model, assemble a presentation to sell your design idea to the client and your classmates.
14. Use your 3D Model to assemble a "Community of Homes" of shipping container homes with your other classmates utilizing green, sustainable urban development rules and regulation.

Closure

After all students have presented their homes/design, on a separate sheet of paper have students answers the following questions as an exit ticket.

a. What was the most difficult part of arranging the shipping containers to use for a home?

b. Describe why you chose this design from your three options.

c. Describe five features you could include in this shipping container home to make it more "green".

d. Would you consider living in a shipping container home? Why or why not?

e. After listening to your classmates' presentations, describe some innovative ideas they shared that are eco-friendly.

Differentiation

Student could be placed groups pre-selected by the teacher, or students may self-select depending on the class population. If there are special needs in the classroom, the teacher should structure groups based on this information. This lesson is intended to be an individual project, but for students that are struggling partners could be beneficial. Also, for students that need extra assistance you could start the student off with one shipping container completed, that way they could use the example to create the other two shipping container homes.

Assessment

- *Exit Ticket* (Formative): Students will answer 5 questions about the project they just completed.
- *Shipping Container Project* (Formative): Students will create and model 3 different shipping container homes. After they have designed the home they will present them to the class.

Elements	Weight	5 Points	4 Points	3 Points	2 Points	1-0 Points	Total
Design Brief		Design brief is completed and includes all required information, including client, designer, problem statement, design statement, constraints, and deliverables.	Design brief is 80% complete.	Design brief is 50% complete.	Design brief is less than 50% complete.	Design brief is less than 25% complete or missing.	
Design Process Notes		The project includes a detailed step-by-step description of the design process.	The project design process notes do not explain all steps thoroughly.	Some design process notes are missing or incomplete.	The design process notes do not describe work done at each step of the design process.	There is little or no evidence of design process notes.	
Research		Research is documented with appropriate citations. Research shows a variety of resources and is not limited to one or two sources.	Research is documented on some topics. One or two do not have proper citation information. Research is limited to two or three resources.	Research is randomly completed with little or no documentation of sources.	There is no research other than what is available from the textbook or lecture notes.	There is little or no evidence of research in the notebook.	
Design Sketches		Three sketches are complete and annotated to show all important information. All designs are unique and are completed in pencil.	One sketch is not complete and is missing important information, such as measurements. The designs are unique and are completed in pencil.	Two sketches are missing more than half of the identification of components.	All sketches are not complete. Sketches are not completely created with pencil.	There is no evidence of sketches in the notebook.	

Decision Making Matrix		The decision matrix is complete with all criteria listed and each drawing evaluated. The student can effectively justify the final decision.	The decision matrix does not evaluate the required number of drawings. The student can justify the final decision.	The decision matrix criteria are incomplete. The option selected is not clearly justified using the matrix.	The decision matrix is missing both criteria and evaluations of drawings. The final project decision cannot be justified using the matrix.	The decision matrix is excessively incomplete or missing. The final project decision cannot be justified using the matrix.	
Required Criteria		90% or more of the required criteria are met: appropriate living, service, and sleeping space, closets, storage, doors, windows, furniture, and appliances. Green features are included.	75% or more of the required criteria are met: appropriate living, service, and sleeping space, closets, storage, doors, windows, furniture, and appliances. Some green features are included.	60% or more of the required criteria are met: appropriate living, service, and sleeping space, closets, storage, doors, windows, furniture, and appliances. Few green features are included.	40% or more of the required criteria are met: appropriate living, service, and sleeping space, closets, storage, doors, windows, furniture, and appliances. Green features are not included.	Less than 40% of the required criteria are met: appropriate living, service, and sleeping space, closets, storage, doors, windows, furniture, and appliances. Green features are not included.	
Required Drawings		Floor plan drawings, 3-D drawing with a roof, and 3-D drawing without a roof are > 90% complete.	Floor plan drawings, 3-D drawing with a roof, and 3-D drawing without a roof are > 75% complete.	Floor plan drawings, 3-D drawing with a roof, and 3-D drawing without a roof are > 60% complete.	Floor plan drawings, 3-D drawing with a roof, and 3-D drawing without a roof are > 40% complete.	Floor plan drawings, 3-D drawing with a roof, and 3-D drawing without a roof are < 40% complete.	
Communicate Solution		The presenter effectively and creatively delivers the information while staying on topic. The presenter appears relaxed and self-confident. Body language, voice modulation, and eye contact are effectively used.	The presenter adequately delivers the information while staying on topic. The presenter appears relaxed and self-confident. Body language, voice modulation, and eye contact are mostly appropriate.	The presenter delivers the information but does not stay on topic. The presenter appears tense or nervous. Body language, voice modulation, and eye contact are inappropriate or lacking.	The presenter omits important information and does not stay on topic. The presenter appears tense or nervous. Body language, voice modulation, and eye contact are inappropriate or lacking.	The presenter does not effectively deliver the necessary information.	