Burn It or Build It

Laser Cutters vs. 3D Printers

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Grade Level	6th – 9th Grade	**Time Frame**	180 minutes
Subject	Science	**Duration**	3~4 class periods
Course	Physical Science		

Essential Question

How does technology advance safety and reliability in housing?

Summary

In this technology lesson, students design and build a model home using their choice of either a 3D printer or laser cutter. To prepare, they brainstorm natural disasters, research architectural defenses, and explore the history of housing. Applying these concepts, they create and test homes designed to withstand apocalyptic scenarios, then reflect on their learning experience.

Snapshot

Engage Students use the Collective Brain Dump instructional strategy to create a list of natural disasters.

Explore Students conduct guided research to find how architects plan to defend against weather.

Explain Students apply the concepts from the Explore to the use of 3D printers and laser cutters. They explore a timeline about the history of houses to gain knowledge on building concepts.

Extend Students design and print a home to survive apocalyptic scenarios. Their assembled homes are tested.

Evaluate Students reflect on their experience and discuss lessons they have learned.

Standards

ACT College and Career Readiness Standards - Science (6-12)

SIN202: Understand the tools and functions of tools used in a simple experiment
SIN401: Understand a simple experimental design
SIN701: Understand precision and accuracy issues
SIN702: Predict the effects of modifying the design or methods of an experiment

Next Generation Science Standards (Grades 6, 7, 8)

MS-PS1-6: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Oklahoma Academic Standards (7th Grade)

7.LS1: A solution needs to be tested, and then modified on the basis of the test results,in order to improve it.
7.PS1.6.3: The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.
7.ESS3.1.3: These resources are distributed unevenly around the planet as a result of past geologic processes.

Oklahoma Academic Standards (7th Grade)

EN.ESS3.4 : Evaluate design solutions for a major global or local environmental problem that reduces or stabilizes the impacts of human activities on natural systems.*
EN.ESS3.4.1: Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.
EN.ESS3.4.2: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Attachments

- Designing the Apocalypse—Burn It or Build It.docx
- Designing the Apocalypse—Burn It or Build It.pdf
- Guided Research—Burn It or Build It.docx
- Guided Research—Burn It or Build It.pdf
- Lesson Slides—Burn It or Build It.pptx
- Student Apocalypse Rubric—Burn It or Build It.docx
- Student Apocalypse Rubric—Burn It or Build It.pdf
- Surviving the Apocalypse—Burn It or Build It.docx
- Surviving the Apocalypse—Burn It or Build It.pdf

Materials

- Lesson Slides (attached)
- Guided Research handout (attached; one per student)
- Surviving the Apocalypse handout (attached; one per student)
- Student Apocalypse Rubric (attached; teacher copy)
- Designing the Apocalypse handout (attached; teacher copy)
- Whiteboard or smartboard with marker
- Internet connected devices (one per student)
- Destruction materials (see the Designing the Apocalypse handout)
- 3D Printer
- Laser Cutter

- Sticky Notes or Stickerss
- Pen/Pencil

Teacher's Note - Lesson Preparation

You will need to provide a list of the materials for 3D printing and laser cutting available to the students as well as their costs. The choice of materials is up to you, but the more variety available, the more diverse the construction will be for the students.

25 minutes

Engage

Teacher's Note - Connected Lessons

If you haven't taught the Cutting Edge: Science of Precision and Cutting Edge: Design to Prototype lessons on laser cutters, or The Right Tool for the Job lesson on 3D printers, you should make sure that students know how they work. Ask students to share what they know about how laser cutters and 3D printers work and clarify any misconceptions. While the term "laser cutter engraver" is the industry name for this type of machine, we will shorten it to "laser cutter" for the sake of clarity and flow throughout this lesson. See our linked Laser Cutter Tech Tool card for more information.

Use the attached **Lesson Slides** to facilitate the lesson. Transition through **slides 3-4** and discuss the Essential Question and Lesson Objectives in as much detail as you feel necessary.

Display **slide 5**. Using the Collective Brain Dump instructional strategy, ask students to think of natural events that can be devastating and have an effect on manmade structures. After students have completed the activity, make sure that the list includes at least the following: flooding, tornado, earthquake, tsunami, and meteor strike.

40 minutes

Explore

Pass out one of the **Guided Research** handouts to every student. Display **slide 6** and explain that students will work with a partner to research different ways to make houses sturdy enough for different natural disasters. Before students start working, take 1-2 minutes to brainstorm as a class about different search terms that relate to this topic. Consider displaying the list somewhere at the front of the room. Allow students time to work.

After students have completed their research, display **slide 7** and explain that now students will share their findings with others. Group students by the natural disaster they focused on and have them share what they found. As a group, have them create a list of top five must-haves to survive this natural disaster. Have them share this list following your classroom norms.

30 minutes

Explain

Move to **slide 8**. Students will now view a timeline of an abbreviated history of construction and building materials. Have students navigate to the History of Building Materials infogram and read through the entire timeline. Once they have had time to finish the timeline, ask what similarities and differences they noticed over time.

Teacher's Note - Optional Video

You might also consider unhiding **slide 9** and showing students this animation as an added support for the timeline if time allows: Housing Through the Centuries.

Move to **slide 10** and ask students the following question:

How does what you learned from the timeline apply to 3D printing or laser cutting?

Using the Elbow Partners instructional strategy, have students work together to formulate an answer. When all of the students have completed their answers, ask them to share with the class.

Teacher's Note - Sample Student Responses

Students will likely point out a variety of parallels. Some of these might include:

- Material choices are different but are still material choices.
- Pre-fabricated homes still need assembly.
- Draft blueprints are still used; they are now just in CAD programs instead of blueprints.

65 minutes

Extend

Teacher's Note - Tinkercad

You will also want to set up a class in Tinkercad before beginning this part of the lesson. See the Tinkercad tech tool card for instructions.

Display **slide 11** and explain that students will work in teams to design a house that can survive an apocalypse consisting of a variety of natural disasters. Give students at least one full class period to design their homes. Explain to students that they will render their design using Tinkercad software. Remind students that when they are finished, they should send the file to you for printing or laser cutting. Have students create their groups.

Once students are in groups, pass out the **Surviving the Apocalypse** handout to every group. During the design process, students should calculate the cost of materials and submit that information to you when they submit their file. Record these for each project on the **Student Apocalypse Rubric** handout.

Teacher's Note - Print and Cut Time

Between the next class period, print and/or cut the student designs. Make sure to write the cut and/or print time in the "Time" column of the Student Apocalypse Rubric handout.

The next day, display **slide 12** and provide students with their prints or cuttings. If they need to complete extra steps to finish their home (e.g. gluing for those who used the laser cutter), make sure to add them to the cost and/or time columns.

Teacher's Note - Optional Score Display

You can make a digital copy of the rubric to display in the background and add to it as each group's homes are scored.

Set up all the homes displayed in a central area and move to **slide 13**. Have each group use the Gallery Walk instructional strategy by placing a sticky note or sticker on the one house they would most like to live in. Record the total number of votes for each home in the livability column on the rubric.

Move on to testing the model homes using the disaster scenarios from the **Designing the Apocalypse** handout. For each disaster each home survives, award them one point in the "# of disasters survived" column of the rubric.

Total up the number of points from all of the columns to determine the winning group.

Teacher's Note

If time allows, consider unhiding **slide 14** and play the video to show how this company used engineering to help design a durable home that still uses traditional building materials.

20 minutes

Evaluate

Move to **slide 15**. Using the Exit Ticket Instructional Strategy, ask students to answer the following questions:

- *How would you have changed your design if you knew the tests?*
- *What else do you think you would have done differently?*
- *What observations did you make regarding the differences in the 3D-printed versus laser-cut homes?*

Have them turn in the exit ticket to you to use for future discussion.

Resources

- K20 Center. (n.d.). Collective brain dump. Strategies. https://learn.k20center.ou.edu/strategy/111
- K20 Center. (n.d.). Elbow partners. Strategies. https://learn.k20center.ou.edu/strategy/116
- K20 Center. (n.d.). Bell ringer and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Gallery walk/carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- K20 Center. (n.d.). Laser cutter engraver. Tech Tools. https://learn.k20center.ou.edu/tech-tool/4451
- K20 Center. (n.d.). Tinkercad. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2166
- Lay, J. (2015, June 5). A visual history of housing through the centuries: An animated exploration of what "home" has looked like throughout human existence [Video]. *YouTube*. https://www.youtube.com/watch?v=GoCZnboThfk
- The Verge. (2017). This hurricane-proof home can withstand powerful storms [Video]. *YouTube*. https://www.youtube.com/watch?v=3Ge-9rARXfo