

Design Thinking: Be Energy Smart

Designing Space- and Energy-Efficient Homes

Introduction

Since humans first created a simple shelter to get out of the elements, our homes have been an essential part of our lives. We now build homes from a wide variety of materials, in every conceivable location, and increasingly use a wide-array of technology to make them healthier, more enjoyable places to be.

But this comes with a cost. The more sophisticated and elaborate our homes become, the more space and energy it takes to build and maintain them. And our supply of both these critical resources is limited. So how do we make our homes use less space and energy, while still being wonderful places to live?

We can apply ideas from science, technology, engineering, and math (STEM) to develop more efficient homes. Scientists and engineers can create new materials and building strategies that make better use of our existing resources, and even provide approaches to have our homes create resources like energy, fresh air, clean water. And we can use technology to monitor the resources we use and help us make the best possible use of them.

Scientists and engineers are always working to design better solutions to develop more space and energy efficient homes. These are complex problems, and they require complex thinking. Design thinking is a powerful way to develop solutions to complex problems. It starts with defining the problem and understanding how that problem affects people. Then it requires brainstorming many, many ideas and designing and testing prototypes of those ideas. In this type of design, failure is just part of the process. There is room for improvement in every design.

There is much we can already do to make our homes more space- and energy-efficient. But there is also much more we could do. And that is where you come in. By applying your understanding of STEM skills and knowledge and by using design thinking, you can come up with new and innovative solutions to create energy-efficient homes for YOUR community.

Your **Day of Design Challenge** is to design an affordable home that is designed to be as space- and energy-efficient as possible.

PART 1. IMAGINE A SOLUTION

STEP 1. Imagine an “Ideal” Solution

Talk to your team. What do you think the “perfect” solution is to create a space- and energy-efficient home?

Teacher Tips and Resources

During this initial “ideation” step give your students free rein. The “solutions” they come up with may be impracticable, even fantastical, but that’s OK. They’ll spend the next part of this activity learning about the constraints that they will have to address to develop a solution for the real-world.

If your students are having trouble starting you may want to show them this video clip (or one like it) that features very innovative home design ideas

<https://www.youtube.com/watch?v=Mb4raWnagV8>. Also worth watching is a short video clip from the HGTV series “Tiny House, Big Living”

(<http://www.hgtv.com/shows/tiny-house-big-living>), especially those that emphasize sustainability.

Sketch your idea here:

STEP 2. Dig into The Problem

Now do your research on the problem of create space- and energy-efficient homes. Go online. Talk to people who live in your community. If possible, interview someone who builds homes. These are your “users”.

Try to get answers to as many of these questions as you can, and ask other questions that you come up with!

What strategies are already being tried in homes to use space and energy as efficiently as possible? Which of these work and which don’t work? Why?

Teacher Tips and Resources

The following article that provides a list of 21 ideas for building sustainable homes is a good starting point for research: <https://jorgefontan.com/sustainable-house-design-21-ideas/>.

For a more technical discussion of energy-efficiency in home building direct your students to websites about net-zero energy buildings (e.g.

<https://www.wbdg.org/resources/net-zero-energy-buildings>) and energy efficiency tips (e.g. <https://www.energystar.gov/>)

Doing interviews with “users” is always the most powerful and productive (and engaging) way to get insights into a design challenge. The questions listed here are suggestions. If you have time, have your students develop their own interview questions. Make sure they keep notes. If your students get confused with the amount of information, coach them to focus on the “most important” things. And suggest that they sketches to summarize their findings. For “interviewees”, use your colleagues or adult volunteers to provide their perspective, or if possible reach out to civic institutions (e.g. Town Hall) or corporations (e.g. architecture firms) to recruit “experts.”

Capture what you learn here:

What is the most important thing your users want space- and energy-efficient homes to accomplish?

Capture what you learn here:

What does your users’ “ideal” solution to creating a more space- and energy-efficient home look like?

Sketch or describe it here:

What is stopping them from creating their “ideal” solution? Is it money, rules, lack of technology or materials?

Capture what you learn here:

What were the key findings from your research?

Capture what you learn here:

What features of your “ideal” solution do you think will work and which won’t? Why?

Capture what you think here:

STEP 3. Create Alternatives to Test

Imagine at least 3 different ways to meet your “users” needs. Make sure that each is as different as possible from the next.

Sketch your 3 or more ideas here:

Ask your “users” or other teams in your classroom what they think of your ideas.

Capture what you learn here:

PART 2. PROTOTYPE YOUR SOLUTION

STEP 1. Reimagine Your “Ideal” Solution

Based on all the insights you have gained, what do you NOW think the “ideal” solution is to create a space- and energy-efficient home.

Sketch your idea here:

STEP 2. Create a Prototype

Using the resources available to you, create a prototype of your solution. It might not match your ideas completely. But it should help bring your ideas to life for your users, and allow you to start testing them.

Teacher Tips and Resources

Prototyping can be done using traditional classroom materials, or virtually using a free 3D design app.

Simple Prototypes:

Have your student draw out the house plan to scale using graph paper. If you have time and resources, have them build a model out of classroom supplies. Working in teams will significantly reduce the supplies used. And reinforce the idea of sustainability by having your students recycle and upcycle building materials as much as possible.

Typical building materials might include foamcore, cardboard, chipboard, recycled cereal boxes. To get precise cuts, you will want to use an exacto knife or box cutter for most materials. To connect materials use tape or hot glue, which tends to work better and creates more structurally sound models.

Virtual Prototypes:

This popular home design blog provides links to a number of available home design apps: <http://freshome.com/10-best-free-online-virtual-room-programs-and-tools/>.

With older students have them help you identify the best one for their project. Have them capture screen shots to develop a presentation on their prototype to test and submit.

With younger students consider using simple text or slide programs (e.g. Google docs, PowerPoint) and have your students import images of key features of their homes and describe the advantages they offer.

This optional activity provides a more structured approach to creating a prototype, specifically

for a small, energy-efficient home with a limited budget:

https://docs.google.com/document/d/1vgleA_398FO06jpRbykAjXsU1CnXjPKkB5QZ-qYzXFM/edit

It can easily be modified to provide scaffolding for your students projects.

Describe how you will create your prototype here:

STEP 3. Test Your Prototype

Using the resources available to you, test your prototype. If possible, ask your “users” what they think.

Teacher Tips and Resources

An important part of the design thinking process is to establish how you need to test your prototype to figure out if its going to successful for your “users”. This is often quite tricky.

Have your students define what the key “metrics of success” are for their prototype. For example, is the most important attribute of the home: energy-efficiency, cost to build or run, or is it more important that people “like to live” in the home? Perhaps all three are important.

Then have them propose ways to test the prototype how it scores for these metrics. It may be difficult to test the design as a whole, so suggest that they focus on specific features and then pull these all together. For example, test the impact of the insulation they choose on energy use, or estimate the impact of reducing size on cost to build. It’s OK to estimate impacts in some cases, as long as they are justified by clear, logical thinking. For example, I think people will like the house better because it has 50% more windows than the average house in my neighborhood, and people prefer homes with more natural light.

Describe how you will test your prototype here:

Capture what you learn here

STEP 4. (OPTIONAL). Refine Your Prototype

If you have the time and the resources, use what you have learned by testing your prototype and improve your solution. You can do this once, twice, or as many times as possible.

PART 3. SHARE YOUR SOLUTION

Teacher Tips and Resources

There are many ways for your students to share their ideas. This is not only empowering for them, as they get to share their ideas and work with a broader audience; it is also a great learning experience, as they identify and focus on their critical findings and outcomes, gain deep mastery of their subject materials, and develop and deliver effective communication messages and assets (e.g. models, diagrams). Remember to emphasize to them not to shy away from describing their failures and what they learned from them. This is an inevitable and powerful part of the (iterative) design thinking process. Ideas and solutions get better through testing and failure.

Now it's time to tell your users and your community about your solution. Using the resources available to you, create a presentation (with pictures if possible) or a short (1-minute video) that describes your solution, how it works, and anything you have learned about it. Don't be afraid to share ideas or designs that didn't work. These are important because they tell you what the tough challenges are and help you make better solutions for the future.

Teacher Tips and Resources

Your students can gain national recognition for their work by participating in the year-long Day of Design initiative and claiming their Be Energy Smart Badge. Register on the Day of Design website (<http://dayofdesign.com/getting-started/>) to receive detailed instructions on this opportunity.

Ask your teacher to upload your presentation / video to the **Day of Design** website so that you can get your **Be Energy Smart Design Thinking BADGE**.

Teacher Tips and Resources

The Be Energy Smart design thinking challenge is intend to help you and your students start on the path to build and practice new career-ready skills, such as design thinking, and explore critical STEM subjects, such as energy use and efficiency, and their relationships to your local and the global community. Do not feel constrained by the guidance and suggestions of this activity. There are many ways to make these important learning opportunities work for your students! Don't hesitate to share your successes and failures by submitting them as well to the Day of Design program.

How can you bring your prototype / solution to your community? What do you need to make this happen? Who could you work with? Are there other opportunities to help your community create space and energy-efficient homes? Be creative, get involved! Then make and share a video to tell the story of your adventure as a DESIGN THINKER!