To begin, remove the box from your home's garage and unpack its contents. You can set your car and water sensor to the side, but you will want to plug your multisensor in now. The multisensor should plug into the black AC adapter in the box, which can then be plugged into one of the smaller power outlets on the back of the house.

After you have plugged the multisensor into the home, you may plug the home into the wall.

Next, open the roof of the home by turning the two pivoting parts of the hasps and lifting the hinged metal strap.

Remove the tablet from its position on the roof by loosening the green strap which holds it in place. With the home set up, you can now turn on your tablet. You are using a tablet to interact with this home, but most home automation systems are set up to be used from a mobile phone — sometimes from many miles away!

The power button is located on the side of the device, where it appears as a circle on the rubber casing. Press and hold the power button for about 5 seconds, let it go, and repeat this process until it turns on.

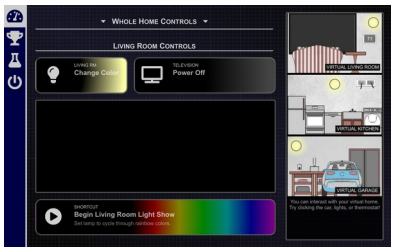
If your tablet does not turn on, its battery may be dead. Plug the included charging cord into the tablet and wait up to 5 minutes before trying to power it on.

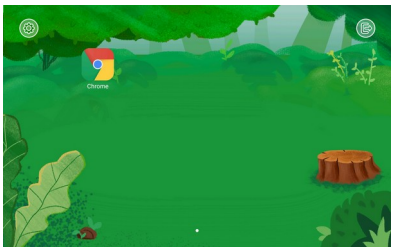
Your tablet may show one of three screens after you swipe up:

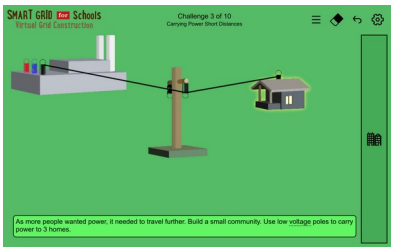
Option 1) The smart home interface, which is a web page in the Chrome browser (http://192.168.1.2). If you are already on this page, you may skip ahead. If you are on a different page in the browser, you can type the address (http://192.168.1.2) into the address bar and press Go.

Option 2) The Android menu screen. If you are seeing this, please open the Chrome browser. You may need to type the correct address into the address bar (http://192.168.1.2).

Option 3) The grid construction game. This is also a web page in the Chrome browser. Click the home icon to go to the smart home interface.







Make sure you are on the home page.

Explore the functions on this page. You can tap many items on this screen to control your home, but some elements provide status information only.

Which of the functions on this page do you think could offer the greatest convenience? Defend your reasoning.

Which of the functions on this page do you think could help best conserve energy? Defend your reasoning.

Proceed to the Challenges page.

For each challenge, follow the on-screen prompts. Many of the challenges have multiple parts, so continue through each part until you see the completion notification at the bottom of the screen. You may need to scroll to see new information which has appeared below the bottom of the page.

Light Bulb Challenge

How much energy can you save with a new bulb?

Complete the activities on screen. Before marking the challenge complete, answer the questions below.

All of the light bulbs produce the same amount of light. Why then does the energy cost of the different light bulbs vary so dramatically?

Each light bulb technology aims to reduce the amount of heat produced by the light bulb so more energy is used for light rather than heat.

If you use 4 bulbs in a room, how much energy do you save in a year by converting incandescent bulbs into LEDs?

(Answers will vary.) The energy cost of an LED is 15% of an incandescent. At 2.5 bulb hours per day, the yearly cost savings is $20.52 for 4 bulbs.

If you use 4 bulbs in a room, how much energy do you save in a year by converting halogen bulbs into LEDs?

(Answers will vary.) The energy cost of an LED is 21% of a halogen bulb. At 2.5 bulb hours per day, the yearly cost savings is $13.68 for 4 bulbs.

If you use 4 bulbs in a room, how much energy do you save in a year by converting CFLs into LEDs?

(Answers will vary.) The energy cost of an LED is 64% of a CFL. At 2.5 bulb hours per day, the yearly cost savings is $2.04 for 4 bulbs.

HVAC Challenge

How much money can you save as the seasons change?

Complete the activities on screen. Before marking the challenge complete, answer the questions below.

Why is the recommended indoor temperature lower when it is cold outside and higher when it is hot outside?

The closer your indoor temperature can be to the outside temperature, the less your HVAC system will need to work.

Take a close look at the graph. This graph is calculated based on your choices. What are two trends you see? Explain why you think each trend might be true.

Trend 1:

Explanation:

Trend 2:

Explanation:

The 20° and 100° lines are often mirror images of one another. Why is the shape of the 60°F line so different?

The 60°F line usually zeroes out at the 2 points in the day where the exterior temperature matches the interior temperature.

Smart Shopping Challenge

How much energy can you save by upgrading your appliances?

Complete the activities on screen. Before you click the check mark, answer the questions below.

Which refrigerator did you choose? Why did you choose that over the other choice?

Which of the reasons for choosing an appliance seems most reasonable to you? Why do you think that is most important?

Why does the U.S. Government mandate that EnergyGuide tags be made available for most appliances?

Without energy guide tags, it would be difficult for consumers to compare energy costs. Energy costs are often higher than the cost of the appliance itself over time, so energy costs are important!

Energy use is recorded in kilowatt hours (kWh). One kilowatt hour is a lot of energy: it would run a microwave for an hour or a clothes dryer for 15 minutes.

If the refrigerator uses an average of 160 watts each hour, how many kilowatts of energy does it use each day?

3.84 kWh per day (160W * 24h/day * 1kW/1000W)

Industrial Energy Challenge

How does business use of energy compare to that at your home?

Complete the activities on screen. Before marking the challenge complete, answer the questions below.

Why do you think the energy profiles of the office building are almost inverted between January and July?

Energy use seems to be fluctuating with outdoor temperature. The warmest part of the day is late morning to mid-afternoon, which reduces energy costs during the winter and increases energy costs during the summer.

In which month is the energy use greatest at each business? Why do you think the energy is highest during those months?

Energy use is greatest during January at the office building and during July at both the grocery store and factory. The grocery store and factory use energy to cool [refrigerators and equipment] during all seasons, but they have to use much more energy to cool during the summer.

How do you think a home's average daily energy usage would compare to that of the office (2,000 kWh), grocery store (400 kWh), and factory (10,000 kWh)?

The average home uses far less (24 kWh per day)

Go to the Experiments page.

Home Automation Experiment

What can your home do to automatically save energy?

Complete the activities on screen. Before marking the challenge complete, answer the questions below.

What was the plan you developed for your car's arrival?

Why was your plan a good one? How would your plan reduce energy use? How would your plan improve convenience?

(Answers will vary. Answers typically surround either energy efficiency or convenience.)

Solar Collection Experiment

Where do solar cells receive the most light energy?

Complete the activities on screen. Before marking the challenge complete, answer the questions below.

Where in the room do you get the greatest lux reading? Why do you think that is?

The multisensor was useful in conducting this experiment, but how could readings like this be used to automate your home? Where could you place a light sensor to best automate your home?

Water Heater Experiment

Complete the activities on screen. Before you click the check mark, answer the questions below.

Why are heat pumps the most efficient electric water heater?

Heat pumps work like refrigerators, except instead of moving heat from inside the fridge into the room, heat pumps move heat from the room into the water. Moving heat requires 1/3 to 1/2 as much energy as warming the water directly.

If you watch closely, you can figure out how much water showers, baths, and sinks commonly use. Which flow rates were you able to identify?

While flow rates in your home may vary some from these averages, the shower in this simulation uses 2.1 gallons per minute (gpm) and the bath uses 6.3 gpm. Kitchen sinks commonly have a higher flow rate than bathroom sinks, so the kitchen sink has a flow rate of 2.2 gpm while the bathroom sink flows at 1.5gpm.

If kWh of electricity cost $0.12 and therms of natural gas cost $0.45, why are natural gas water heaters cheaper to power than electric?

kWh are not equivalent to therms—it takes many more kWh to heat the same amount of water.

Why is “heat demand met” a valuable number?

Heat uptime describes how much of the day the desired hot water was available. Some smaller, tankless, on-demand water heaters are unable to heat more than a few gallons a minute, so at times when showers and dishwashers are all running, the water heater may be unable to keep up.

Wind Power Experiment

What happens when there is not enough wind? Too much wind?

In either case, the wind turbine will not turn. When there isn’t enough wind, the blades cannot turn. When there is too much wind, the turbine will use brakes to stop the blades from spinning unsafely.

Where do you get your electricity if there is no power coming from the turbine?

Most homes do not rely exclusively on wind power. Instead, they are connected to the country's electrical grid. This allows them to use other sources of energy when they need them and gives them a place to send any extra power.

What happens when the turbine generates more power than you need? Where does the extra power go?

Most homes do not rely exclusively on wind power. Instead, they are connected to the country's electrical grid. This allows them to use other sources of energy when they need them and gives them a place to send any extra power.

In Part 2, you can see a comparison of how different devices (eg. mobile phone, refrigerator, electric vehicle) use the power generated by your wind turbine. Do these energy use comparisons make sense to you? Why or why not?

This simulation assumes that the home we are looking at has power storage capabilities. In the real world this is rarely true, but is only sometimes a problem. Why would a lack of power storage be a problem? Why is it only a problem sometimes?

Most homes do not rely exclusively on wind power. Instead, they are connected to the country's electrical grid. This allows them to use other sources of energy when they need them and gives them a place to send any extra power.
While this doesn't create a huge problem for consumers, it does create something of a problem for producers. Utility companies must produce the amount of power consumed at any given moment (no more, no less). Unpredictable energy sources like wind make this a more difficult job.

Final Reflections

You have explored and experimented with many different parts of the smart home. Imagine how these parts could work together to make your home safer, more energy-efficient, and less likely to be damaged in an emergency. The homes of the future truly will be smart!

What kinds of household tasks use the greatest amount of energy?

Any tasks which involve heating or cooling have high energy costs (and high financial costs too!).

Based on what you've learned today, what could you do in the next week to reduce your energy usage?

Shutting the System Down

Because the home includes a computer, it is important to safely shut the system down before pulling the plug. The system should be powered down using the Safe Shutdown option in the tablet's Admin menu (power icon). Please be sure to power the tablet off also: press and hold the power button on the side, then press Shut Down on the screen. Please leave the tablet plugged in to charge.

Repacking the Home

Return each of the components to their places in the home's garage box. Please ensure that all components fit snugly in the box and that they will not be jostled when the home is shipped to the next school.

Problem-Solving

If you encounter problems with some of the home's devices, check that each device is intended for that home. (Each item should be labeled to match the house number.)

Next, restart the system by going to the Admin menu (power icon) and selecting Refresh System. You might also shut the system down, unplug it, and plug it back in.

If you are having more major problems, please contact CeMaST. The homes do not connect to your school's wireless network, so your school's technology specialist may not be able to help.