Today I Learned About Energy Efficiency

Description:

Saving energy reduces current fossil fuel use, makes the transition to non-carbon energy sources easier, and often makes buildings more comfortable to be in. A qualitative energy efficiency audit, combined with an interview with a facilities manager for the school, allows students to explore options to reduce energy use in the classroom. A quantitative energy audit provides students with data to present to school decision-makers.

Skills & Objectives

SWBAT

- Explain the connection between fossil fuel use and climate change.
- Explain why energy efficiency is important.
- Identify key behavioral and technological fixes for energy efficiency in the classroom.

Skills

- Data collection
- Observation
- Communication

Students Should Already Know That

- Lights, appliances, heat, and other aspects of a school building require electricity or other energy sources.

Standards Alignment:
HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs.
HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
CCSS.ELA-LITERACY.RH History/Social Studies
CCSS.ELA-LITERACY.SL Speaking & Listening
Disciplinary Core Ideas:
ESS3.C Human Impacts on Earth Systems
ETS1.A Defining and Delimiting an Engineering Problem
ETS1.B Developing Possible Solutions

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How To Use These Activities:

Pages with the circular "TILclimate Guide for Educators" logo and the dark band across the top are intended for educators. Simpler pages without the dark band across the top are meant for students.

Each of the included activities is designed to be used as a standalone, in sequence, or integrated within other curriculum needs. A detailed table of contents, on the next page, explains what students will do in each activity.

Depending on your goals and context, the "Make Your Recommendations" piece of this activity could be relatively quick or an in-depth information campaign.

A Note About Printing

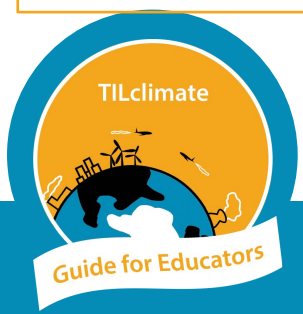
All student pages are designed to be printable in grayscale.

The worksheets do not leave space for students to answer questions. Students may answer these questions in whatever form is the norm for your classroom – a notebook, online form, or something else. This allows you, the teacher, to define what you consider a complete answer.

A Note To Teachers

The physical state of schools in the US is extremely variable. School buildings (even within the same district) can run the gamut from state-of-the-art to those badly in need of repair. Before embarking on a full energy efficiency audit of your school, secure support from school or district administration to make at least some of the changes recommended by students. Students who already perceive their school as poorly-maintained and ignored may experience an energy audit as a reminder that their school is under-supported. On the flip-side, well-supported student-led energy audits have the capacity to be a profound experience. Students who have influenced their school building have a sense of agency that can encourage future endeavors.

Podcasts in the Classroom: Throughout these Guides for Educators, we invite students to think about how they would share their learning with family and friends. One way to do this is to encourage your students to create their own podcasts - they're shareable, creative, and have multiple options for embedded assessment. We would love to hear any podcasts or see any other projects you or your students create! Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.



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Detailed Table of Contents

Page	Title	Description	Time (min)
	Podcast Episode	Students listen to TILclimate: TIL about energy efficiency, either as pre-class work at home or in the classroom. https://climate.mit.edu/podcasts/e5-til-about-energy-efficiency	10-15
1	History of Energy Efficiency	Reading: A brief history of energy efficiency in the US.	5-10
2	Classroom Energy Audit: Qualitative (Feelings-Based)	Students consider the lived experience of their classroom, which will help determine the focus of the quantitative audit.	5-10
3	Interview with a Custodian	Students interview a custodian, facilities manager, or other person who manages the physical building.	20-30
4	Make Your Recommendations	Students consider and recommend behavioral and technological improvements to the efficiency of their classroom. Then, they consider who the decision-makers are and how they would communicate with those people.	Varies
5-15	Quantitative (Numbers-Based) Audit: Team Instructions	Five teams of students collect data using an adaptation of the Oregon Green Schools energy audit. Instructions for each team are included. See the last page of the Educator portion of this guide for complete instructions.	More than one class period

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Season 2 Collection

Season 2 of TILclimate from MIT covers a series of interrelated energy subjects. The associated teacher guides are structured for maximum flexibility. Each episode's activities could be done as a whole class or as small-group work while other teams work on other topics and share back in a jigsaw. Some activities also can be enrichment or homework, and many as asynchronous assignments for remote work. Activities of similar length could also be set up as rotating stations, with a group discussion at the end of class.

- Introductory activities are quick (15-25 minutes) and require no internet.
- Dive Deeper activities are longer (30-60 minutes) and require internet access.

The City of the Future overall project is flexible in terms of time, space, and materials. It will be engaging whether students have completed all activities in the collection, or just one. If teams of students have been working on one topic each, the City of the Future process will help them share their learning with the rest of the class.

Energy Efficiency

This Educator Guide includes a qualitative energy audit and a more in-depth quantitative audit. Educators may pick and choose among the pieces of the Guide, as suits their class needs.

Parts of this Guide may align with the following topics:

- Physical science: electricity, circuits, thermodynamics, light, building design
- Life/environmental science: impacts of energy use
- History/social science: history of school buildings, history of energy use
- ELA/nonfiction: presenting results to school decision-makers

MIT Resources

We recommend the following as resources for your own better understanding of climate change or as depth for student investigations. Specific sections are listed below:

- Climate Science, Risk & Solutions, an interactive introduction to the basics of climate change. https://climateprimer.mit.edu/
  - Chapter 02 The greenhouse effect and us
  - Chapter 05 How much of the CO_2 increase is natural?
  - Chapter 10 What can we do?
- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. https://climate.mit.edu/explainers
  - Greenhouse Gases
  - Carbon Offsets
  - Renewable Energy

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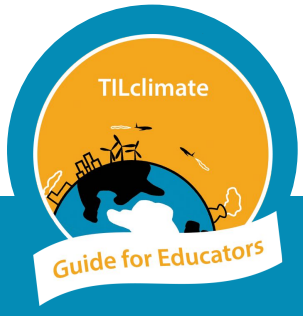
Wrap-Up Discussion Questions

- Why aren't buildings as efficient as they could be?
- What is your top recommendation for improving the efficiency of our classroom/school?
- As more and more of our electric grid moves to energy sources that produce little to no carbon dioxide, why is it important to improve energy efficiency?
- How has the focus of energy conservation and efficiency changed since the 1970s?
- In the podcast episode, Professor Michaels says that the biggest challenge to energy efficiency is that each building is owned and operated by a different person. How could this be overcome? What kinds of programs or incentives could make it easier for each building manager to improve efficiency?

Climate Solutions

Climate solutions can be thought of as falling into four categories outlined below. Across all categories, solutions at the community, state or federal level are generally more impactful than individual actions. For example, policies that increase the nuclear, solar and wind mix in the electric grid are generally more effective at reducing climate pollution than asking homeowners to install solar panels. For more on talking about climate change in the classroom, see "How to Use This Guide".

- **Energy Shift**
  How do decision-makers make the switch from carbon-producing energy to carbon-neutral and carbon-negative energy?
- **Energy Efficiency**
  What products and technologies exist to increase energy efficiency, especially in heating and cooling buildings?
- **Adaptation**
  How can cities and towns adapt to the impacts of climate change?
- **Talk About It**
  Talking about climate change with friends and family can feel overwhelming. What is one thing you have learned that you could share to start a conversation?



What solutions are the most exciting in your classes? We would love to hear from you or your students! Images, video, or audio of student projects or questions are always welcome. Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.

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Instructions for Quantitative (Numbers-Based) Audit

How much energy does your school use? How could the school be saving energy? Your class will use a toolkit adapted from Oregon Green Schools to measure the amount of energy used in lighting, heating, cooling, appliances, and behavior of your school. Each team will gather data around the building, and then the whole class will combine the data to make recommendations to decision-makers in the school.

Materials

- ❑ Data collection tools (clipboards and paper or tablets/devices)
- ❑ Portable electricity usage monitor (Kill-A-Watt or similar, $20-35 from online retailers)
- ❑ Thermometer for measuring air temperature

Instructions

1. Split the class into five teams: Lighting, Heating and Cooling, Plug Loads and Appliances, School Energy Behavior, and School Energy Use Analysis.
2. Agree as a class on which rooms you will be auditing. Create a plan for how each team will get access to these rooms.
3. Once all data has been collected (this may take more than one class period), the whole class completes the final two pages of the audit.
4. If possible, present the results to decision-makers at your school.

Collecting Data

- We have adapted the Oregon Green Schools Energy Audit into a Google Sheets spreadsheet, which you may copy and use as-is, modify, or print for your students. The spreadsheet can be found at https://climate.mit.edu/ed/energyaudit

Oregon Green Schools

Schools in Oregon can apply for certification as a Green School. This energy audit is adapted from the energy certification step. For more information, visit https://oregongreenschools.org/