

Chill Out

Title of Unit: Chill Out

Grade level: 6-10

Summary of lesson:

Students will design and build a lunchbox cooled with a thermoelectric tile and heat sink fans in this unit. Students will learn about heat and heat transfer and explore how engineers and inventors apply these concepts in fields ranging from food safety and transportation to green design to public health. Focusing on the idea of keeping foods and beverages at an ideal temperature, students will consider the design of currently available coolers, lunchboxes, and other food transportation and storage devices. They also will consider new designs for improving these devices and new users of them, ultimately designing and prototyping a thermoelectrically cooled lunchbox using Peltier tiles.

Time/Duration:

Each unit is designed to be 90 minutes. Teachers break down the lesson based on schedule minutes and available time. Example: 7th-8th grade science teaches 1 unit a week, and he meets 3 days a week, once for 55 minutes and twice for 90 minutes. It depends on deep educators who want to take it.

Learning Principles by Subject Area:

Science: Heat transfer and energy, heat, prototyping, electricity and circuits

Subject areas/Standards:

Chill Out Next Generation Science Standards - Middle School

Meeting	Science Standards	Technology/Engineering Standards	Cross-Cutting Concepts	Practices
Meeting 1: Invention Introduction	ETS1.A ETS1.B	MS.ETS1-1 MS.ETS1-2	6th G - Structure & Function 7th G - Systems & Cycles 8th G - Cause & Effect	- Asking Questions & Defining Problems - Constructing Explanations & Designing Solutions - Engaging in Argument from Evidence - Obtaining, Evaluating, & Communicating Information
Meeting 2: What is Heat?	ETS1.A ETS1.B	MS.ETS1-1 MS.ETS1-2	6th G - Structure & Function 7th G - Systems & Cycles 8th G - Cause & Effect	- Asking Questions & Defining Problems - Developing & Using Models - Analyzing & Interpreting Data - Constructing Explanations & Designing Solutions
Meeting 3: Keep Your Cool	ETS1.B ETS1.C	MS.ETS1-1 MS.ETS1-4 MS.PS3-3	6th G - Structure & Function 7th G - Systems & Cycles 8th G - Cause & Effect	- Asking Questions & Defining Problems - Developing & Using Models - Planning & Carrying Out Investigations - Analyzing & Interpreting Data - Constructing Explanations & Designing Solutions
Meeting 4: Removing Heat	ETS1.A ETS1.B PS3.A PS3.B	MS.PS3-3	6th G - Structure & Function 7th G - Systems & Cycles 8th G - Cause & Effect	- Analyzing & Interpreting Data - Developing & Using Models - Constructing Explanations & Designing Solutions
Meeting 5: Peliter Prototyping	ETS1.B ETS1.C	MS.ETS1-4	6th G - Structure & Function 7th G - Systems & Cycles 8th G - Cause & Effect	- Developing & Using Models - Constructing Explanations & Designing Solutions - Analyzing & Interpreting Data
Meeting 6: Invention Extension	ETS1.A ETS1.B	MS.ETS1-1	6th G - Structure & Function 7th G - Systems & Cycles 8th G - Cause & Effect	- Asking Questions & Defining Problems - Constructing Explanations & Designing Solutions

Standards alignment conducted by graduate students at Boston College's Lynch School of Education

Chill Out
Next Generation Science Standards - High School

Meeting	Science Standards	Technology/Engineering Standards	Cross-Cutting Concepts	Practices
Meeting 1: Invention Introduction	ETS1.A ETS1.B	HS.ETS1-3	Structure & Function	- Asking Questions & Defining Problems - Constructing Explanations & Designing Solutions - Engaging in Argument from Evidence - Obtaining, Evaluating, & Communicating Information
Meeting 2: What is Heat?	ETS1.A ETS1.B	HS.ETS1-3	- System & System Models - Energy & Matter - Stability & Change - Patterns	- Asking Questions & Defining Problems - Developing & Using Models - Analyzing & Interpreting Data - Constructing Explanations & Designing Solutions
Meeting 3: Keep Your Cool	ETS1.B ETS1.C	HS.ETS1-2 HS.ETS1-3	- Structure & Function - Cause & Effect - Systems & System Models - Energy & Matter	- Asking Questions & Defining Problems - Developing & Using Models - Planning & Carrying Out Investigations - Analyzing & Interpreting Data - Constructing Explanations & Designing Solutions
Meeting 4: Removing Heat	ETS1.B PS3.A PS3.B		- System & System Models - Energy & Matter - Cause & Effect - Patterns - Influence of Science, Engineering, and Technology of Society & the Natural World	- Analyzing & Interpreting Data - Developing & Using Models - Constructing Explanations & Designing Solutions
Meeting 5: Peliter Prototyping	ETS1.B ETS1.C	HS.ETS1-2 HS.ETS1-3	- System & System Models - Energy & Matter - Cause & Effect - Influence of Science, Engineering, and Technology of Society & the Natural World	- Developing & Using Models - Constructing Explanations & Designing Solutions - Analyzing & Interpreting Data
Meeting 6: Invention Extension	ETS1.A ETS1.B	HS.ETS1-1	Influence of Science, Engineering, and Technology of Society & the Natural World	- Asking Questions & Defining Problems - Constructing Explanations & Designing Solutions

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Breakdown of lessons:

1. Invention Introduction

Students do warm-up activities and discuss invention. Students play “Four Corners” to help the educator assign diverse teams.

2. What is Heat?

Students do hands-on activities that demonstrate convection, conduction, and radiation, and begin to discuss problem solving and invention in the context of food safety and transportation.

<https://lemelson.mit.edu/resources/curricula>

For more information, contact info-lemelson@mit.edu

3. Keep Your Cool

Students explore the thermal properties of various materials, then design and build a simple device that will both keep a cold item from warming up and a warm item from cooling down.

4. Removing Heat

Students learn about evaporation and evaporative cooling. They also learn about the thermoelectric effect, experiment with Peltier tiles, and brainstorm ways they might use these devices in their invention.

5. Peltier Prototyping

Students build a Peltier cooling unit, made of a Peltier tile sandwiched between two heat sink fans. They compare how the tiles function, with and without being attached to a heat sink. Then they design and build a lunchbox prototype out of cardboard and a Peltier cooling unit. Finally, they test out their lunchboxes and provide feedback to other teams.

6. Invention Extension

Students conceptualize a purposeful invention that uses their new minds-on and hands-on skills.

Materials: [Link to List](#)

