



Lesson Plan: Heat and heat technology

Grade Level: 8

Subject: Physical Science

Duration: 45–60 min

NGSS MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Learning Objectives

By the end of this lesson, students will be able to:

- **Distinguish** between temperature and heat, explaining that temperature measures the thermal energy of a substance's particles while heat is that energy on the move from a warmer object to a cooler one.



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- **Temperature:** A measure of how much thermal energy the particles of a substance have, and therefore how fast those particles are moving. It is usually read on the Celsius scale, where water freezes at 0 degrees and boils at 100 degrees.
- **Heat:** Thermal energy that is moving from an object at a higher temperature to an object at a lower temperature. An object does not store heat; the word names the energy only while it is being transferred, and the transfer always runs warmer to cooler.
- **Conduction:** The transfer of thermal energy through direct contact, as vibrating particles pass energy along to the particles touching them while the material itself stays put. A metal pan warming up on a stove burner is conduction.



- **Convection:** The transfer of thermal energy carried by the movement of a heated liquid or gas itself. Warmer material rises and cooler material sinks, setting up currents that spread the energy, as when water heating in a pot circulates from bottom to top.
- **Radiation:** The transfer of thermal energy through space as electromagnetic waves, needing no matter in between to carry it. This is how energy from sunlight or from a glowing lamp reaches and warms your skin.
- **Conductor:** A material that carries thermal energy easily, so energy moves through it quickly. Metals are good conductors, which is why a metal spoon left standing in hot soup soon becomes too hot to hold.
- **Insulator:** A material that thermal energy moves through very slowly, so it slows both heat loss and heat gain. Trapped air, foam, and paper are good insulators, which is why insulation in an attic keeps warm air from escaping through the roof.

 **Materials Needed:** (all links are included in this PDF)



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- Two thermometers marked in degrees Celsius
- An insulated foam cup and a thin metal or ceramic cup of the same size
- Ice cubes
- An oven mitt or knit mitten

Lesson Procedure

Step 1: Introduction (8 minutes)



- Hand each student an ice cube and ask: is cold moving into your hand, or is thermal energy moving out of it? Collect predictions before establishing that only heat moves, and always from the warmer object to the cooler one.
- Pass around a metal spoon and a plastic spoon that have been sitting side by side in the room, and ask students why the metal one feels colder even though both are at room temperature.
- Post the Study Guide's checkpoint question on the difference between temperature and heat, and tell students they will answer it in writing at the end of the lesson.
(<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-heat-and-heat-technology-1.pdf>)

Step 2: Direct Instruction (15 minutes)

- Use the Study Guide to define thermal energy as the energy of an object's vibrating particles and temperature as the measure of that energy, then contrast its three transfer examples: the frying pan on the stove, currents in heating water, and sunlight.

(<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-heat-and-heat-technology-1.pdf>)



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[heat-technology-1-1.pdf](#))

- Have pairs settle the melting-ice-cube items on Practice Worksheet 1 by agreeing on which object gains thermal energy and which loses it before they mark an answer.
(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-heat-and-heat-technology-1-1.pdf>)
- Sort the demonstration objects together, metal spoon, foam cup, oven mitt, and ceramic cup, into conductors and insulators, and require students to state the evidence behind each placement.

Step 4: Independent Practice (13 minutes)



- Assign Practice Worksheet 2, where students explain how a double-paned window, a covering wrapped around a hot water tank, and nonmetal pot handles each slow thermal energy transfer. (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-heat-and-heat-technology-1-2.pdf>)
- Have students annotate the same sheet's internal combustion engine and evaporating puddle items to trace where the thermal energy comes from and where it ends up. (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-heat-and-heat-technology-1-2.pdf>)
- Ask each student to name one device in their own home that maximizes thermal energy transfer and one that minimizes it, and to justify both choices in a sentence.

Step 5: Assessment (12 minutes)

- Administer Practice Worksheet 0 as the graded check; its items span refrigerators, insulators, and methods of heat transfer, plus the particle diagrams that link how fast and how spread out particles are to the temperature of each box.



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- Challenge students to redesign the foam cup demonstration so the hot water cools as slowly as possible using only the materials on the demonstration table, and to predict which of the three transfer methods their design blocks best.

For learners needing support:

- Give students a pre-labeled three-picture reference card showing the frying pan (conduction), the currents in heating water (convection), and the sun (radiation) so new examples can be matched to an image rather than to a definition.



- Let students re-touch the metal and plastic spoon handles from the hot-water demonstration before answering the conductor and insulator items, so the classification rests on a direct observation they made.

Extension Activities

- Build and test insulated cups: wrap identical cups in different materials, fill each with hot water, and record the temperature every two minutes to find which wrapping minimizes thermal energy transfer.
- Time how long an ice cube lasts on a metal tray versus on a foam block, and explain the difference in terms of conduction.
- Assemble a simple solar cooker from a lined box, measure how much the temperature inside rises over 30 minutes in sunlight, and identify which transfer method delivers the energy.



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HEAT AND HEAT TECHNOLOGY

Thermal Energy

All matter is made up of particles that vibrate with kinetic energy. This movement of particles occurs even when the temperature goes well below zero. When we use the term **temperature**, we are referring to the amount of thermal energy that a substance has. **Thermal energy** is the sum of the energy of the moving particles and the potential energy of the resting particles.

Temperature is usually measured on the Celsius or Centigrade scale. On this scale, the freezing point of water is 0 degrees and its boiling point is 100 degrees.

Boiling Points of Various Liquids

water = 100° C



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Lesson Checkpoint:

What is the difference between temperature and heat?

Heat Transference

Heat is transferred in three different ways:

The first way is by **conduction**. When an object heats up without the movement of any particles in the object, conduction has occurred. A frying pan heating up on a stove is a good example of this (that is, the pan itself, not the food in it).



The next way is by **convection**. This occurs whenever there is a movement of particles in the object being heated. For example, heating water causes currents to develop and it is these currents that make the heat spread.

The third way is by **radiation**. This type of heat transfer does not involve matter. Instead, heat is transferred by electromagnetic waves such as artificial light and sunlight.

Lesson Checkpoint:



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Heat is also used in internal combustion engines like car engines. In these engines, gasoline is burned and the heat released gets transformed to mechanical energy.

In refrigerators and air conditioners, heat is transferred for the opposite effect of creating lower temperatures.

Lesson Checkpoint:

Name two ways heat is used in your area.

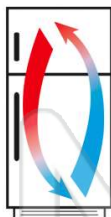


Name _____ Class _____ Date _____

1

To keep food fresh, a **refrigerator** _____ the food stored in it.

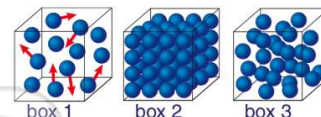
- A adds coldness to
- B takes heat away from
- C makes ice to cool
- D takes moisture away from



2

Using the diagram below, predict the **state of matter** of the particles in **box 1**.

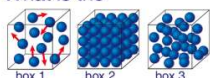
- A solid
- B liquid
- C gas
- D porous



3

In the diagram below, the particles in **box 1** are **moving around** more and are more **scattered** than in the other boxes. What is the explanation for this?

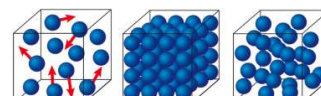
- A these particles are at a higher temperature



4

Using the diagram below, predict which box or boxes would have the **lowest temperature** inside of it.

- A 1
- B 2
- C 3



5



PREVIEW

7

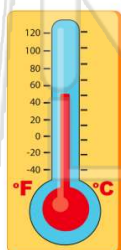
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9

Use the formula to **convert** the Fahrenheit temperature to the temperature on the Celsius scale.

$$^{\circ}\text{C} = \frac{5}{9} \times (^{\circ}\text{F} - 32)$$

- A 5°C
- B 10°C
- C 15°C
- D 20°C

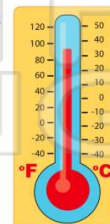


10

This thermometer reads **95°F**. How much of a rise in degrees **Celsius** would be necessary to reach the temperature at which water boils?

$$^{\circ}\text{C} = \frac{5}{9} \times (^{\circ}\text{F} - 32)$$

- A 100°C
- B 212°C
- C 65°C
- D 137°C



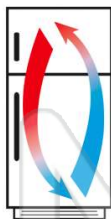


Name _____ Class _____ Date _____

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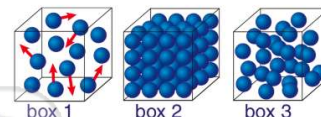


(B)

2

Using the diagram below, predict the **state of matter** of the particles in **box 1**.

- A solid
- B liquid
- C gas
- D porous

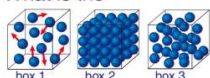


(C)

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In the diagram below, the particles in **box 1** are **moving around** more and are more **scattered** than in the other boxes. What is the explanation for this?

- A these particles are at a higher temperature

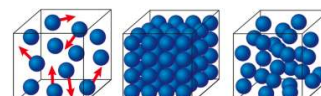


(A)

4

Using the diagram below, predict which box or boxes would have the **lowest temperature** inside of it.

- A 1
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- C 3



(B)

5



(C)

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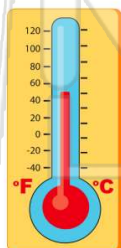
(B)

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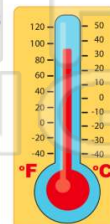
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(C)



Name _____ Class _____ Date _____

1

In the relationship of **heat** and **temperature**, temperature is a measurement of how much thermal energy an object contains.

Heat is _____.

- A** the same thing as temperature
- B** only a measurement of thermal energy above 99°C
- C** the transfer of thermal energy from cooler objects to warmer ones
- D** the transfer of thermal energy from warmer objects to cooler ones

2

In the picture below, an ice cube is **melting** as it is being **held**. What is the explanation for this?



- A** heat is being transferred from the ice cube to the hand
- B** heat is being transferred from the hand to the ice cube
- C** heat is being transferred from the ice cube to the air
- D** friction is causing the cube to melt

3

In the picture below, heat is being **transferred** from the hand to the ice cube by which **process**?



- A** radiation
- B** conduction
- C** convection

4

When an **ice cube melts**, which of the following must have taken place?



- A** the hand gained heat
- B** ice cube lost heat
- C** the ice cube gained heat

5

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- B** radiation
- C** condensation
- D** fission



- D** evaporation

**9**

While swimming in a lake, a boy notices pockets of both **colder** and **warmer** water. This is explained by _____.

- A** convection in the water
- B** conduction in the water
- C** radiation in the water
- D** cloud cover over the water

10

Which object would make the best **conductor**?

- A** a plastic fork
- B** a metal spoon
- C** a paper plate
- D** plastic wrap





Name _____ Class _____ Date _____

1

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D**2**

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B**3**

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B**4**

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C**5****A**

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C

- B** radiation
- C** condensation
- D** fission

**D** evaporation**9**

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A**10**

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B

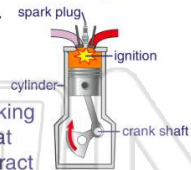


Name _____ Class _____ Date _____

1

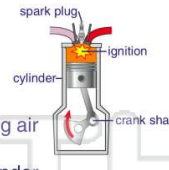
Most vehicles are powered by an internal combustion engine. In the diagram below of a cylinder in an internal combustion engine, the **ignition** causes _____.

- A** an expansion of vapor
- B** the engine to stop working
- C** the cylinder to lose heat
- D** the metal parts to contract

**2**

Ignition of fuel in the cylinder of an internal combustion engine causes a rise in temperature. This **rise in temperature** is caused by _____.

- A** increased amounts of chemical energy
- B** increased amounts of thermal energy
- C** heat transfer from the cylinder to the surrounding air
- D** heat transfer from the surrounding air to the cylinder

**3**

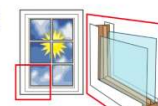
Where in this double-paned window is an **insulator** present?

- A** 1
- B** 2
- C** 3
- D** 4

**4**

In the diagram below, the **air** between the glass panes _____.

- A** prevents the movement of thermal energy
- B** increases the amount of thermal energy

**5**

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- C** thermal energy is destroyed by the sunlight
- D** chemical energy is converted to thermal energy

**9**

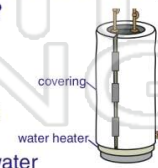
The reason why cooking pots are made of metal with nonmetal handles is that **metals** do **not** conduct thermal energy well, but **nonmetals** do.
True or false?

- A** true
- B** false

**10**

This hot water tank is wrapped with a **thick covering**. What is the reason for this covering being on the hot water tank?

- A** it reduces the heat loss from inside the tank
- B** it helps absorb heat from outside the tank
- C** it produces heat for the water
- D** it reduces the heat inside the tank





Name _____ Class _____ Date _____

1

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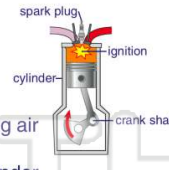


A

2

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- C heat transfer from the cylinder to the surrounding air
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B

3

Where in this double-paned window is an **insulator** present?

- A 1
- B 2
- C 3
- D 4

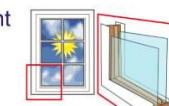


A

4

In the diagram below, the **air** between the glass panes _____.

- A prevents the movement of thermal energy
- B increases the amount of thermal energy



A

5



D

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C

- C thermal energy is destroyed by the sunlight
- D chemical energy is converted to thermal energy



9

The reason why cooking pots are made of metal with nonmetal handles is that **metals** do **not** conduct thermal energy well, but **nonmetals** do.
True or false?

- A true
- B false

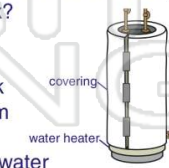


B

10

This hot water tank is wrapped with a **thick covering**. What is the reason for this covering being on the hot water tank?

- A it reduces the heat loss from inside the tank
- B it helps absorb heat from outside the tank
- C it produces heat for the water
- D it reduces the heat inside the tank



A



Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Radiation

Conductor

Insulator

Conduction

Refrigerant

Convection

1. _____ - the transfer of heat energy from the contact of one object to another



2. _____ - a material that easily carries heat

3. _____



4. _____
through
escape

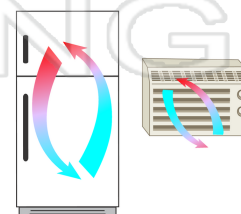
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5. _____ - heat that is transferred through space; energy that is given off in the form of particles or rays



6. _____ - a substance used in cooling systems to absorb and then remove heat





Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Radiation

Conductor

Insulator

Conduction

Refrigerant

Convection

1. conduction - the transfer of heat energy from the contact of one object to another



2. conductor - a material that easily carries heat

3. convection



4. insulation
through
escape

PREVIEW

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