Workbook Preview

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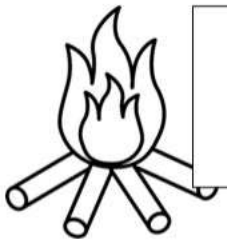

Grade 7 Science – 2022 Curriculum

Heat in the Environment

	Curriculum Expectations	Pages
E1.1	assess the social and environmental benefits of technologies that reduce heat loss in enclosed spaces or heat transfer to surrounding spaces	139–142, 145–149
E1.2	analyse various social, economic, and environmental impacts, including impacts related to climate change, of using non-renewable and renewable sources of energy	93–97, 100–114, 123–138
E2.1	use particle theory to explain how heat affects the motion of	8–18, 21–26
E2.2		1
E2.3		–18, 2–39
E2.4	explain how heat is transmitted through conduction, and describe natural processes that are affected by conduction	40–45, 59–67
E2.5	explain how heat is transmitted in liquids and gases through convection, and describe natural processes that depend on convection	40–43, 46–47, 50–53, 59–67
E2.6	explain how heat is transmitted through radiation, and describe the effects of radiation from the Sun on different kinds of surfaces	40–43, 54–67
E2.7	describe the role of radiation in heating and cooling Earth, and explain how greenhouse gases affect the transmission of radiated heat through the atmosphere	68–81
E2.8	identify common sources of greenhouse gases, including sources resulting from human activity, and describe how humans can reduce emissions of these gases	77–81, 84–87

Preview of 100 pages from this product that contains 232 pages total.

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Grade 7 Science Unit

Strand A - STEM Investigation and Communication Skills

	Curriculum Expectations	Pages
A1.1	use a scientific research process and associated skills to conduct investigations	119–122
A1.2	use a scientific experimentation process and associated skills to conduct investigations	19–20, 48–49, 143–144
A1.3	use an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems	82–83, 91–92, 98–99
A1.4	follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment and clothing and safely using tools, instruments, and materials	19–20, 48–49, 82–83, 91–92, 98–99, 143–144
A1.5	communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes	19–20, 48–49, 82–83, 91–92, 98–99, 143–144
A2.1	write and execute code in investigations and when modelling concepts, with a focus on planning and designing programs	88–90, 115–118, 121
A2.2	identify and describe impacts of coding and of emerging technologies, such as artificial intelligence systems, on everyday life, including skilled trades	88–90, 115–118, 121
A3.1	describe practical applications of science and technology concepts in various occupations, including skilled trades, and how these applications address real-world problems	88–90, 115–120
A3.2	investigate how science and technology can be used with other subject areas to address real-world problems	88–90, 115–120, 122
A3.3	analyse contributions to science and technology from various communities	88–90, 115–120

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NAME: _____

HEAT IN THE ENVIRONMENT



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Name: _____ 11

Curriculum Connection
E2.1, E2.3

What is Thermal Energy?

Matter and Energy

Matter is made up of particles we call atoms. These atoms are moving constantly. In a solid, the atoms are packed tight. In a gas, they are more spread out. The atoms in all matter are constantly moving or vibrating. When we raise the temperature of matter, the atoms will vibrate faster. The heat we apply to matter is called thermal energy.



Thermal Ener[illegible]

When you put your [illegible] ov[illegible] are feeling thermal energy. **Thermal energy** is created when [illegible] ampe[illegible] uses the atoms to move faster and collide with [illegible] oth[illegible] that comes from the temperature of the [illegible] matt[illegible] thermal energy. For example, when you light a [illegible] the a[illegible] the candle are moving faster and faster, whic[illegible]



All matter contains thermal energy. Even we co[illegible] rm[illegible] ergy. You may have more thermal energy than the person beside you, especial[illegible] g in the sun and they aren't. After you exercise, you have more thermal e[illegible] s the particles in your body are moving faster and colliding with each other. When someone stands next to you, you will likely radiate heat their way.

Even ice contains thermal energy, but it doesn't have much! You would never try to get any heat from an ice cube as it only has small amounts of thermal energy. The particles in an ice cube do not move as much as the particles in boiling water. Some households use boiling water in what are called radiators to heat their homes. The water heats up and the particles move faster and faster, which creates a rise in temperature. This creates heat (thermal energy) that is sent into the air.

PREVIEW

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Curriculum Connection
E2.1, E2.3

True or False

Circle whether the statement is true or false.

1) Only warm things have thermal energy.	True	False
2) All matter has thermal energy.	True	False
3) Thermal energy is released when atoms in matter rise in temperature.	True	False
4) When matter heats up, the atoms move slower.	True	False
5) Humans [illegible] heat from our thermal energy.	True	False

Questi[illegible]

Wh[illegible]ns do you have after reading the information?

1)	
2)	

Questions

Use information from the text to [illegible]

1) What is thermal energy? What things have a lot of thermal [illegible]ergy

2) Does everything have thermal energy? Explain.

PREVIEW

Name: _____ 13

Curriculum Connection
E2.1

The Particle Theory of Matter

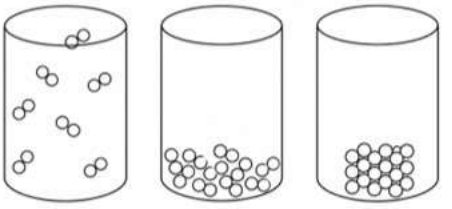
Matter

Matter is anything that has mass and takes up space. All matter can be classified as either a pure substance or a mixture. All matter is made up of tiny particles. The study of matter and its changes is called chemistry.

The Particle Theory

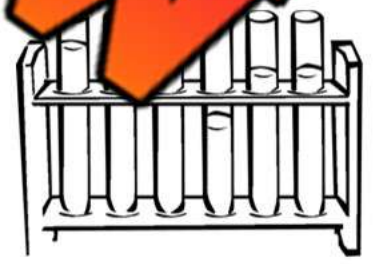
Matter can be classified according to its physical characteristics. The particle theory of matter helps to explain the physical characteristics of matter.

1. Everything is made of tiny particles
2. There are spaces between the particles
3. Particles are attracted to each other
4. Temperature affects the speed at which particles move
5. Particles are always moving because they have kinetic energy
6. There are different kinds of particles, but all particles of a substance are identical



Solids

In solid form particles are close together. The particles are strongly attracted to each other. They are locked in a pattern and vibrate in place. Solids have shape and volume. The spaces between the particles are small.



Liquids

In liquid form, particles are slightly farther apart. Particles are less attracted to each other and are able to slide past each other. The spaces between the particles are larger than in a solid.

Gas

In gas form, particles are far apart and can move in any direction because the attraction forces between them are weak. Gases have no fixed shape and no fixed volume. They expand to fill their container.

PREVIEW

Name: _____ 14

Curriculum Connection
E2.1

True or False Circle whether the statement is true or false.

1) All matter is made of particles.	True	False
2) Temperature affects how fast particles move.	True	False
3) In solid matter, particles are further apart.	True	False
4) When matter heats up, the atoms move slower.	True	False
5) In gases, particles expand and fill their container.	True	False

Question What questions do you have after reading the information?

1)	
2)	
3)	

Explain List the properties of each state of matter.

State of Matter	Properties of the State of Matter
Solid	
Liquid	
Gas	

PREVIEW

Curriculum Connection
E2.1

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____

Mark

Draw a line to match each term to its correct description.

Solid	❑ Particles are far apart and can move freely in all directions.
Liquid	❑ Anything that has mass and takes up space.
Gas	❑ Particles are close together and vibrate in place.
Matter	❑ Particles are close together but can slide past each other.

Name: _____

Mark

Draw a line to match each term to its correct description.

Solid	❑ Particles are far apart and can move freely in all directions.
Liquid	❑ Anything that has mass and takes up space.
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Name: _____

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Name: _____

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Matter	❑ Particles are close together but can slide past each other.

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Name: _____ 17

Curriculum Connection
E2.1, E2.3

Heat Transfer and The Particle Theory

Heat Transfer and The Particle Theory

Heat transfer from one thing to another happens in different ways for different forms of matter. In order to understand how heat is transferred we have to go back to the particle theory of matter. Heat transfers in solids mainly through conduction. Heat transfers in liquids and gases by convection and heat can travel through gases, liquids, or no matter at all by radiation.

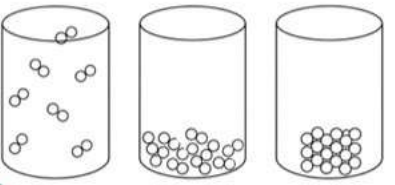
PREVIEW

Matter

Matter is [illegible] that has mass and takes up space. All matter can be classified as either [illegible] or a mixture. All matter is made up of tiny particles.

The Particle The[illegible]

Matter can be [illegible] according to its physical characteristics. The particle theory of matter helps to ex[illegible] the ph[illegible]acteristics of matter. The particle theory can be used to explain ho[illegible]



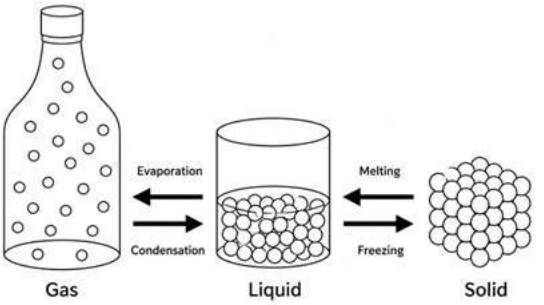
1. Everything is made of pa[illegible]
2. There are spaces between the par[illegible]
3. Particles are attracted to each ot[illegible]
4. Temperature affects the speed at which part[illegible] mov[illegible]
5. Particles are always moving because the[illegible] kinet[illegible]
6. There are different kinds of particles, but all [illegible]nce are identical.

Solids

In solid form, particles are close together. The particles are very [illegible]ted to each other. They are locked in a pattern and vibrate in place. Solids ha[illegible]ed shape and volume. The spaces between the particles are small.

Liquids

In liquid form, particles are slightly farther apart. Particles are less attracted to each other and are able to slide past each other. The spaces between the particles are larger than in a solid.



Gas

In gas form, particles are far apart and can move in any direction because the attraction forces between them are weak. Gases have no fixed shape and no fixed volume. They expand to fill their container.

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Curriculum Connection
E2.1, E2.3

Questions

Answer the questions below using evidence from the text.

1) How are the particles arranged in the different states of matter?

2) Give an example of how matter can change states. Explain why it changed states.

PREVIEW

Summarize

What is the main idea of the reading and supporting details.

True or False

Is the statement true or false?

1) Most things we can see are made of particles.	True	False
2) Heat transfer happens in solids through conduction.	True	False
3) The particle theory can be used to explain how heat transfer happens.	True	False
4) Particles in all matter are close together.	True	False
5) Temperature affects how fast particles move.	True	False

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Curriculum Connection
E2.1, E2.3

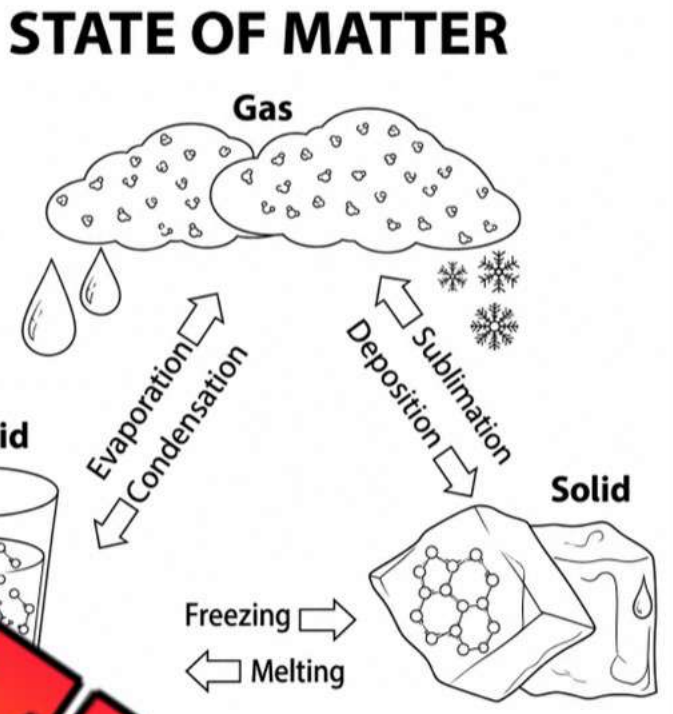
Changes in State – Physical Changes Involving Heat

Changes in State – Physical Changes

When a solid, liquid or gas changes state, they have completed a physical change. Changes in state are reversible because no new substance is formed. The matter's chemical [illegible] is the exact same.

For example, [illegible] as the chemical mak[illegible] oxygen (H_2O).

It does not matter [illegible] matter is in liquid form, gas form, [illegible] form, it still has the same chemical [illegible] of H_2O.



PREVIEW

Changes in State Involve Heat

When matter changes state, it can be reversed [illegible] heat. When matter absorbs heat, it could undergo the [illegible] of evaporation, melting (fusion), or sublimation.

When matter releases heat, it could undergo the process of freezing (solidification), condensation or deposition.

Heat changes the particles in matter by changing the attractions between particles. When heat is absorbed by matter, the particles in the matter lose attraction and begin to move faster. They collide with each other and spread out, changing the state to a liquid or a gas.

When heat is released by matter, the particles in the matter gain attraction and get closer together. If enough heat is released, the particles may slow down and begin to vibrate instead of move, causing a change of state to a solid.

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Name: _____

Curriculum Connection
E2.1, E2.3

Matter and Heat

How is heat affecting the matter below?

Matter	Heat	New State of Matter?	Particles Movement – Circle One		
Water	Absorbed		Vibrate	Slow	Fast
Water	Released		Vibrate	Slow	Fast
Ice	Absorbed		Vibrate	Slow	Fast
Vapour	Released		Vibrate	Slow	Fast

Questi[illegible]

[illegible]sw[illegible]uestions below using evidence from the text.

1) If matter is [illegible]t[illegible]ame e[illegible]ent (no heat added or released), will it change states? Explain usi[illegible]exam[illegible]

_____

_____

_____

2) What happens when heat is released by matte[illegible]

_____

_____

_____

Visualizing

Draw what you were picturing while you were reading. Explain the picture.

	_____ _____ _____ _____ _____ _____

PREVIEW

Name: _____ 23

Curriculum Connection
E2.1, E2.3

Melting and Freezing

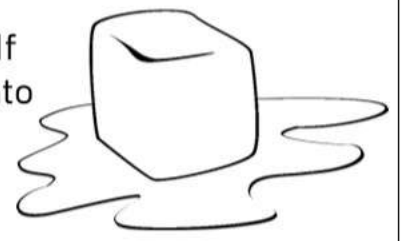
What is Melting?

Melting is the process of a solid changing into a liquid when heat is applied. For example, an ice cube in a freezer will remain a solid because there is no heat added. If you take the ice cube out of the freezer, the room temperature is warmer, which means the ice will absorb the heat.

The heat will cause the particles inside the solid to move. This will cause the particles to spread out and flow into the bottom of the container they are held in.

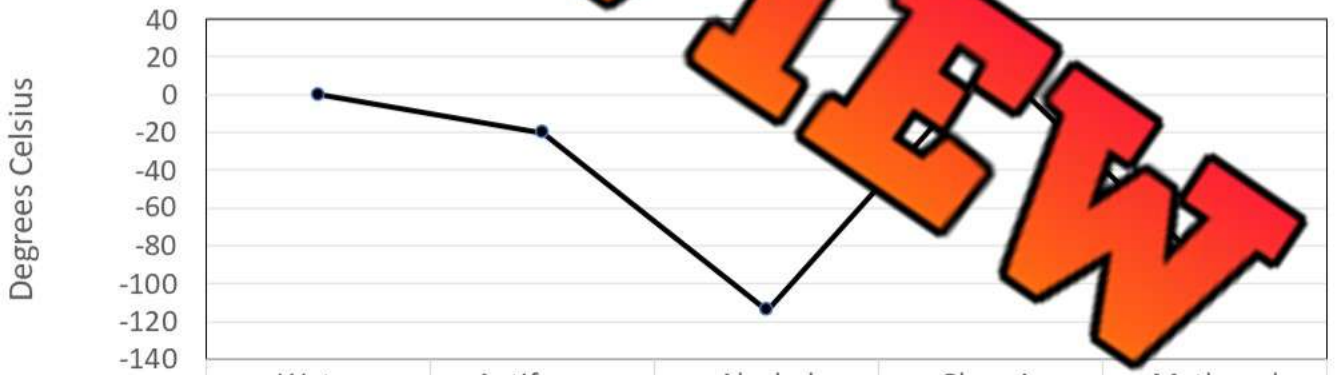
What is a Melting Point?

All solids have a melting point. The melting point for ice is 0°C. If you take an ice cube out of a freezer and then bring it outside into an environment of 10°C, it will stay a solid because it hasn't reached its melting point.



Freezing and Freezing Points

Freezing is the opposite of melting. Freezing is when a liquid changes state to a solid. Different liquids have different freezing points. Water has a freezing point of 0 degrees Celsius. Check out the graph to see other liquids freezing points.



	Water	Antifreeze	Alcohol	Glycerin	Methanol
Freezing Point	0	-20	-114	18	-96

Understanding Science to Help Our Lives

Water will freeze at 0°C, which means it would not make good anti-freeze for your car. Anti-freeze is used to stop water from freezing and damaging a car's engine. Anti-freeze is made of ethylene glycol, which has a freezing point of -20°C.



Windshield wiper fluid is made of methanol. Methanol has a freezing point of -96°C. This makes it a great choice to clean our windshields on extremely cold days!

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Curriculum Connection
E2.1, E2.3

Fill in the Blanks

Fill in the blanks using words from the word bank.

Word Bank				
Solid	Melting	Liquid	Temperature	Same
Gas	Boiling			

Melting occurs when a _____ reaches a temperature warmer than its _____ point, turning it into a _____. For example, an ice cube melts at a _____ warmer than 0 degrees Celsius. The melting point is the _____ as the freezing point! Liquids don't melt, however they do have a _____ point. They change states into a _____.

Questions

Fill in the blanks using words from the word bank.

1) Explain how melting and freezing create changes in states.

2) Why is it helpful to understand freezing points, especially wi

Making Connections

What does the reading remind you of in your life?

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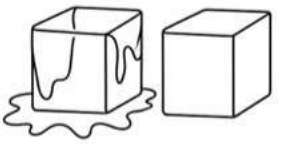
Curriculum Connection
E2.1, E2.3

Lab Experiment - Melting



Research Question

What are we trying to answer?

How does salt, sugar, hot water, and cold water affect the melting process? Will applying these substances to ice slow down or speed up the melting process?

Hypothesis

Answer the research questions below before you do the experiment.

1) Which o[illegible]ances above will speed up the melting process?

_____

_____

_____

2) Which of the substan[illegible]he melting process? Explain.

_____

_____

_____

Which will melt first? Rank (1-5) with 1 being the first to melt and 5 being the last to melt

Control - Just Ice	
Sugar	
Salt	
H[illegible]	
Cold [illegible]	

Materials

What will you need for the experi[illegible]t?

1) Small plastic cups (mini-solo cups)
2) Water (hot and cold)
3) Salt
4) Sugar
5) Muffin Tin



Procedure

Instructions – How to complete the experiment.

1) Fill 5 plastic cups with the same amount of water in each.
2) Put them in the freezer overnight.
3) Pop the ice out of each cup. You may need to cut the cup around the ice.
4) Place one ice cup in each compartment in a muffin tin.
5) Pour hot water on one ice cup, cold water on another, salt on another, and sugar on another. Leave one of the ice cups as is. This will be the control. Consider labelling the muffin tins so you can remember how you treated each ice cup.
6) Record the order in which the ice cups melt by checking frequently.

PREVIEW

Name: _____ 26

Curriculum Connection
E2.1, E2.3

Observations

Fill in the table below as your complete the experiment.

Step	What Happened – Which is melting the fastest? Slowest?
After 10 Minutes	
After 30 Minutes	
After	
After they have all melted	

Results

Answer the questions below after you have completed the experiment.

1) What surprised you about the results? What did you get wrong from your hypothesis?

2) Why do you think the cold water melted the ice cup faster than the untreated (control)?

3) Why do people use salt on their driveway or steps in the winter to melt the snow or ice? Why don't they use hot water?

PREVIEW

Name: _____ 32

Curriculum Connection
E2.3

Effects of Heat on States of Matter

Effects of Heat on the States of Matter

When matter in any state is heated, the matter will expand. The particles the matter is made up of do not expand, but the volume the particles take up does. This leads to an expansion of the matter.

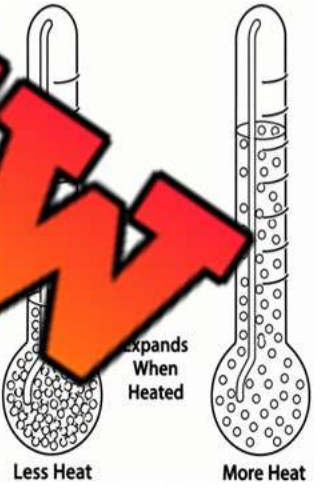
Thermal E[illegible]sion of Gases

The parti[illegible] a gas are furthest apart and weakly attracted to each other. When we heat [illegible]t [illegible] the particles to move faster. If the gas is not contained in a contain[illegible]he gas [illegible] very rapidly. If it is contained, the pressure inside the container will [illegible]as [illegible]the ga[illegible]e pushing harder on the container walls.

For example, [illegible]as in [illegible]ll will expand and make the ball bouncier on a hot summer day. On the c[illegible] you le[illegible] ball in the car in the winter, the ball will appear to have less gas, but on[illegible] ba[illegible] will bounce well again.

Thermal Expansion of Liquids

The particles in a liquid are further apart than a ga[illegible] close[illegible] a solid. When we heat a liquid, the particles move[illegible] ar[illegible] more space. A thermometer works because of thermal [illegible]sio[illegible] The mercury inside a thermometer will rise up the glass if the te[illegible]atur[illegible] is warm. This is because the liquid mercury expands when it is heate[illegible]



In addition, sea levels are rising because of global warming. As ocean temperatures rise, the water is expanding.

Thermal Expansion of Solids

The particles inside a solid are tightly compacted because the particles have a strong bond to each other. This is what gives the solid its shape and structure.

When a solid is heated, its particles vibrate faster in their fixed position. This means the solid expands very slightly. An example of this is how railway tracks are put together with gaps between the tracks. When the tracks expand, they do not buckle against each other, which would cause a misalignment and an eventual derailment of a train.

PREVIEW

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Name: _____ 33

Curriculum Connection
E2.3

Questions How does heat affect each state of matter?

Gas	
Liquid	
Solid	

Making Connections What does reading remind you of in your life?

Examples Provide an example of how heat affects each state of matter.

Gas	
Liquid	
Solid	

PREVIEW

Name: _____ 34

Curriculum Connection
E2.3

Heat vs Temperature

Heat vs Temperature

There is a connection between heat and temperature, however, they do not mean the same thing. **Heat** is a form of energy where energy moves from a hot area to a cooler area. **Temperature** is a measurement of how hot or cold something is. Therefore, heat is a form of en hile temperature is a measure of energy.

Heat

Whe ink of h ould think of the movement of particles. When we put a on t stove, the heat energy from the stove transfers i ooler r. The heat also transfers from the metal into the o r. Thi eat as energy that moves from warmer areas t are



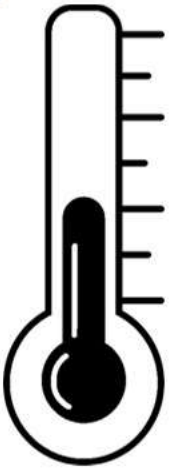
Temperature

When we put a pot of water on the stove, he heat y fr stove causes the water to rise in temperature. The temperature is not t rred f ve to the pot, but instead it is the heat that transfers which causes the te e to ri

The temperature describes how much kinetic energy e t being measured. As we heat the pot of water, the water particles move fa kinetic energy and a rising temperature. In Canada, temperature is measu Celsius.

Key Differences

- The main feature of heat is that it travels from hotter regions to cooler regions. On the other hand, temperature rises when heated and falls when cooled
- Heat is energy and temperature is a measurement
- Heat can do work but temperature describes a substance (hot, cold)
- We can measure heat energy using joules or calories and we measure temperature using Celsius (or Fahrenheit/Kelvin).



PREVIEW

Name: _____ 35

Curriculum Connection
E2.3

Definitions

What do each of the terms below mean?

Heat	
Temperature	

Questi

Answ estions below using evidence from the text.

1) What is the d betwe nd temperature?

2) When you boil a pot of water, is heat or tempera being ferred? What is happening to the water?

PREVIEW

Heat or Temperature

Is the description an example of heat or temperature?

1) _____ is transferred from the Sun to the Earth.	
2) The _____ of the water is cold.	
3) The heat from the furnace made the _____ too warm in my room.	
4) _____ is a form of energy that can do work.	
5) _____ describes how much kinetic energy is inside a substance.	

Name: _____ 36

Curriculum Connection
E2.3

Thermal Expansion and Contraction

Thermal Expansion and Contraction

When solids, liquids or gases are heated, the particles which they are made of speed up. This means they have more kinetic energy. The faster moving particles take up more space. This makes the substance increase in volume. This is called **thermal expansion**.



Likewise, when you cool solids, liquids or gases, they decrease in volume. This is called **thermal contraction**. When substances contract, their particles travel shorter distances, so, they occupy less space.

Mass and Volume

Mass is a measure of the amount of matter in an object. Mass is usually measured in grams (g) or kilograms (kg). Volume is the three-dimensional space occupied by matter or enclosed by a surface. Volume is usually measured in cubic centimeters or litres.

When thermal expansion or contraction occurs, the mass of the substance stays the same, but the volume increases or decreases. The change in volume happens because the spaces between the particles expand in thermal expansion and decrease in thermal contraction. For any given change in temperature, gases expand and contract more than liquids and solids. Liquids expand and contract more than solids.



Examples of Thermal Contraction

An example of thermal contraction in solids is the lid on a jar. In a fridge, the metal lid contracts more than the glass. This makes the lid too tight for the jar. If you run the lid under hot water for a minute, it will heat and expand, making it easier to twist off. Another example is when power lines snap in cold weather as they contract too much.

An example of thermal contraction in gases happens with our car tires. During the winter, tires are more likely to become flat as the air pressure inside the tire lessens. The particles slow down and get closer together.

In liquids, if you fill your car with gas on a cold day, the gas has contracted already. If it warms up, the gas will expand in the tank and could overflow due to thermal expansion.

PREVIEW

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Name: _____ 37

Curriculum Connection
E2.3

Questions Answer the questions below using evidence from the text.

1) What is the difference between mass and volume?

2) Write on ample of how thermal contraction affects solids, liquids, and gases.	
Solids	
Liqui	
Gases	

Visualizing Draw what yo ictu ou were reading. Explain the picture.

True or False Is the statement true or false?

1) Thermal expansion makes substances weigh more.	True	False
2) Volume is measured by weight.	True	False
3) Mass is a measured by weight.	True	False
4) Car tires will become flatter during the summer months.	True	False
5) Matter expands in the summer heat and contracts in the winter cold.	True	False

PREVIEW

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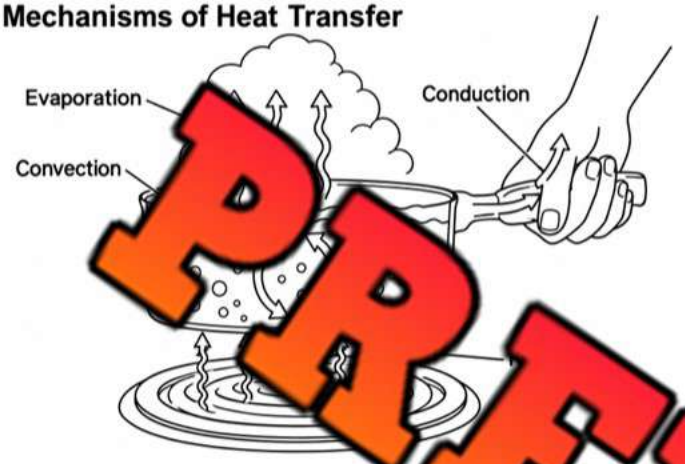
Name: _____ 40

Curriculum Connection
E2.4, E2.5, E2.6

Convection, Conduction, Radiation

Heat Transfer
Heat Transfer occurs in 3 different ways - conduction, convection, and radiation. Study the diagrams below and answer the questions.

Mechanisms of Heat Transfer



1) What are some ways that the heat transfers from the source (stovetop)?

_____

_____

_____

_____

_____

_____

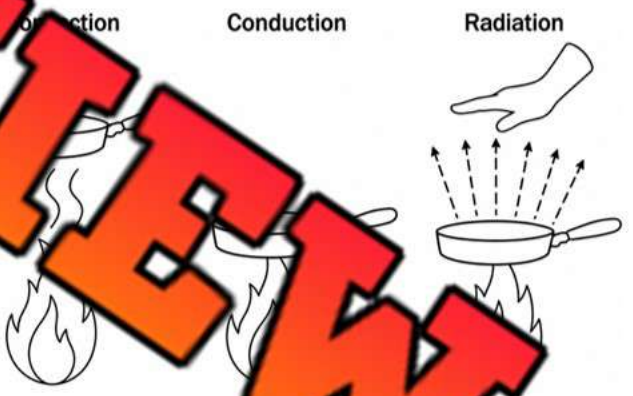
2) Which form of heat transfer happens when direct contact with the heat source?

_____

3) Which form of heat transfer happens when heat is transferred by moving air.

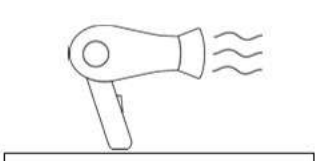
_____

4) Which form of heat transfers in waves or rays _____



PREVIEW

Practice Label the pictures – convection, conduction, or radiation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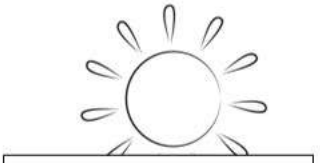
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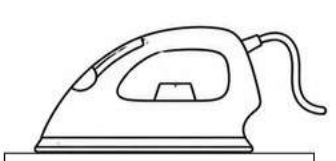
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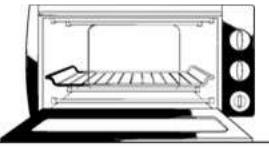
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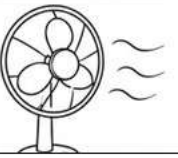
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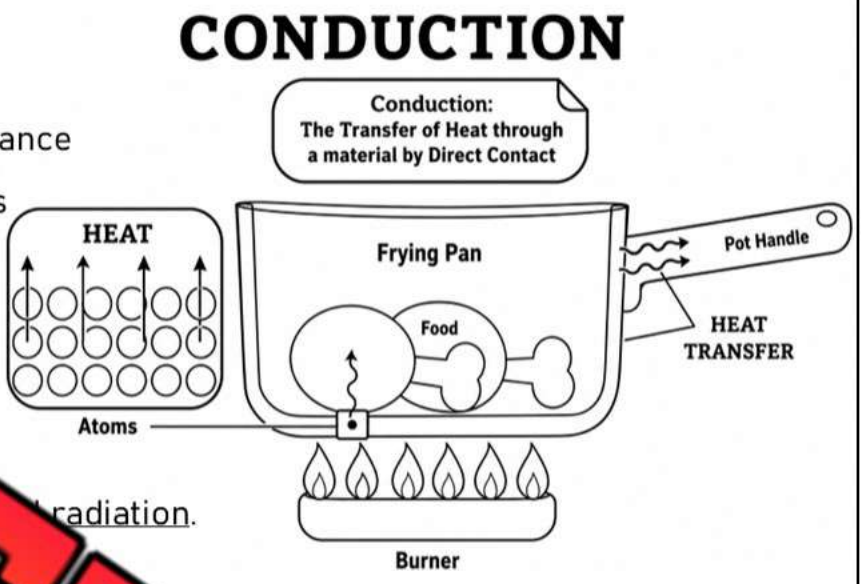
Name: _____ 41

Curriculum Connection
E2.4, E2.5, E2.6

Heat Transfer - Conduction

Heat Transfer

Heat transfer is when heat (thermal energy) moves from a warmer substance to a cooler substance. Heat is always transferre[illegible]he direction [illegible] temp[illegible]m to cool. [illegible]at tran[illegible] happens by co[illegible]ic[illegible]onvect[illegible] radiation.



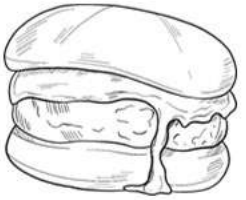
Conduction

In solid matter, heat transfe[illegible]duc[illegible]uction, the particles which make up a solid, for example the bottom of a pan, [illegible]d. W[illegible]he particles are heated, they begin to vibrate faster. These vibrating p[illegible]cles col[illegible]with [illegible]articles next to them. These collisions cause these particles to begin [illegible]e fast[illegible] up.

The fast-moving particles continue to bump i[illegible]les be[illegible]hem making them speed up and spreading the heat evenly across the [illegible]f th[illegible]nd[illegible] the sides.

Examples of Conduction

- Touching a metal spoon in a cup of hot liquid
- Putting a heating pad on your back
- Ironing clothes
- Walking barefoot on hot sand
- Using a frying pan on a stove
- Cheese melting on a warm cheeseburger
- Grabbing the black monkey bars on a hot day
- Sitting on the hood of a black car





PREVIEW

Name: _____ 42

Curriculum Connection
E2.4, E2.5, E2.6

Questions

Answer the questions below using evidence from the text.

1) What is conduction? How is heat transferred through conduction?

2) What ha[illegible]s to the particles in matter when the matter has been heated by conductio[illegible]

PREVIEW

Making Connections

W[illegible]t do[illegible]ding remind you of in your life?

True or False

Is the statement true or false?

1) When heat is transferred it goes from a cold substance to a hot substance.	True	False
2) Conduction is one way heat is transferred.	True	False
3) For conduction to happen there must be contact.	True	False
4) Gases can be heated by conduction.	True	False
5) Metals are good heat conductors.	True	False

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Curriculum Connection
E2.4, E2.5, E2.6

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____

Mark

Circle the correct answer.

1) In which type of matter does conduction mainly occur?	Solid matter	Gas
2) What happens to particles in a solid when they are heated?	They stop moving	They vibrate faster
3) Which is an example of heat transfer by conduction?	Feeling heat from the Sun	Touching a metal spoon in hot liquid
4) During conduction, heat moves from...	A warmer area to a cooler area	A cooler area to a warmer area

Name: _____

Mark

Circle the correct answer.

1) In which type of matter does conduction mainly occur?	Solid matter	Gas
2) What happens to particles in a solid when they are heated?	They stop moving	They vibrate faster
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Name: _____

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Circle the correct answer.

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4) During conduction, heat moves from...	A warmer area to a cooler area	A cooler area to a warmer area

PREVIEW

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Name: _____ 44

Curriculum Connection
E2.4

Thermal Conductivity

Thermal Conductivity

Sometimes we want heat transfer to happen easily, like when we are cooking a steak. To make heat transfer happen quickly, pots and pans are made of metal which has a high thermal conductivity.

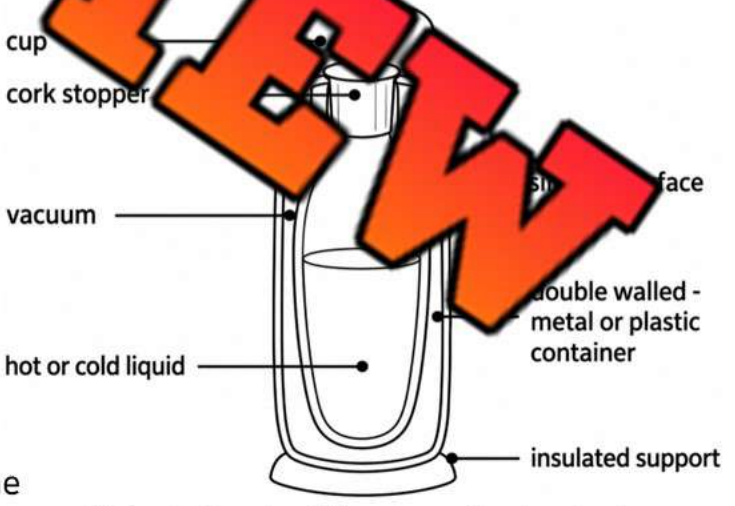
Thermal conductivity is the measure of how well a material conducts heat. Metals have a high thermal conductivity, while plastics, wood, gases and most fluids have a low thermal conductivity.

Materials with a low thermal conductivity can be used as insulators. An insulator protects against the heat of the object, for instance when cooking, the pan often has a handle made of material that is an insulator such as wood or plastic. If the pan doesn't have an insulated handle, you can use oven mitts made of thick fabric to pick it up. Fabric is an insulator because thermal energy doesn't transmit through it well.

Thermal Resistivity

Thermal resistivity is the opposite of thermal conductivity. Something with high thermal resistivity does not transfer heat very well. Sometimes we want heat transfer to be prevented or slowed down, like when we want to be warm remain warm, like our cup of hot chocolate on a cold day.

To keep our hot chocolate hot longer we use travel mugs designed to resist heat transfer. Travel mugs that keep liquids hot the longest have many inside surfaces that reflect heat back inside the cup.



They have a 2-part construction that is a cup within a cup with a gap in between. The cups are put together and then the air is removed from between the 2 cups creating a vacuum. Heat cannot travel through the vacuum because there are no vibrating particles in the vacuum space to carry the heat.

In our houses we use fiber glass insulation that traps air. Gases have poor thermal conductivity because the particles are not close together. When a gas particle is heated it moves faster but because gas particles are farther apart, they do not create as many collisions that would transfer the heat from one gas particle to another.

Our clothing keeps us warm in the same way. Thick sweaters and coats have lots of tiny air pockets around the fabric fibers. These air pockets do not transfer the heat from our bodies to the outside air very well, so our body heat is not lost into the air, and we stay warm.

PREVIEW

Name: _____ 45

Curriculum Connection
E2.4

Questions Answer the questions below using evidence from the text.

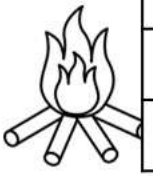
1) Define the terms below – thermal conductivity and thermal resistivity?	
Thermal Conductivity	
Thermal Resistivit	

2) H[illegible] travel mug help keep drinks hot or cold?

PREVIEW

You Choose Is the matter a therma[illegible] resistor?

1) Metal spoon	Conduc[illegible]	R[illegible]
2) Oven mitt	Conductor	
3) Tin can	Conductor	Resi[illegible]
4) Ceramic mug	Conductor	Resistor
5) Log of wood	Conductor	Resistor
6) Metal frying pan	Conductor	Resistor
7) Rubber shoe	Conductor	Resistor
8) Black car	Conductor	Resistor
9) White t-shirt	Conductor	Resistor
10) Glass lightbulb	Conductor	Resistor



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Name: _____ 46

Curriculum Connection
E2.5

Heat Transfer - Convection

What is Convection?

Heat transfer in liquids and gases happens by convection. Because the particles in liquids and gases are not attached to each other, when they are heated, they move around faster, rather than simply vibrating like in solids.

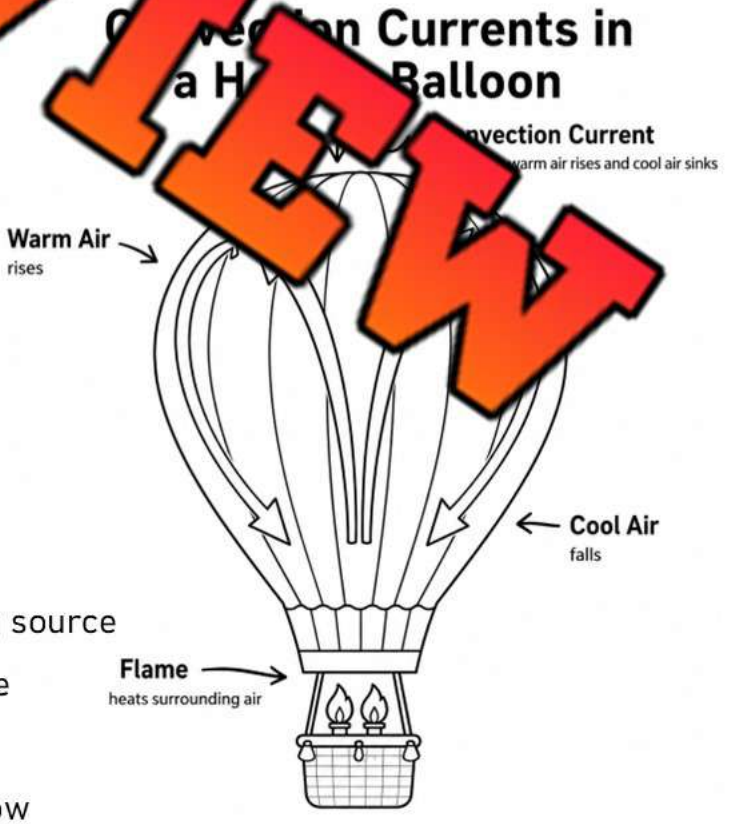
The particles move away from the warmer region to the cooler area. The particles are farther apart in the warmer region and are less dense. The less dense particles rise above the surrounding distributed cooler particles and as they move away from the heat source they begin to cool.

When the particles become denser and sink to the bottom of the container where the heat source is. The liquid or gas being heated rises and this creates a current called a **convection current**. The cycle of particles rising when heated and falling when cooled as they move away from the heat source continues as long as the container is being heated by the heat source.

PREVIEW

Convection Currents in Hot Air Balloon

The continuous cycle of hot air rising from a heat source to cold air falling towards the heat source is a convection current. You can see the cycle in action in the diagram of the hot air balloon.



Examples of Convection

- Air movement in our home from heating source
- Water in a pool is warmer on the surface
- Pot of water boiling
- Wind – air moves from area of high to low pressure (colder air to warmer areas as warm air rises, colder air moves in)

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Curriculum Connection
E2.5

Questions

Answer the questions below using evidence from the text.

What is convection? What happens when convection heats up gases or liquids?

Diagrams

Follow the instructions to draw two diagrams of gases and liquids being heated.

1) Draw and label a diagram showing what happens when water is heated in a pot.	2) Draw and label a diagram of a room with a heating radiator heating up the air.

PREVIEW

True or False

Is the statement true or false?

1) Convection currents are the continuous cycle of warm and cold air moving.	True	False
2) Heat transfer happens in liquids through convection.	True	False
3) Convection requires contact for heat transfer.	True	False
4) When you touch something hot, convection is transferring the warm air.	True	False
5) Warm particles rise and cool particles sink.	True	False

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Name: _____ 48

Curriculum Connection
A1.2, A1.4, A1.5

Science Experiment - Convection

Convection currents can be seen not only in gases, but in liquids as well. The movement of water particles are affected by the temperature of the water. This happens in our ocean currents. Today, you will be creating your own convection current using water.

Materials

What will you need for the experiment?

- Ice cube tray
- Water
- Food colouring (dark)
- Clear cup or jar



Procedure

How will you perform the experiment?

1) Mix the food colouring and water to make a dark colour. Use enough food colouring so that the water is a dark colour.
2) Pour the coloured water into the ice cube tray.
3) Put the ice cube tray into the freezer and wait until it is frozen.
4) Fill a clear glass with warm water.
5) Add one ice cube to the glass of water.
6) Observe the action! What happens to the warmer water versus the colder water?



PREVIEW

Name: _____ 49

Curriculum Connection
A1.2, A1.4, A1.5

Diagram Draw a diagram of what you saw happening with the ice cube.

Results Answer the [illegible]s bel[illegible]

1) Describe what you saw happen when [illegible]pped [illegible]loured ice cube into the warm water.

2) Describe using scientific terms, why the coloured ice and colder water moved in the direction it did.

PREVIEW

Name: _____ 50

Curriculum Connection
E2.5

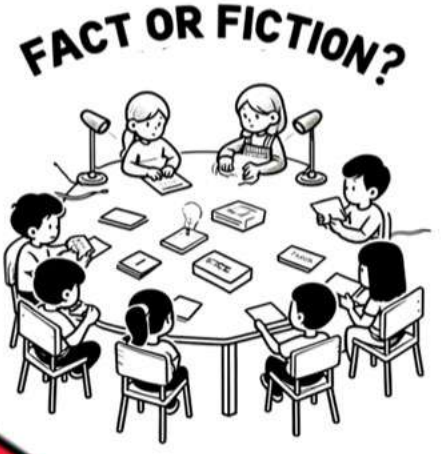
Fact or Fiction – Heat Transfer

Objective What are we learning about?

Students will identify correct and incorrect statements about conduction, convection, and radiation while explaining how heat is transferred in everyday situations.

Material What will you need for the activity?

- A list of statements about heat transfer
- A 'Fact' sign and 'Fiction' sign to distinguish the two sides of the room
- Designated areas in the classroom for the 'Fact' and 'Fiction' signs, allowing enough space for students to move to either side



Instructions How will you complete the activity?

1) Your teacher will read statements. Pay close attention as each statement is shared.
2) Consider carefully whether you think the statement is true or false.
3) If you decide the statement is true, walk to the 'Fact' side of the room.
4) If your guess is that it's not true, move to the 'Fiction' side of the room.
5) Stay on your chosen side and listen attentively for the correct answer to be revealed.
6) When the right answer is announced, return to your seat, ready for the next round.
7) Have fun getting up and moving!

PREVIEW

Name: _____ 51

Curriculum Connection
E2.5

Fact or Fiction Read the statements to the class.

#	Statement	Fact or Fiction
1	Heat from the Sun reaches Earth mainly through radiation.	Fact
2	Conduction happens best when objects are not touching.	Fiction
3	A metal spoon can become hot when left in a pot of hot soup.	Fact
4	Conv[illegible]n can only happen in solids.	Fiction
5	War[illegible]ally rises because it is less dense than cooler air.	Fact
6	[illegible]mpfire to feel heat from it.	Fiction
7	Co[illegible]ection [illegible]an form when water is heated in a pot.	Fact
8	Wood us[illegible]ucts h[illegible]ter than metal.	Fiction
9	Radiation can [illegible]mpty space.	Fact
10	Oven mitts help prot[illegible]han[illegible] they slow down heat transfer.	Fact
11	A frying pan heating up on a ho[illegible]e is an [illegible] convection only.	Fiction
12	Cool air tends to rise while warm air sink[illegible]	Fiction
13	Heat can move through a solid by conduction.	Fact
14	Radiation requires moving air or water to transfer h[illegible].	[illegible]
15	Sea breezes can form because land and water heat at different rates.	Fact
16	Conduction transfers heat through the movement of large currents of liquid.	Fiction
17	You can feel radiant heat from a fireplace without touching it.	Fact
18	Convection currents can occur in both liquids and gases.	Fact
19	Wrapping an ice cube in an insulating material can make it melt faster.	Fiction
20	Heat naturally moves from a colder object to a warmer object without any added energy.	Fiction

PREVIEW

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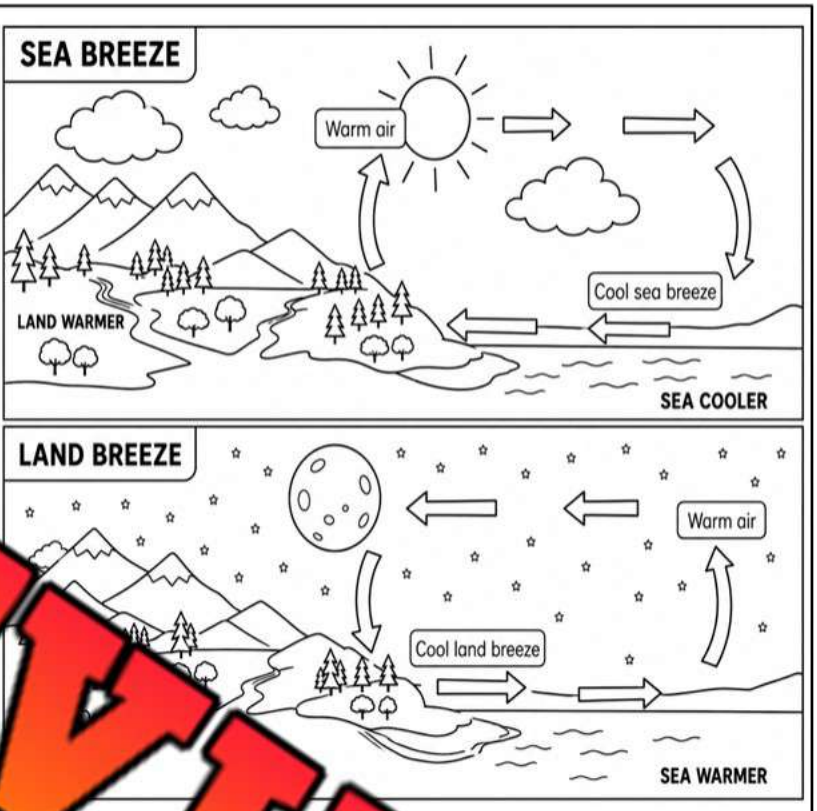
Convection – Sea vs Land Breeze



Sea and Land Breeze

Sea and land breezes describe the wind that blows onshore from sea to land during the day and offshore from land to se[illegible]e evening. Both sea and land [illegible]appen in coastal area[illegible]an[illegible]e bodies of water. [illegible]he mo[illegible]e w[illegible]rm air happens be[illegible]onvect[illegible]

Sea Breeze

A sea breeze happens when [illegible]e day, the Sun heats up the land and sea. However, land heats up much faster than water, so the land becomes warmer than t[illegible]er. Th[illegible]ally true in the summer and spring months, when the Sun's radiant [illegible]gest.

The warm air over the land rises because of its low[illegible]re[illegible]warm air spreads out, creating less pressure. Over the sea, the air is coole[illegible] particles are closer together. This causes a higher pressure. The air from [illegible]e sea will move from high pressure to low pressure towards the land. The warm air from the land will fall back towards the cooler sea, which will cool the air. This process creates a convection current.

Land Breeze

At night, the situation reverses as the air over the ocean is now warmer than the air over the land. The land loses heat quickly after the sun sets, which means the air above land is now cooler than the air above the sea. The warmer sea air rises, and the cooler land air moves into its position creating another convection current.

PREVIEW

Name: _____ 53

Curriculum Connection
E2.5

Diagram

Draw your own diagrams showing the direction of warm/cool air.

S… …eze	**Land Breeze**

Explain

Why do the c… …n c… …pen naturally in coastal regions?

True or False

Circle whether the statement is true or false.

1) Air moves from areas of high pressure to areas of low pressure.	True	False
2) Cold air rises.	True	False
3) Cold air has lower pressure than warm air.	True	False
4) Warm air has lower pressure than cold air.	True	False
5) Sea breezes happen because of the sun.	True	False

PREVIEW

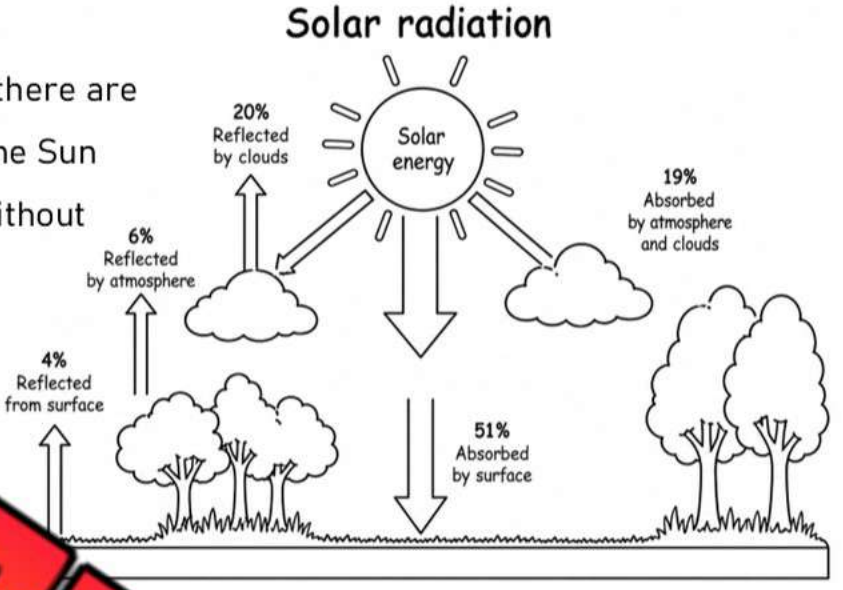
Name: _____ 54

Curriculum Connection
E2.6

Heat Transfer - Radiation

Radiation

The Earth is warmed by the Sun, but there are no particles between the Earth and the Sun outside of the Earth's atmosphere. Without particles, h[illegible]annot transfer by conductio[illegible]ection. Heat trave[illegible]y e[illegible]agnetic radiation waves o[illegible]



Radiatio[illegible]nsfer of energy through w[illegible]wit[illegible] needing matter (air, solids[illegible]). Ra[illegible]n be in the form of heat, sound and light. We call heat that has been [illegible]iate[illegible]**on.**

Heat radiation is transferred in s[illegible] lines a[illegible]d of light in all directions from one body to another. The waves can be ref[illegible]or abs[illegible]When a colder object absorbs the waves, the object becomes warmer, a[illegible]h[illegible]nsferred.

Absorbing and Reflecting Radiation Heat

Some objects are better at absorbing or reflecting heat than others[illegible]ar will absorb heat better than a white t-shirt, which means the heat has tra[illegible]ed better to the car.

We all emit heat through radiation. The warmer you are, the more thermal radiation you will emit. After gym class, a friend who didn't participate will likely feel the heat you are emitting. The classroom after gym class will also be warmer as you and your classmates are heating up the class by emitting heat through thermal radiation.

The Sun is sending thermal radiation at the speed of light in all directions. The clouds, atmosphere, and surface reflect 30% of this heat back towards the Sun. The remaining 70% is absorbed, which heats up our planet.

PREVIEW

Name: _____ 55

Curriculum Connection
E2.6

Questions

Answer the questions below using evidence from the text.

1) What is radiation? How is it transmitted by the Sun?

2) How m[illegible]hermal radiation from the Sun is reflected or absorbed by the Earth?

PREVIEW

Making Connections

W[illegible]s the [illegible]g remind you of in your life?

True or False

Is the statement true or false?

1) Radiation transmits heat through gas and liquids.	True	False
2) Radiation transmits heat through space (no particles).	True	False
3) 90% of the heat from the Sun is absorbed by the Earth.	True	False
4) 20% of the heat from the Sun is reflected back towards the Sun.	True	False
5) Thermal radiation is heat that has been radiated.	True	False

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Name: _____ 59

Curriculum Connection
E2.4, E2.5, E2.6

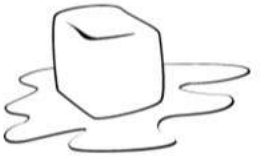
Convection, Conduction, Radiation

Questions Read the descriptions and label them convection, conduction, or radiation.

1) Heat from a fireplace warming up a room.



2) An ice cube melts after holding it in your hand.

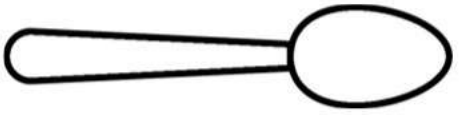


3) Th… ba… irculates rapidly

4) Your hot chocolate heats the air above it.



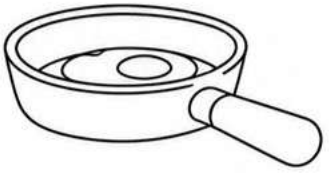
5) A spoon in a cup of hot coffee gets h…



A m… allow is heated from a campf…



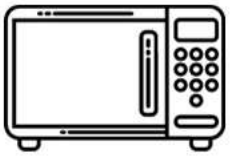
7) An egg is cooked in a frying pan.



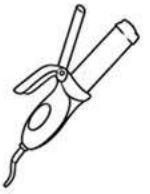
8) A cell phone gets h… your ear.



9) A microwave heats up food.



10) A curling iron heats up hair to curl it.



PREVIEW

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Name: _____ 62

Curriculum Connection
E2.4, E2.5, E2.6

Memory Game: Heat Transmission Types

Objective

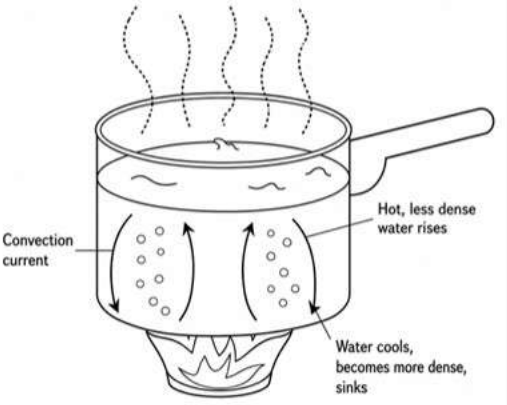
What are we learning about?

To help students identify and remember various ways heat can be transmitted through solids, liquids, and gases through a fun and engaging memory game.

Materials

What will you need for the activity?

- Me y gam ovided) with the terms on one set a nitio nother set.
- A flat surface like t he fl lay out the cards.



Instructions

How will you complet the acti

1. Divide the class into groups of 3 or 4. Give ch a se mory Game cards. (Provided)
2. Have each group lay all the cards face down in a grid on a h .
3. The students take turns flipping over two cards at a time, tr ing a matching term and its definition.
4. If a student finds a match, they remove those cards from the grid and keep them.
5. If the cards do not match, they are turned back over, and the next student takes a turn.
6. The game continues until all the cards have been matched.
7. After the game, review the terms and definitions with the class.
8. Discuss why these terms are important to understand and how they relate to the concept of heat transmission.

PREVIEW

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Name: _____ 63

Curriculum Connection
E2.4, E2.5, E2.6

Cards | List of heat transmission type terms

Term	Definition
Conduction	The transfer of heat through a solid material by direct contact of particles.
Convection	The transfer of heat in a fluid (liquid or gas) where warmer parts move up and cooler parts move down.
Radiation	The transfer of heat through electromagnetic waves that can travel through a medium (liquid or gas).
Thermal Conductivity	A measure of how well a material can conduct heat.
Sea Breeze	A wind that blows from the sea to the land, usually during the day, due to temperature differences.

PREVIEW

Name: _____ 64

Curriculum Connection
E2.4, E2.5, E2.6

Cards | List of heat transmission type terms

Term	Definition
Land Breeze	A wind that blows from the land to the sea, usually at night, due to temperature differences.
Electron[illegible]c Ra[illegible]	Energy that travels through space in the form of waves, such as light and heat from the sun.
Insulator	[illegible]l that does not [illegible]du[illegible]ell, helping [illegible]heat[illegible]r out.
Conductor	A material that al[illegible]ws heat to pass through it easily.
Heat	A form of energy that is transferred between objects at different temperatures.

PREVIEW

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Name: _____ 65

Curriculum Connection
E2.4, E2.5, E2.6

Cards | List of heat transmission type terms

Term	Definition
Temperature	A measure of how hot or cold something is.
Th[illegible]meter	An instrument used to measure temperature.
Melting Point	[illegible] tem[illegible]ture at which [illegible] a liquid.
Thermal Expansion	The increase in v[illegible]e of a substance due to an increase in temperature.
Heat Transfer	The movement of heat from one place to another.

PREVIEW

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Name: _____ 66

Curriculum Connection
E2.4, E2.5, E2.6

Cards | List of heat transmission type terms

Term	Definition
Greenhouse Effect	The trapping of heat in the Earth's atmosphere by certain gases, keeping the planet warm.
Conv[illegible] Curr[illegible]	A circular movement of fluid caused by the rising of warmer fluid and the sinking of cooler fluid.
Thermal Resistivity	[illegible]eas[illegible] of a material's abi[illegible]sist the [illegible]
Freezing Point	The temperature [illegible] which a liquid becomes a solid.
Thermal Expansion of Matter	The increase in size of a material as its temperature increases.

PREVIEW

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Name: _____ 70

Curriculum Connection
E2.7

The Sun and The Water Cycle

The Sun and The Water Cycle

All living things on Earth need water to survive. Water is not made in nature; it is recycled through the water cycle. The Sun's heat energy drives the water cycle.

Water exists on the Earth in all three of its states, liquid, solid as ice and as water vapour. Water changes easily from one state to another by evaporation, melting, freezing, sublimation, condensation and deposition. Each of these changes requires a transfer of energy.

Evaporati process of water changing from a liquid into water vapour. It is the most co t liquid water moves back into the water cycle.

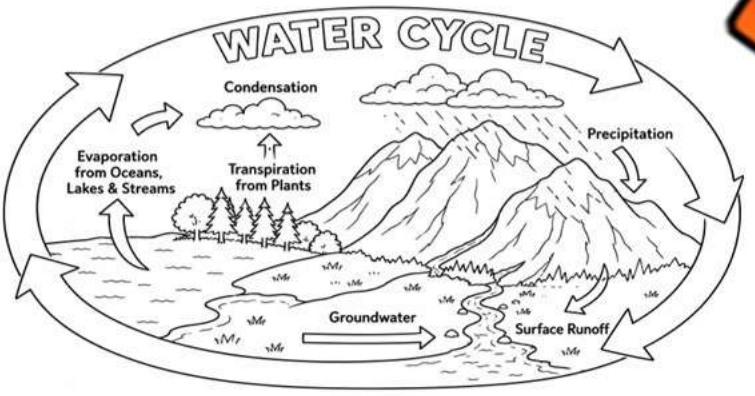
Melti the proc id ice becoming liquid by adding heat.

Freezing: is the p co g solid ice by loss of heat.

Sublimation: is s of g m solid ice to water vapour without first becoming liquid. Sublimation sed h at being absorbed.

Condensation: is the proc ater vap ing into liquid. This happens when the vapour is cooled.

Deposition: is the process when w ter v ange ctly into a solid without becoming a liquid first. This happens hi e atm where temperatures are very low. Another example is frost. Deposition is a resul eat



and
sublim pen eat energy is absorbed ensa and deposition happen decrease in the he loss) in the water particles.

In the water cycle, water moves from the surface of the Earth into the air and back to the surface of the Earth over and over again. This continued movement of water Is only possible because of heat energy from the Sun. Without the Sun's heat energy, water would not evaporate and all water on Earth would freeze.

When water molecules are heated, they exchange freely with the air in a process called evaporation. Ocean water is constantly evaporating, increasing the temperature and humidity of the surrounding air to form rain and storms that are then carried by trade winds. In fact, almost all rain that falls on land starts off in the ocean. The tropics are particularly rainy because heat absorption, and thus ocean evaporation, is highest in this area.

PREVIEW

Name: _____ 71

Curriculum Connection
E2.7

Questions Answer the questions below using evidence from the text.

1) What are the 6 processes that change water from one state of matter to another?

2) How do[illegible]t transfer from the Sun drive the water cycle?

Summarize What is [illegible]ea of [illegible]ading and supporting details?

True or False Is the statement true or false?

1) Melting, evaporation and condensation happen when there is heat loss in the water particles.	True	False
2) The water cycle recycles the same water repeatedly.	True	False
3) Water evaporates and forms clouds, which are moved by winds. This is one way water moves from one place to another.	True	False
4) Deposition is when water is deposited into an ocean.	True	False
5) Most of the rain that falls on land started in the ocean.	True	False

PREVIEW

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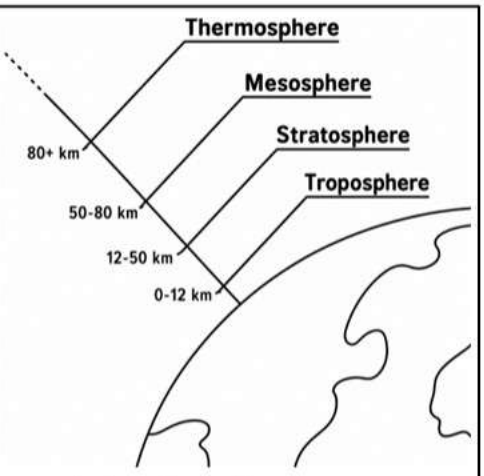
Name: _____ 72

Curriculum Connection
E2.7

The Atmosphere

The Atmosphere

Earth is a planet that is able to sustain life because it has an atmosphere. The Earth's atmosphere is a layer of gases that surround the Earth. Clean air is essential to life. Oxygen is one of the gases in the Earth's atmosphere. All humans and animals need oxygen to breathe.



The Earth is surrounded by a mixture of gases that make up the atmosphere. There are 5 layers in the atmosphere which are distinguished by their temperature including:

1. **The Troposphere** - It is the layer closest to the Earth. It contains the air we breathe. It extends from the ground to 20 kilometers above the Earth. Our weather is found in this layer including rain, snow, wind and storms. Most clouds form in this layer. The troposphere contributes to the greenhouse effect that traps the heat close to the Earth. Hot air balloons fly in the troposphere. The temperature gets colder the higher you go in this layer.

2. **The Stratosphere** - It is the layer from 20 to 50 km above the Earth's surface. The stratosphere contains 20% of the Earth's atmosphere. The part of the stratosphere farthest from the Earth is the hottest. The ozone layer which protects us from harmful rays from the Sun, is located in the stratosphere. The ozone layer protects us from the Sun's ultraviolet radiation. The ozone is generated here. Airplanes and jets fly in the stratosphere.

3. **Mesosphere** - It is the layer between 50 km to 85 km above the Earth's surface. The mesosphere is the coldest layer of the atmosphere with temperatures at minus 90 degrees Celsius. Most meteors burn up in this layer and are called shooting stars. Rockets may go up to the mesosphere.

4. **The Thermosphere** - It is the layer between 85 km and 690 km above the Earth's surface. The thermosphere is very hot with temperatures up to 2760 degrees Celsius because the air in the thermosphere absorbs lots of the Sun's radiation. The International Space Station orbits in the thermosphere.

5. **Exosphere** - It is the layer between 690 km and 10,000 km above the Earth's surface. It does not have a defined end. The exosphere's gases get thinner and thinner until there are none left. The exosphere's temperatures vary between night and day. At night it is freezing cold and during the day it is very hot. The atoms and molecules escape into space. The satellites orbit in **the exosphere.**

PREVIEW

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Name: _____ 73

Curriculum Connection
E2.7

Questions

Answer the questions below using evidence from the text.

1) Name one thing you might see in each of the atmosphere's layers?	
Troposphere	
Stratosphere	
Mesosphere	
Thermo[illegible]	
Exos[illegible]	

2) W[illegible] the harm[illegible]er of the Earth's atmosphere and which is the widest layer?

Making Connections

What does the [illegible]g rem[illegible] of in your life?

True or False

Circle whether the statement is true or false.

1) The ozone layer is one of the 5 layers of the Earth's atmosphere.	True	False
2) The International Space Station is located in the Exosphere.	True	False
3) The mesosphere is the middle layer of the Earth's atmosphere.	True	False
4) All clouds are formed in the troposphere.	True	False
5) The ozone layer protects us from the Sun's heat.	True	False

PREVIEW

Name: _____ 75

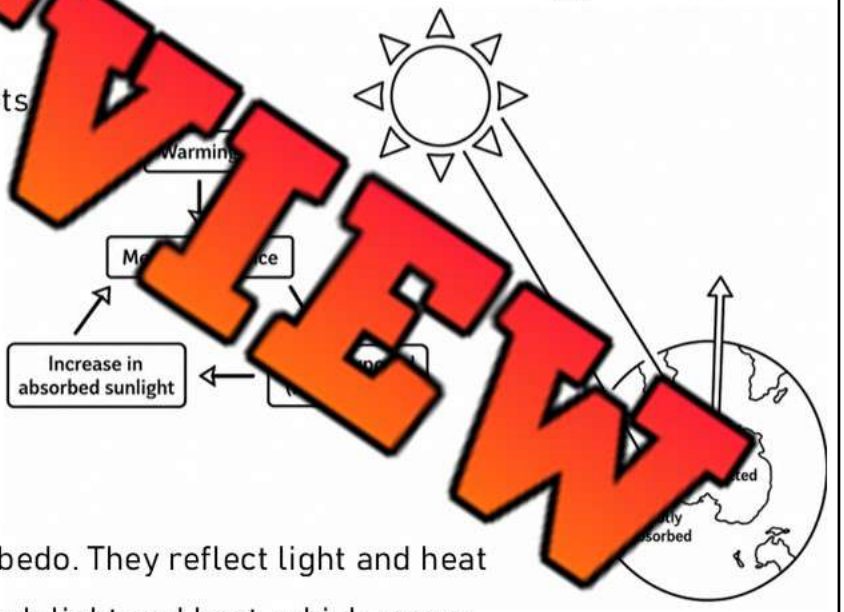
Curriculum Connection
E2.7

Energy From the Sun - Albedo

Energy from the Sun

Most of the Earth's energy comes from the Sun. Our Sun is an average sized star that emits huge amounts of energy every day. Scientist estimate that only 1 billionth of the energy produced daily by the Sun reaches Earth. The amount of energy that reaches the Earth every day from th[illegible]n is more than 6000 times the amount of energy used by the entire populatio[illegible]rth each day. The energy from the Sun drives the Earth's water cycle and create[illegible] patterns and ocean currents.

A[illegible]ximate[illegible]e Sun's radiation that reaches Earth is absorbed by the Earth's land and wate[illegible]un's [illegible]on that reaches Earth's atmosphere is reflected back out into space by th[illegible]'s s[illegible]osphere. 20% of the Sun's energy that reaches Earth is absorbed in the a[illegible]
by dust, water vapour and wat[illegible]ets



Albedo

Albedo is a measure of how much light is reflected back from an object. It usually refers to planetary bodies like Earth and the amount of sunlight that is reflected back into space. Snow and ice have a high albedo. They reflect light and heat very well. Oceans and dark forests absorb light and heat, which means they have a low albedo.

Because of climate change, more of the arctic ice caps are melting. As the ice caps melt and turn to water, even more heat is absorbed by the dark-coloured water than by the bright white ice it replaced. This makes even more of the polar ice melt because areas of low albedo, (the dark water) attract more solar radiation.

Thick white clouds also have a high albedo that cause the Sun's radiation to be reflected back out to space.

PREVIEW

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Curriculum Connection
E2.7

Questions Answer the questions below using evidence from the text.

1) How much of the Sun's radiation is reflected back into space? How much is absorbed by the Earth's surface or atmosphere?

2) What do [illegible] do mean? How does the melting ice affect the Earth's albedo?

PREVIEW

Questioning Write 3 que[illegible]s yo[illegible]t the reading.

1)	
2)	
3)	

True or False Is the statement true or false?

1) The Earth receives all of the Sun's radiation.	True	False
2) The energy from the Sun drives the Earth's water cycle.	True	False
3) 50% of the Sun's radiation that reaches Earth is absorbed by the land and water.	True	False
4) Thick white clouds have a low albedo.	True	False
5) The albedo of an object determines how much of the Sun's radiation is absorbed or reflected.	True	False

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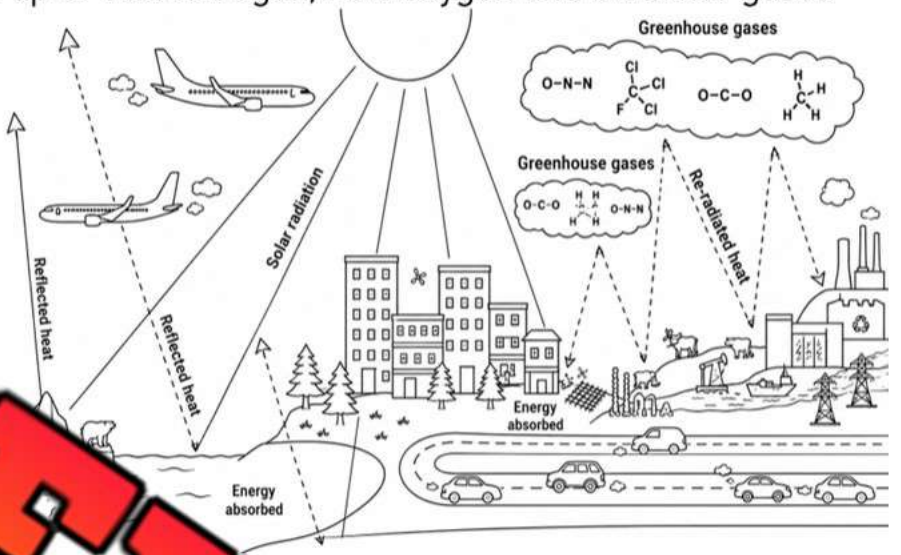
Curriculum Connection
E2.7, E2.8

Greenhouse Gas Effect

What is in the Air we Breathe?

The Earth's atmosphere is made up of 78% nitrogen, 21% oxygen and 1% other gases including, carbon dioxide, argon, helium, hydrogen and ozone. Plants use nitrogen to make protein. People and animals need oxygen to breathe. Plants produce oxygen during photosynthesis. [illegible] and animals consume to breathe is replaced by oxygen that plants make. This is an important balance. When humans cut down too many trees, we disturb the balance of oxygen needed to keep the air we breathe healthy for humans.



PREVIEW

Greenhouse Gas Effect

A greenhouse is a building made of glass that is used to grow plants indoors when the weather is too cold for them to survive outside. The sun shines through the glass greenhouse and warms the air and contents inside. At night when the Sun is not shining the greenhouse stays warm because the glass walls trap the heat inside.

The greenhouse gas effect works the same way on Earth. The layer of greenhouse gases acts the same way as the glass walls of a greenhouse, trapping heat inside the Earth's atmosphere.

Greenhouse Gases

The best-known greenhouse gases in the Earth's atmosphere are carbon dioxide, methane, and nitrous oxide. They work together to allow the right amount of solar heat in and to trap some of the heat in the Earth's atmosphere to keep the Earth warm. This is called the greenhouse effect.

The problem is that when human activities produce extra greenhouse gases, mainly carbon dioxide, the thickness of the gases is trapping more heat than what is naturally supposed to happen. This is leading to global warming and climate change.

<u>Human activities that produce greenhouse gases include:</u>

- burning fossil fuels which makes carbon dioxide (driving, airplanes, factories)
- raising huge numbers of cattle which produce methane gas
- Cutting down trees which would have absorbed carbon dioxide
- creating landfill sites that give off methane

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Curriculum Connection
E2.7, E2.8

Questions

Answer the questions below using evidence from the text.

1) Describe the balance between oxygen and carbon dioxide used by plants and animals.

2) What a[illegible]f the things you do that create greenhouse gases?

PREVIEW

Visualizing

Draw what y[illegible]ictu[illegible]ou were reading. Explain the picture.

True or False

Is the statement true or false?

1) The Earth's atmosphere contains equals parts oxygen and carbon dioxide.	True	False
2) Some greenhouse gases occur naturally, and some are human made.	True	False
3) Planting trees helps reduce greenhouse gases.	True	False
4) Oxygen is an important greenhouse gas.	True	False
5) Examples of greenhouse gases are carbon dioxide, methane, nitrous oxide.	True	False

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Name: _____ 82

Curriculum Connection
A1.3, A1.4, A1.5

Experiment – Greenhouse Gas Effect

Research Question | What are we learning about?

Is the temperature rising on Earth because of a thick carbon blanket? Will the temperature in a bottle rise more if we wrap it in plastic wrap?

Materials | What will you need for the experiment?

1) P[illegible]
2) Tw[illegible]ttles – [illegible] with the tops cut off will work
3) Two ther[illegible]t[illegible]at ca[illegible] the bottles
4) Heat lamp, ra[illegible] or s[illegible]da
5) Elastic
6) Water
7) ~8 Ice cubes
8) Clay or tape – optional



Method | How will you complete the experiment?

1) Fill the two bottles about one-quarter full of water.
2) Add equal amounts of ice cubes to both bottles. Mark the water level.
3) Put the thermometers inside the bottles. You can use the clay to balance the thermometers or tape the thermometers to the side of the bottles.
4) Make sure the thermometers are visible so you can read the temperatures throughout the experiment.
5) Wrap plastic wrap over one of the bottles to simulate the greenhouse effect. Wrap the elastic around to secure it.
6) Place the two bottles under a heat source, making sure they receive the same amount of heat.
7) Check the temperatures periodically over the next couple of hours. See if there is a difference in temperature.

PREVIEW

Name: _____ 83

Curriculum Connection
A1.3, A1.4, A1.5

Hypothesis Which bottle will have a higher temperature? Explain why.

Observations What happened?

Which bo[illegible]warmer? Did the ice melt faster in one bottle? Did the water levels rise or lowe[illegible]?

Results Answer the question[illegible] belo[illegible]

1) Explain why the bottle with the plastic wrap [illegible]tter.

2) How does this represent the greenhouse gas effect?

3) What is happening with our glaciers on Earth? How was this represented in the experiment?

PREVIEW

Name: _____ 88

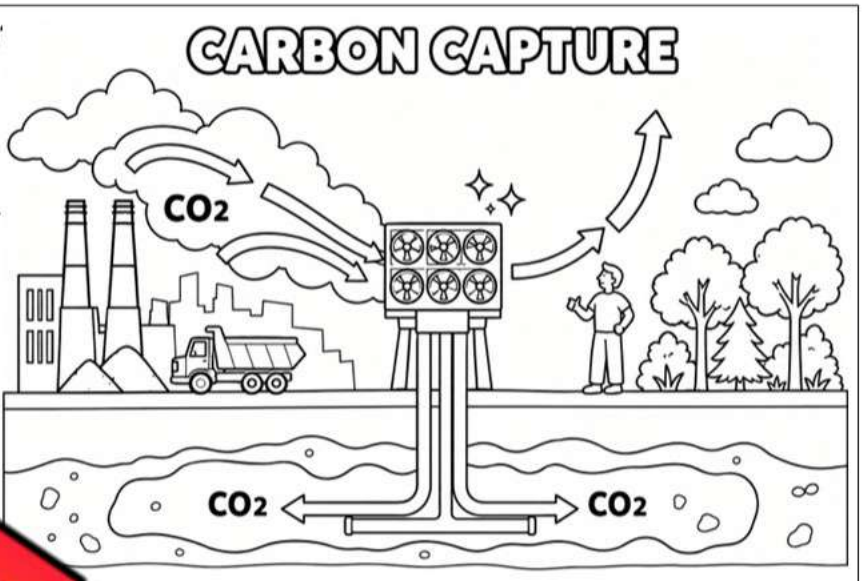
Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

Carbon Capture Technologies

What is Carbon Capture and Storage?

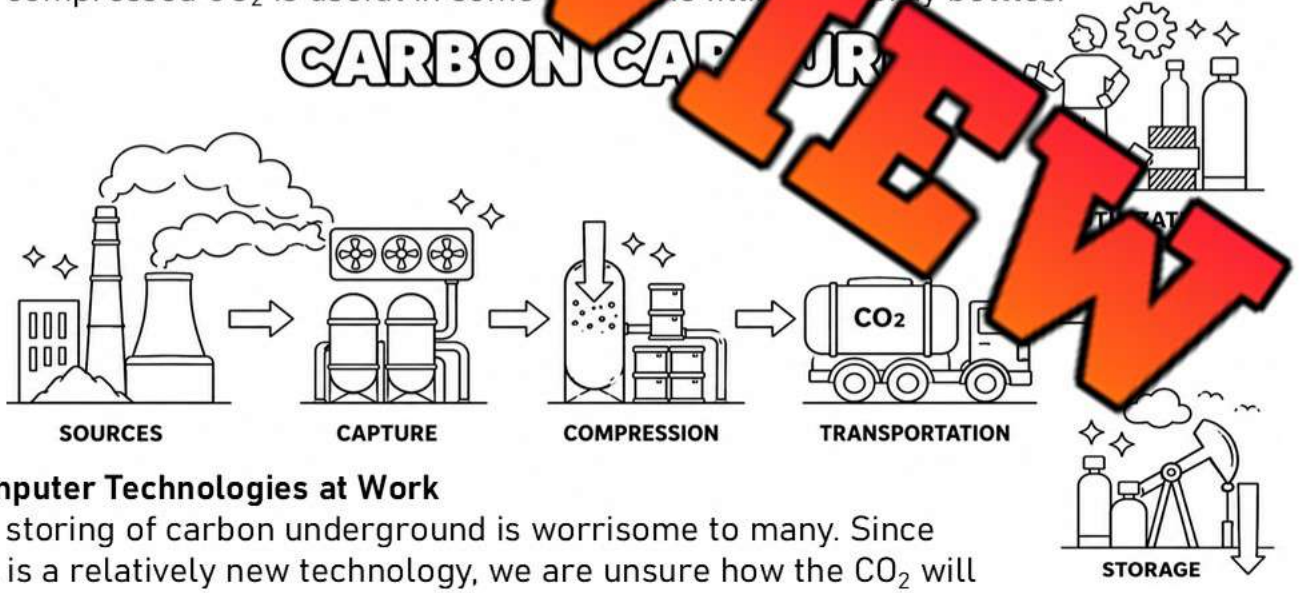
We've learned that the release of carbon dioxide from factories, transportation, and other human activities is creating global warming. Leaders around the world are working to reduce these emissions through new technologies such as the carbon tax.

Scientists are working to reduce these emissions through new technology has been developed to capture carbon dioxide released from factories.



In the diagram, carbon dioxide is released by releasing CO_2. Beside the factory is a gigantic fan that is sucking in the CO_2. There is a filter in it that releases clean air back into our atmosphere. The collected CO_2 is stored underground.

In fact, after the CO_2 has been collected it is compressed to take up less room. The compressed CO_2 is useful in some way like filling spray bottles.



Computer Technologies at Work

The storing of carbon underground is worrisome to many. Since this is a relatively new technology, we are unsure how the CO_2 will react underground.

The company Shell is currently sending their CO_2 emissions 2 kilometres underground. Shell is acting responsibly by monitoring these underground reservoirs filled with CO_2. They have installed sensors in the underground reservoirs to monitor whether the reservoir is saturated or if there is room for more CO_2 storage.

Coding is used to monitor how full the reservoirs are. When a reservoir is full, it will alert the employees who manage the CO_2 storage.

PREVIEW

Name: _____ 89

Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

Questions Answer the questions below using evidence from the text.

1) Explain how carbon capture and storage works. How will it help decrease greenhouse gas emissions?

2) How i[illegible]hnology helping decreasing carbon dioxide emissions?

PREVIEW

Directions Write defined counts and ru[illegible]to cal[illegible]hen the alarm should go off.

Defined C[illegible]

set [sq metres] of reservoir to [ ]

set number of kilograms of [CO_2] that can fit in a square m[illegible]eter

run square metres * CO_2

print [ ]

if [ ] kilograms of CO_2 are put into the reservoir

then [ ]

else [ ]

Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____

Put a checkmark (✓) on the correct answer!

Mark

What does carbon capture technology collect?	
○ Water vapour	○ Carbon dioxide
○ Oxygen	○ Sunlight
Where can captured CO_2 be stored?	
○ Underground	○ In the atmosphere
○ In rivers	○ In clouds

Name: _____

Put a checkmark (✓) on the correct answer!

Mark

What does carbon capture technology collect?	
○ Water vapour	○ Carbon dioxide
○ Oxygen	○ Sunlight
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○ Water vapour	○ Carbon dioxide
○ Oxygen	○ Sunlight
Where can captured CO_2 be stored?	
○ Underground	○ In the atmosphere
○ In rivers	○ In clouds

PREVIEW

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Curriculum Connection
A1.3, A1.4, A1.5

Experiment – Carbon Dioxide Effects

Research Question — What are we learning about?

How does carbon dioxide affect the air temperature on Earth? If we add carbon dioxide to an environment, will it heat up faster than an undisturbed environment?

Materials — What will you need for the experiment?

1) Tw[illegible] bottl[illegible]
2) Two ther[illegible]e[illegible] [illegible]hat c[illegible]in the bottles. Glass thermometer[illegible]k we[illegible]d[illegible]hermometer
3) Heat lamp, radiator, [illegible]y day
4) 2-4 seltzer tablets



Method — How will you complete the exp[illegible]t?

1) Fill the two bottles about one-quarter full of w[illegible]
2) Take the lids off the bottles and cover one of them with du[illegible]
3) Make a hole in the duct tape using scissors. Put the thermomete[illegible]ough this hole.
4) Drop the seltzer tablets into the second bottle. Cover it immediately using the duct tape. Cut a hole in this tape as well and stick the thermometer in.
5) Place the two bottles under a heat source, making sure they receive the same amount of heat. You could take them outside on a hot, sunny day or use a heat source.
6) Check the temperatures periodically over the next couple of hours. See if there is a difference in temperature.

PREVIEW

Name: _____ 92

Curriculum Connection
A1.3, A1.4, A1.5

Observations | What happened?

1) What was released when the seltzer tablets interacted with the water?

2) What eff[illegible] did the extra carbon dioxide have on the temperature in the bottle?

Results | Answer the [illegible]o[illegible]s belo[illegible]

1) Why do you think the bottle with selt[illegible] high[illegible]erature?

2) How are we releasing carbon dioxide into our environment?

3) Why is this dangerous for our environment and the living things in our environment?

PREVIEW

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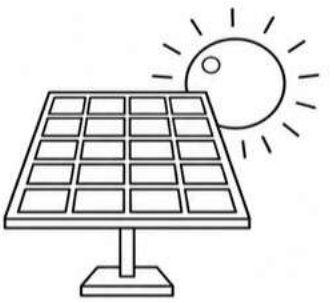
Name: _____ 93

Curriculum Connection
E1.2

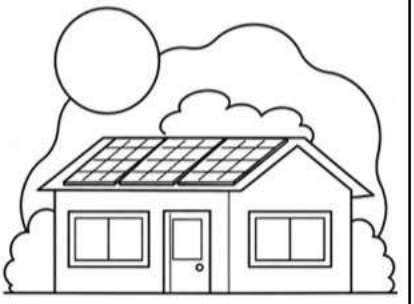
Solar Energy

What is Solar Energy?



Solar energy is energy given off by the sun's rays. The sun has been providing humans with solar energy for thousands of years. The sun has given us thermal energy to keep us warm and dry our clothes, and light e y to allow us to see.

As t ies advance, humans are now using solar energy to create electricity. Using f tricity means the sun is powering our electronics, machines, electric s and m



Solar en s ewab gy source because we cann use it up. It is an **in** esou e supply is endless.

How Solar Energy Works

Solar energy is harnessed by so anel d store the sun's energy. The stored energy is p energy sed on demand. Solar panels are made of many solar cells that are all connected

The solar cells have two sides. One side ha tron ar vely charged and the other side has a negative charge. When the sunlight the sola ne energy knocks the electrons loose and they begin to flow from one s the an electrical circuit. We can plug our electronics into a solar panel so th electrons can continue through the circuit inside the electronic device.

PREVIEW

Benefits and Drawbacks to Solar Energy

Benefits	Drawbacks
Renewable energy we won't run out of	Solar energy can only be collected when it is sunny. Cloudy, rainy days will slow down energy storage.
No greenhouse gases (no air pollution)	Batteries store the solar energy. Batteries don't decompose, meaning they will end up in landfills when they no longer work.
Once setup in homes, the cost is free to use electricity.	It costs a lot to install solar panels.

Name: _____ 94

Curriculum Connection
E1.2

Questions

Answer the questions below using evidence from the text.

1) What is solar energy?

2) How does solar energy work?

PREVIEW

Benefits and Drawbacks

...he benefits and drawbacks of solar energy.

Benefits	Drawbacks

Reaction

Do you think we should use more solar energy? Explain.

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Curriculum Connection
E1.2

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____ Mark

Circle the correct answer.

1) Solar energy comes from the ___.	
Sun	Moon
2) Which device collects energy from sunlight?	
Wind turbine	Solar panel
3) Solar energy is considered a _____ energy source.	
Renewable	Non-renewable
4) What is one drawback of using solar energy?	
It produces greenhouse gases	It depends on sunlight

Name: _____ Mark

Circle the correct answer.

1) Solar energy comes from the ___.	
Sun	Moon
2) Which device collects energy from sunlight?	
Wind turbine	Solar panel
3) Solar energy is considered a _____ energy source.	
Renewable	Non-renewable
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Name: _____ Mark

Circle the correct answer.

1) Solar energy comes from the ___.	
Sun	Moon
2) Which device collects energy from sunlight?	
Wind turbine	Solar panel
3) Solar energy is considered a _____ energy source.	
Renewable	Non-renewable
4) What is one drawback of using solar energy?	
It produces greenhouse gases	It depends on sunlight

PREVIEW

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Name: _____ 96

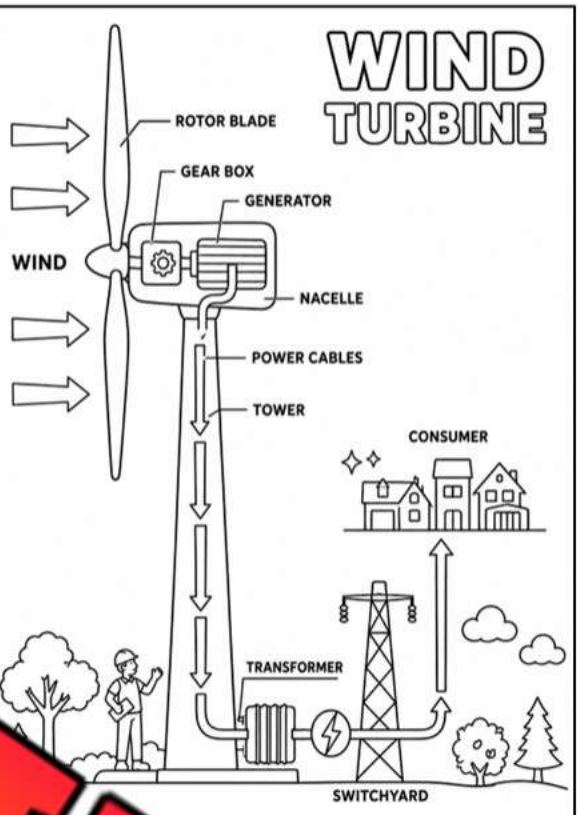
Curriculum Connection
E1.2

Wind Energy

What is Wind Energy?

Wind is the movement of air from areas of high-pressure to areas of low pressure. When the gases that make up our air are warmed, they spread out and have higher pressure. W the air is cooled, the pressure is lower as the gas get closer together.

W nergy we harness from the moven f the w nergy can fly a kite, move a sailboat and bin we use a wind turbine, we can use energ lectricity.



What is a Wind Turbine?

A wind turbine is like a windmill the are spun by wind energy, they spin a shaf cted to a generator. The generator converts the mechanical gy int rical energy by forcing the electrons through an electrical circuit. The el y is s a transformer, so it is the proper voltage. It is carried to a switchyard and th homes.

Use of Wind Energy in Canada

Wind energy is the second most used renewable energy source in Can % of Canada's electricity. Moving water is number one, with 59% of Canada's elec generation.

Benefits and Drawbacks of Wind Energy

Benefits	✓ Clean energy that doesn't produce greenhouse gases and won't run out ✓ Free energy once you have setup the wind turbine ✓ Wind turbines don't take up much space on the ground
Drawbacks	✓ Dangerous to birds and bats who can fly into the blades ✓ They are noisy so they are usually built in rural areas ✓ Are expensive to setup ✓ They only work when the wind is blowing. This causes unpredictable amounts of energy. If it isn't windy for a long period of time, the stored wind energy will run out

PREVIEW

Name: _____ 97

Curriculum Connection
E1.2

Questions Answer the questions below using evidence from the text.

1) Why does wind happen?

2) How does wind energy work?

Benefits and Drawbacks Explain the benefits and drawbacks of wind energy.

Benefits	Drawbacks

Reaction Do you think we should use more wind energy? Explain.

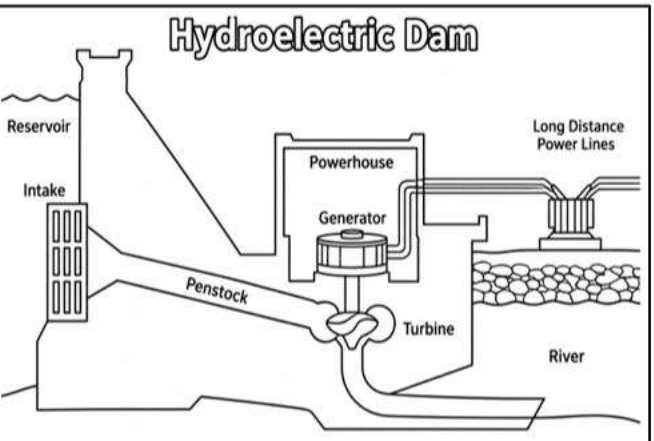
PREVIEW

Name: _____ 100

Curriculum Connection
E1.2

Hydro Energy

What is Hydro Energy?



Hydro energy is energy that is harnessed from the flow and movement of falling water. You have likely noticed in a stream or river that there is a current tha[illegible]nds water downhill. This movement of water c[illegible]nessed to create energy for huma[illegible]icity.

[illegible] energ[illegible]he oldest forms of energy. Watermills were first used in the 3rd century by the [illegible]ove[illegible]f water would spin a watermill that would spin a pipe. The pipe could be [illegible]ed to [illegible]at could do work.

How Hydro Energy Works

A hydroelectric dam is built to [illegible]e f[illegible]The water is built up in a reservoir that acts like a lake. The water stored in [illegible]voir a[illegible]ltitudes is potential energy. At the bottom of the concrete wall, there is an intake th[illegible]ows water to travel down the penstock. The water flo[illegible]sister spinning the turbine and generating electricity.



Hydroelectric Dams in Canada

The Canadian government is serious about using less fossil fuels for energy and more renewable forms of energy. This is why there are over 15,000 dams in Canada. Hydro creates 59% of all electricity used by Canadians! Canada makes the second most hydroelectricity, behind only China.

Benefits and Drawbacks

Benefits	✓ Renewable source of energy that we won't run out of ✓ The energy is clean because it doesn't emit greenhouse gases ✓ It's the most reliable form of renewable energy as water always flows
Drawbacks	✓ It has an impact on fish because the dam stops the natural flow of water ✓ Can only be built in certain areas where water flows already. It can be difficult to get the electrical energy to big cities from remote locations ✓ High cost to build dams

PREVIEW

Name: _____ 101

Curriculum Connection
E1.2

Questions

Answer the questions below using evidence from the text.

1) What is hydro energy?

2) Does Canada use hydroelectricity? Why do you think they do?

Benefits and Drawbacks

...nefits and drawbacks of hydro energy.

Benefits	Drawbacks

PREVIEW

Reaction

Do you think we should use more hydro energy? Explain.

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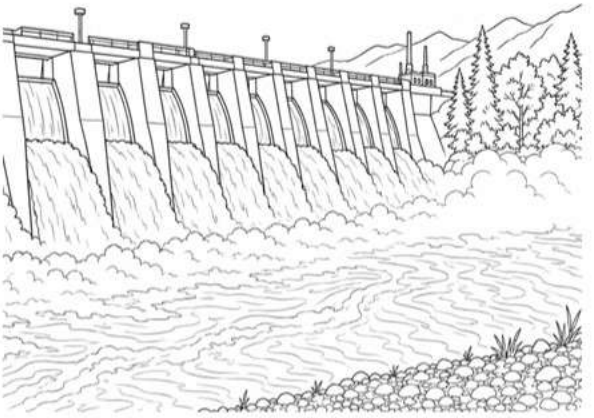
Name: _____ 102

Curriculum Connection
E1.2

Using Energy – Effect on Environment

Why We Generate Electricity



Electricity is an energy source we rely on in our everyday lives. It is used for lighting, heating, cooling, refrigeration, appliances, computers, electronics, and even electric vehicles. When the electricity has gone out, you've realized this reliance to it!

Generating Electricity Effect on Environment

In Canada, generating electricity produces far less air pollution than other countries, like the United States. Over 80% of the electricity Canadians use comes from sources that produce no air pollution. These sources are hydroelectricity, wind, solar, and nuclear.

This is not to say that generating electricity has no effect on the environment. The creation of hydroelectric dams, wind and solar farms, and nuclear power plants all have an effect on the environment.

Hydroelectric Dam	• The dams block the flow of water and release some water from time to time. This changing environment is hard for wildlife living in the water to survive • The structure itself is massive. It takes up a lot of land • Many of the dams are built in the north parts of Canada, where the Indigenous have rights to the land
Wind	• Pose a threat to flying wildlife like birds and bats • They also change ecosystems with their large structures • Noise pollution as the spinning blades are loud
Solar	• They need a lot of land to generate a significant amount of electricity • These panels get very hot and cause a threat to birds that land on them
Nuclear	• When a nuclear accident happens, radioactive pollution enters our air. It is poisonous to humans • Radioactive waste is created in the process of generating electricity. The waste is being buried underground • The nuclear power plants release their used water back into rivers, lakes, or oceans they are near. They filter it, but many believe the water is still contaminated

PREVIEW

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Name: _____ 103

Curriculum Connection
E1.2

Generating Electricity – Effect on Environment

Explain Write the effects of each energy source in your own words.

Hydroelectric Dam	
Wind	
Solar	
Nuclear	

PREVIEW

Reaction Which energy source(s) do you think is best for the environment? Explain.

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Name: _____ 106

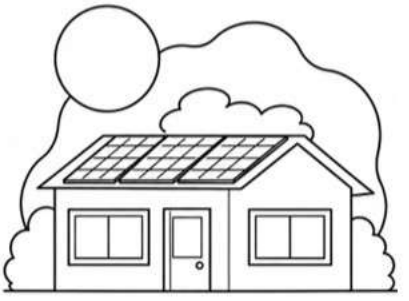
Curriculum Connection
E1.2

Heating our Homes – Renewable/Non-Renewable Energy

Renewable versus Non-renewable Energy Sources

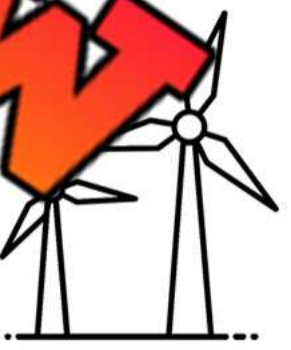
Renewable energy is energy that will not run out. Renewable energy sources include, burning wood, solar, wind, hydroelectricity, geothermal and biomass. Wood burning or pellet stoves use wood, which is a renewable source of energy as long as we manage our forests. Trees can t[illegible]0 to 150 years to reach maturity depending on their species, so if we do not keep plan[illegible]to replace those we cut for fuel, we could exhaust our forests.

[illegible]od [illegible]od pellets creates greenhouse gas emissions which contribute toward c[illegible]ate ch[illegible]s play an important role in absorbing carbon dioxide [illegible]si[illegible]so cut[illegible]s for fuel can have an additional negative i[illegible]t on [illegible]t because trees help clean our air. Trees also h[illegible]o flooding [illegible]d erosion, so cutting trees has a negative effe[illegible]the[illegible].



Hydroelectricity is clean energy th[illegible]s not cr[illegible]ot of greenhouse gas emissions, but it takes a lot of land because rivers u[illegible]y hav[illegible]dammed and reservoirs created to ensure a steady stream of w[illegible]for th[illegible]i[illegible]. Hydroelectricity is distributed through power lines that are strung along hi[illegible]s, also req[illegible]lots of land. Hydroelectricity is convenient and affordable.

Solar and wind energy are renewable forms of energy that req[illegible] lots of land to build wind turbines and solar farms. Manufacturing the solar panels creates toxic substances that may cause water pollution. Wind and solar are less reliable forms of energy because if the wind does not blow, energy is not produced, and solar power is not produced at night. When there is heavy cloud cover or on a rainy-day, solar panels generate approximately 75% less energy than on a sunny day.



Solar and wind energy can be fed into the power grid, or it can be stored in batteries. Small home solar panels, often mounted on the roof of the home can create power for individual homeowner use.

PREVIEW

Name: _____ 107

Curriculum Connection
E1.2

Questions

Answer the questions below using evidence from the text.

1) What are the advantages and disadvantages of solar energy?

2) What [illegible] renewable energy?

PREVIEW

Summarize

What is the m[illegible]dea[illegible]and supporting details?

1)	
2)	
3)	

True or False

Is the statement true or false?

1) Renewable energy is energy that can be reused over and over again.	True	False
2) When well managed, a renewable energy source will not run out.	True	False
3) Renewable energy sources do not cause greenhouse gas emissions.	True	False
4) Hydroelectricity creates lots of greenhouse gases.	True	False
5) Solar and wind energy are clean energy sources.	True	False

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Name: _____ 115

Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

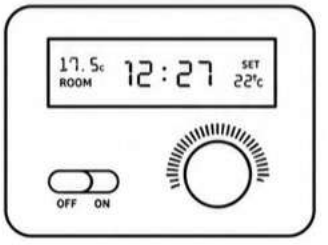
Coding - Thermostat

A **thermostat** is a computer that uses code to turn our heating and air conditioning on and off. When a thermostat heats our house up to the right temperature, it turns off to save energy. When the house gets cold again, it turns back on.

An **HVAC technician** is an expert in the heating and cooling of buildings. They install thermostats, air conditioners, furnaces, and the ductwork that air travels through.

You can program your thermostat to different temperatures depending on when you are ho[illegible]. In the winter, you don't want to let your heat turn off completely because your pipes [illegible] freeze. Instead, you would turn the temperature down to above freezing, but not to [illegible] you'll be wasting heat (around 16°C).

T[illegible]st [illegible]ogram uses coding to work. First, you need to define the time. Then [illegible] th[illegible]ature for that time. The backend of the cod[illegible]ll look [illegible] like this:



define [illegible]	00:00 [illegible]
set time 1 = [illegible]	

Directions Help program Kyle's thermost[illegible]per[illegible] you think are best for the winter

define time1 as 00:00 – 07:[illegible]	
set time 1 to	

define time2 as 07:01 – 08:30	
set time 2 to	

define time3 as 08:31 – 16:00	
set time 3 to	

define time4 as 16:01 – 22:00	
set time 4 to	

define time5 as 22:01 – 23:59	
set time 5 to	

PREVIEW

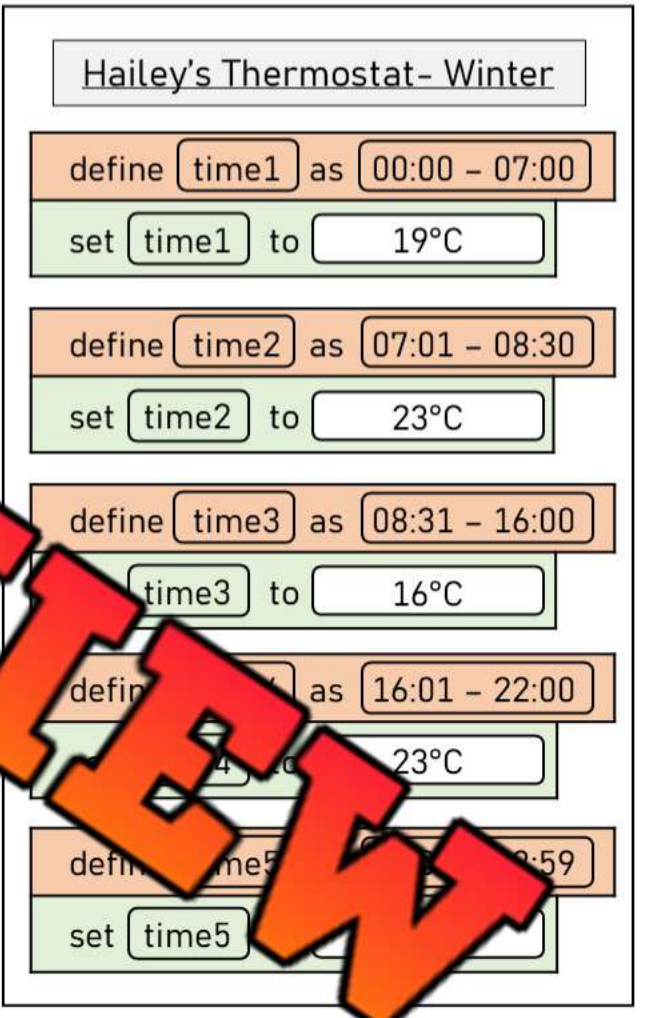
Name: _____ 116

Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

Reading Code – Hailey's Thermostat

Directions Read Hailey's thermostat program and write what temperature it is based on the time.

	Time	Temperature
1)	:00 am	
2)		
3)	5:00	
4)	10:01	
5)	1:00 am	
6)	6:00 pm	
7)	2:30 pm	
8)	4:00 am	
9)	12:00 pm	
10)	8:31 am	



PREVIEW

Results What do you think of Hailey's thermostat program? What would you change?

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Name: _____ 117

Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

Writing Code – My Thermostat

Directions Write your own thermostat program below to heat or cool your home.

define time1 as

set time1 to

define

set to

define time3 as

set time3 to

define time4 as

set time4 to

define time5 as

set time5 to

define time6 as

set time6 to

PREVIEW

© Super Simple Sheets

Name: _____ 119

Curriculum Connection
A1.1, A3.1, A3.2, A3.3

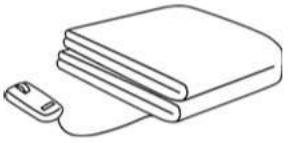
Assignment – Heating and Cooling Invention

Whether it is scorching hot or snowing outside, the average temperature inside buildings is likely around 20°C. To heat or cool an entire building uses a massive amount of energy. Furthermore, it is a huge waste of energy to heat or cool rooms that no one is using.

That is why we need you to research and develop a heating and cooling technology that only heats the people in a building, not the entire building itself. You can research these ideas online by typing in: "Technologies that heat or cool people, not buildings"

Some of th ideas include:

- ✓ A heat cooling robot that follows people around buildings
- ✓ Wear that heats and cools
- ✓ H ffice chairs



PREVIEW

Think Be sign heating and cooling technology below.

1) How does your tec it heat or cool people, not buildings?

2) What kind of technologies does your invention use? Does fac recognition to know what to heat and cool? Does it use temperature ng? Explain.

3) What will the name of your invention be?

Name: _____ 120

Curriculum Connection
A1.1, A3.1, A3.2, A3.3

Draw Draw a sketch of your invention. Label the important parts that allow it to work.



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Name: _____ 121

Curriculum Connection
A1.1, A2.1, A2.2

Coding

Write the code that allows your technology to work.



How will your invention use code? If your technology uses buttons, it will need code for the buttons to know what to do. Write code for each button or function that the technology does. Even if it doesn't use buttons, it will likely need temperature sensors that tell the technology when to heat or cool.

Write if/else statements below for each of the functions your invention does. Consider using defined counts to define variables that help your technology work.

PREVIEW

Name: _____ 122

Curriculum Connection
A1.1, A3.2

STEM Math connection – find out the financials for your invention.

1) How much will one unit of your invention cost you to make?

2) How many units will you make at first?

3) How [illegible] cost you in total?

4) How much will you sell on [illegible]?

5) How much money will you gross (earn) if you sell [illegible] earnings, do not factor in the cost of each machine.

6) How much net profit will you earn if you sell 5,000 units? For net profit, you'll find the gross and subtract the cost to build the 5,000 units.

7) If you want to make $5 million in net profits, how many units will you need to sell?

PREVIEW

Name: _____ 123

Curriculum Connection
E1.2

Nuclear Power



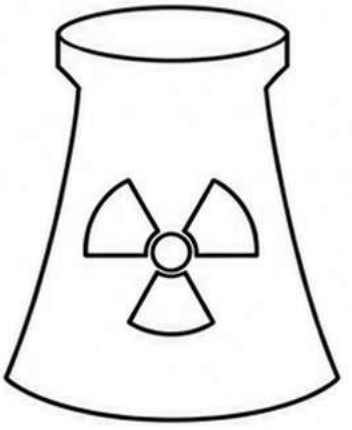
Nuclear Power

Nuclear energy is produced by splitting a uranium atom into two smaller atoms. This process releases heat from the nucleus of the atom that is used to create steam. The steam is used to turn turbines that create electricity.

Nuclear Fission of a Uranium Atom

In Canada there are 19 nuclear reactors, 18 in Ontario and 1 in New Brunswick. Nuclear energy provides 15% of Canada's energy needs. Nuclear energy is the second largest producer of low carbon emission energy after hydroelectricity. Nuclear energy creates 10% of the energy used worldwide. Nuclear energy is not entirely renewable because it uses Uranium which is a finite resource. There are many advantages to nuclear energy:

- It does not use large amounts of land like other power-solar power uses 450 times more land to generate the same amount of power.
- It is a stable consistent source of energy- it can be produced around the clock while solar and wind only produce energy 20% per day depending on weather conditions and whether it is day or night.
- The waste from nuclear is contained. It is regulated and stored either in steel and concrete capsules or buried underground. Waste from fossil fuels is emitted into the air as air pollution.
- It is efficient 1kg of uranium produces the same amount of energy as burning 10,000 kg of oil or 14,000 kg of coal.
- Nuclear energy does not emit greenhouse gases.



<u>Nuclear energy is controversial because:</u>

- the same raw materials used to create nuclear power could also be used to create nuclear weapons.
- the risks of an accident at a generating station that could cause damage to people and the environment.
- the used uranium is radioactive for thousands of years and must be disposed of carefully to avoid contamination.

PREVIEW

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Name: _____ 124

Curriculum Connection
E1.2

True or False

Circle whether the statement is true or false.

1) Nuclear energy is renewable energy.	True	False
2) Nuclear energy uses fission to generate heat.	True	False
3) Nuclear energy generates less air pollution than burning fossil fuels.	True	False
4) Fear of nuclear accidents is why people are against using nuclear energy.	True	False
5) Nuclear [illegible] is not widely used.	True	False

Summ[illegible]

[illegible] the reading by writing the important information.

PREVIEW

Questions

Use information from the text to support yo[illegible] swe[illegible]

1) Do you think we should build more nuclear power generating stations [illegible]ada? Why or why not?

2) What are the benefits of nuclear power?

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Curriculum Connection
E1.2

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____ Mark

Nuclear power has advantages and concerns below. Can you circle the advantages?

Low greenhouse gas emissions	Radioactive waste	Reliable energy	Accident risk	Uses little land
Produces energy day and night	Uranium is non-renewable	Produces large amounts of energy	Waste needs careful storage	Low air pollution
Long-lasting radioactive waste	Efficient energy source	Nuclear weapon concerns	Stable power supply	Risk of contamination

Name: _____ Mark

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Long-lasting radioactive waste	Efficient energy source	Nuclear weapon concerns	Stable power supply	Risk of contamination

PREVIEW

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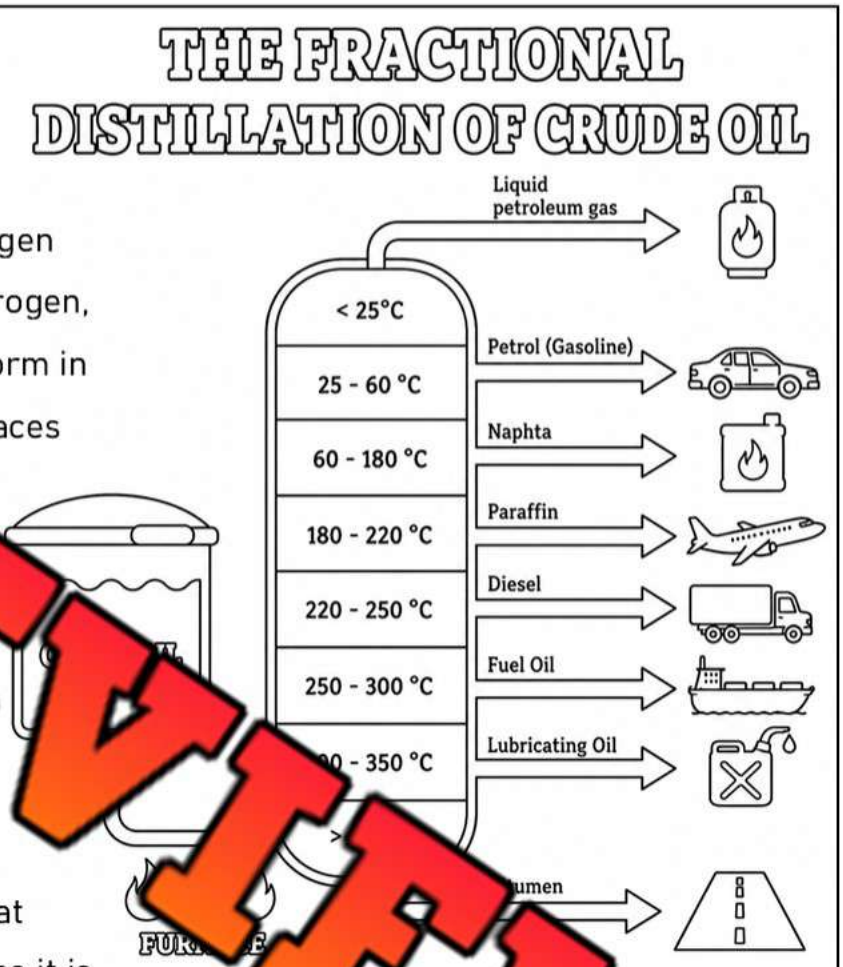
Name: _____ 129

Curriculum Connection
E1.2

Refining Oil

Crude Oil

When oil is found in its natural form underground, it is called **crude oil**. Crude oil is a mixture of mainly hydrogen and carbo[illegible] small amounts of nitrogen, sulfur, an[illegible]lt exists in liquid form in unde[illegible]rv[illegible]the tiny spaces within s[illegible]mentar[illegible] Canada, crude [illegible]f[illegible] most in Alberta, where 42[illegible]rilli[illegible] are pumping out crude oi[illegible]th[illegible] ground.



PREVIEW

Refining Crude Oil

Crude oil is a dark and sticky liquid that cannot be used without refining it. Once it is refined, it is used to make bitumen for roads, lubricating oil[illegible]engi[illegible] diesel, propane, and fuels for different machines (airplanes, ships, [illegible]

Fractional Distillation of Crude Oil

To refine crude oil, a process known as fractional distillation is used. First, a furnace is used to boil the liquid crude oil. The vapours from the boiling crude oil rise into the next chamber, where they are heated at a different temperature. The only thing remaining is the parts of the crude oil that do not vapourize at that temperature.

As you can see from the graphic, liquid gas (propane) continues to vapourize as it is heated at lower and lower temperatures. Using the fractional distillation method allows crude oil to be used in many useful ways so nothing is wasted.

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Name: _____ 130

Curriculum Connection
E1.2

Questions Answer the questions below using evidence from the text.

1) What is crude oil? Where is it found?

2) Why do[illegible]de oil need to be refined? How is it refined?

PREVIEW

Summarize How [illegible]illation refining process work?

True or False Is the statement true or false?

1) Crude oil is very useful in its natural state.	True	False
2) Crude oil is found in solid form underground.	True	False
3) Crude oil is found in liquid form between sedimentary rocks.	True	False
4) When you heat crude oil, it boils and vapours rise.	True	False
5) The fractional distillation method wastes a lot of crude oil.	True	False

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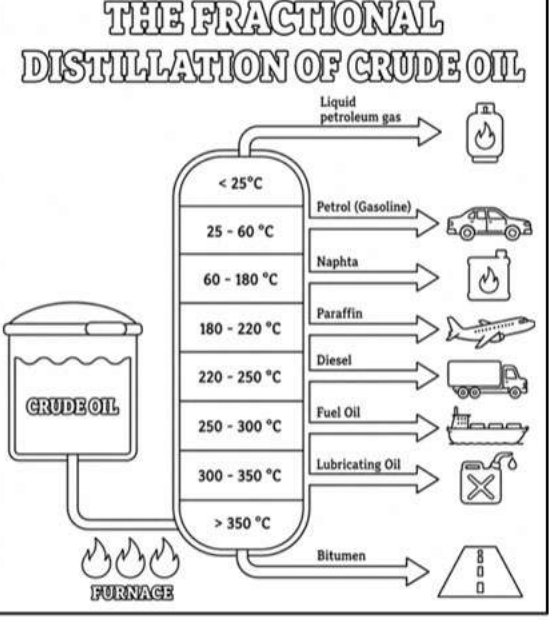
Name: _____ 131

Curriculum Connection
E1.2

Coding – Oil Refinery

A computer is programmed at an oil refinery in Alberta. The refinery heats up crude oil to 400° C. The computer uses temperature sensors on a feedback loop to keep the temperature at 400° C.



Example of feedback loop for a self driving vehicle

Run inf loop
if s el w 100
speed u 00
if speed i 0
then slow peed

PREVIEW

Coding Write your own f k lo p il refinery computer to keep the temperature at 400 .

IF/THEN Write the if/then statements for the code below, showing what will be made from the crude oil at the temperatures below.

If the temperature is between 250 – 300 ° C
THEN

If the temperature is between 220 – 250 ° C
THEN

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Name: _____ 134

Curriculum Connection
E1.2

Oil Spills

Oil Spills

Almost 14,000 oil spills are reported each year. Oil can be spilled in many ways. Oil tankers carrying large amounts of oil can spill oil in the oceans they travel in. From 2010-2020, approximately 164,000 tonnes of oil was lost from tanker spills.

Oil can also be spilled in pipelines. In 2021, the Keystone pipeline that carries oil from Alberta to North Dakota began to leak. Approximately 2 million litres of oil was spilled out [illegible] the underground pipes and onto farmland in North Dakota.

The [illegible]ter Horizon oil spill was the biggest marine spill in history. It was caused b[illegible]sion on the Deepwater Horizon oil rig. The oil rig was working to extra[illegible]d, 1,522 metres below sea level. The spill [illegible]ued for [illegible] they could not control the leak[illegible] of oil [illegible]illi[illegible] litres of oil was pumped into t[illegible]xico.



Oil Spills – Impact [illegible] Envi[illegible]e

When oil spills, the ef[illegible]s [illegible]elt for [illegible]es. Oil spills have numerous envi[illegible] con[illegible]

1) Death of Birds and Marine M[illegible]als

Birds are the most likely to be covered [illegible]ills in [illegible]ter. This is because oil floats on top of the water, and sea birds dive [illegible]gh the [illegible]n of the water to find their food. Even a small amount of oil can be dea[illegible]a bir[illegible] their feathers are coated, they can no longer fly. The Exxon Valde[illegible]ill ki[illegible] seabirds.

Marine Mammals such as whales, dolphins, s[illegible]s [illegible]ften killed by oil spills. Oil can clog the blowholes of whales and dol[illegible]king it[illegible]sible for them to breathe. Otters and seals become coated by oil, w[illegible]ves [illegible]ble to hypothermia.

2) Groundwater

When oil spills from pipelines underground, it pollutes our groundwater [illegible]il. The chemicals inside of oil end up leaching into the groundwater and soil, which affects the growth and development of plants and animals. These pollutants can cause cancers in humans as well when the polluted groundwater is consumed. This is why it is important to test well water often because it is taken directly from the groundwater. Water that a city provides is tested often.

Oil Spills – Impact on the Economy

When oil is spilled, it is very costly to cleanup. The Deepwater Horizon oil spill cost the BP oil company over $63 billion in legal fees and cleanup costs. If anyone or any company was affected by the spill, they had the right to sue BP and earn money as compensation. The government also pays when oil is spilled. In 2010, they sent the Louisiana National Guard to help assist local communities to remove the oil from critical habitats.

PREVIEW

Name: _____ 135

Curriculum Connection
E1.2

Questions

Answer the questions below using evidence from the text.

1) What is an oil spill? How do they happen?

2) What h[illegible]with the Deepwater Horizon oil spill?

PREVIEW

Impacts

How do oil spills impac[illegible]t and the economy?

Environment	
Economy	

True or False

Is the statement true or false?

1) Oil spills from underground pipelines affect the groundwater and soil.	True	False
2) The Deepwater Horizon explosion happened in South Dakota.	True	False
3) The BP oil spill cost their company over $63 billion.	True	False
4) Sea birds are affected the most by oil spills as the oil sits on the surface.	True	False
5) Well water is automatically tested by cities.	True	False

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Curriculum Connection
E1.2

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____ Mark

Is the statement true (T) or false (F)?

1) Oil spills can harm birds and marine animals.	T / F
2) Oil spills are usually inexpensive and easy to clean up.	T / F
3) Oil spills can pollute groundwater.	T / F
4) Oil spills are cheap to clean up.	T / F
5) The environmental effects of a large oil spill can last for many years.	T / F

Name: _____ Mark

Is the statement true (T) or false (F)?

1) Oil spills can harm birds and marine animals.	T / F
2) Oil spills are usually inexpensive and easy to clean up.	T / F
3) Oil spills can pollute groundwater.	T / F
4) Oil spills are cheap to clean up.	T / F
5) The environmental effects of a large oil spill can last for many years.	T / F

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Curriculum Connection
E1.2

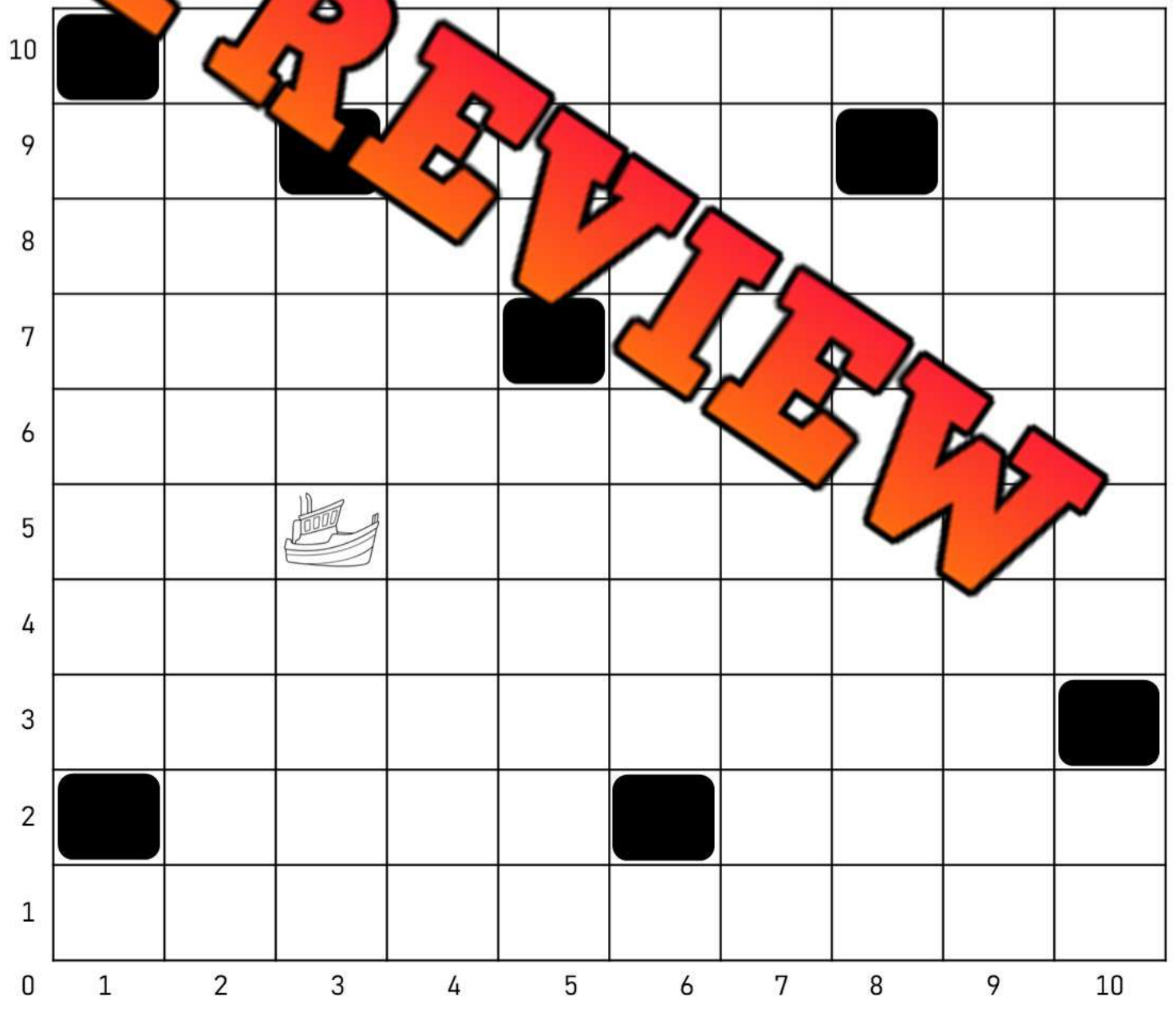
Coding – Cleaning Oil Spills

To clean an ocean oil spill, the following steps are performed.

1) Booms (floating barriers) are placed around the oil spill to trap the oil in one spot.
2) A skimmer is used to scoop up or absorb the oil.
3) Vacuums suck up the remaining oil.

Write a sub-program with the three steps above. Then program a boat to travel to the oil spill. Once you are there, run your sub-program to clean up the oil.

Mapping ... map to write the code on the next page.



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Curriculum Connection
E1.2

Code	Write code below to clean up the oil spill in as few lines as possible.

1) Write your sub-program below with each step of cleaning up an oil spill.

2) Write code that expla[illegible] boat [illegible]t to the coordinates on the grid.
Check out the example bel[illegible]
move to (1, 2)
run sub-program (which you will name [illegible]ing el[illegible]

PREVIEW

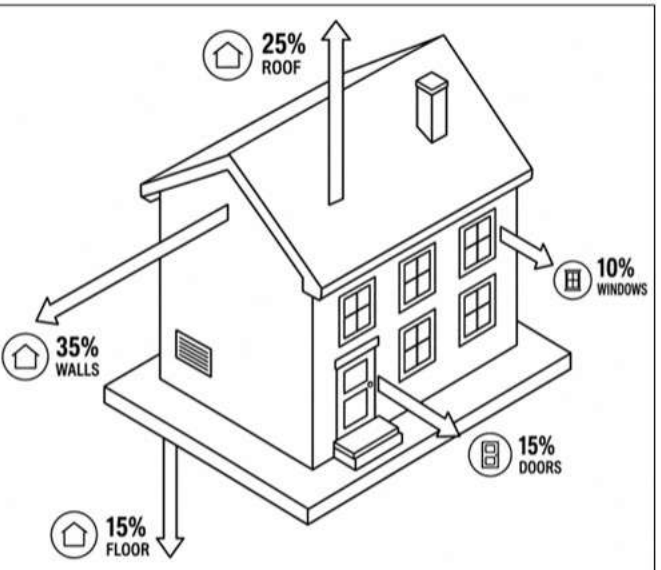
Name: _____ 139

Curriculum Connection
E1.1

Energy Efficient Homes

Losing Heat

When we heat our homes, we want the heat to stay inside the home. This can be difficult to achieve as homes are built by piecing materials together. If the seal between the pieces are not airtight, h[illegible]d its way to the cooler areas outsi[illegible]e.



I[illegible]st hom[illegible]o[illegible] the heat is lost through the wa[illegible]b[illegible]towe[illegible]e roof (25%), doors (1[illegible]oor ([illegible]a[illegible]dows (10%).

PREVIEW

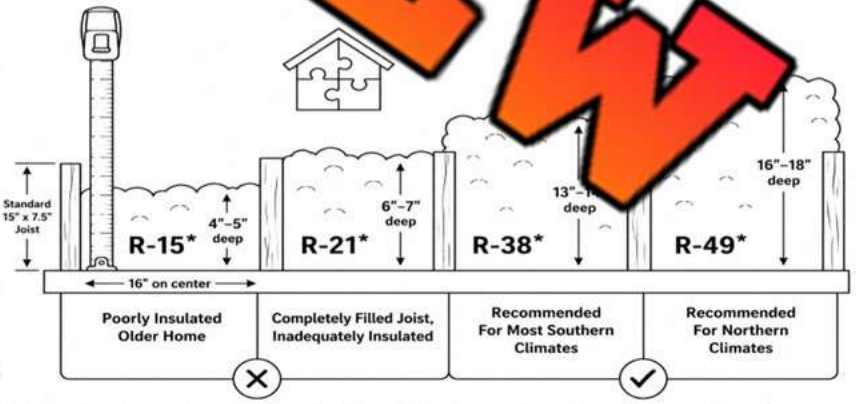
Insulation

Insulation is used to prevent the [illegible] of h[illegible]r out of a certain area. Your lunchbox is likely insulated so that heat [illegible] of you[illegible]o[illegible] cannot easily pass through the insulated materials. This keeps the cold items in [illegible] lunch.

You have probably seen pink insulation befo[illegible] your [illegible]e[illegible] the walls. It is used to keep the heat inside your house in the winter, an[illegible]e[illegible] outsi[illegible]ur house in the summer.

Walls and Attic

Since most of the heat is lost through the walls and the roof, most homeowners should focus on these two areas to add insulation.



R-values tell homeowners how much insulation they need. The higher the R-value, the better the area is insulated. In an attic, you should have an R-value of R38-R49. To achieve a higher R-value, you will need to layer the insulation, which prevents heat from passing through.

Some materials provide better R-value ratings than other, meaning you can use less to achieve a higher R-value. Spray foam is a good choice because it expands into all gaps.

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Curriculum Connection
E1.1

Questions

Answer the questions below using evidence from the text.

1) What is insulation and how does it help conserve energy?

2) What is R-value? Where is the highest R-value needed?

PREVIEW

Making Connections

Wh[illegible] the [illegible]mind you of in your life?

True or False

Is the statement true or false?

1) The lower the R-value, the better the house is insulated.	True	False
2) Most of the heat in a house escapes out of the roof.	True	False
3) Spray foam insulation is good as it expands into gaps.	True	False
4) Spending money to insulate your home is a waste of money.	True	False
5) Insulation only keeps heat inside a home or container.	True	False

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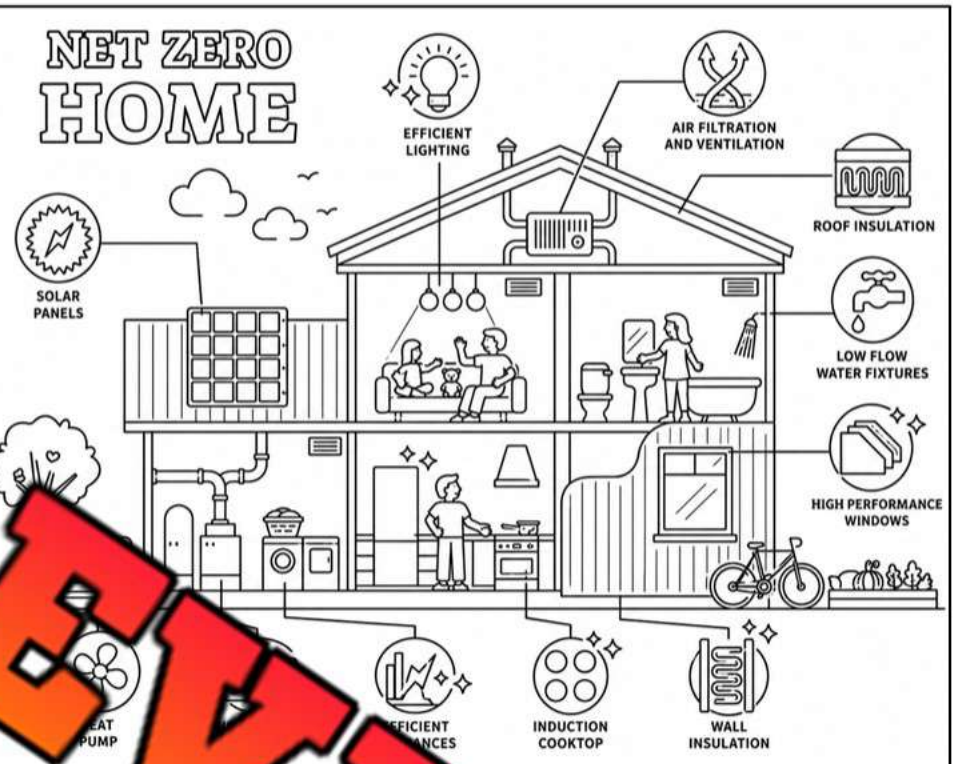
Curriculum Connection
E1.1

Net Zero Homes

What is a Net-Zero Home?

A **net-zero home** produces as much energy as it consumes and is up to 80% more energy efficient th normal home. Therefore homes must rg renewa energy and they need e energy efficiently, s energy is not wasted.



PREVIEW

Features of Net-Zero Homes

- ✓ Air-tight construction – thermal lea when t because of poor construction or inefficient materials. Triple-p ndow insulation, and new age materials that provide strong insulation a ngs have. These construction materials allow a tiny furnace or air co to ma the ideal temperature inside the home. A furnace the size of a hair er ca y net-zero homes to heat the entire house!
- ✓ Renewable energy systems – solar energy is the main renewable ener ource used in net-zero homes. The solar panels used on the roof produce as much power as the household uses. The house is still connected to the power grid. That way if the solar panels cannot generate enough energy, the house can utilize power from the grid. If the house produces more energy than it needs, the energy is given to the energy grid for other houses to use. This produces a net-zero amount of energy used.
- ✓ High-efficiency appliances and LED lighting – appliances are becoming greener and more energy efficient each year. Using new appliances reduces the amount of energy used, which keeps the house net-zero.

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Curriculum Connection
E1.1

Questions Answer the questions below using evidence from the text.

1) What is a net-zero home?

2) How is energy generated for most net-zero homes? What happens if they use too much energy or have an excess amount of energy?

Draw Draw your own net-zero home. Label the features of the home below.

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Curriculum Connection
E1.1

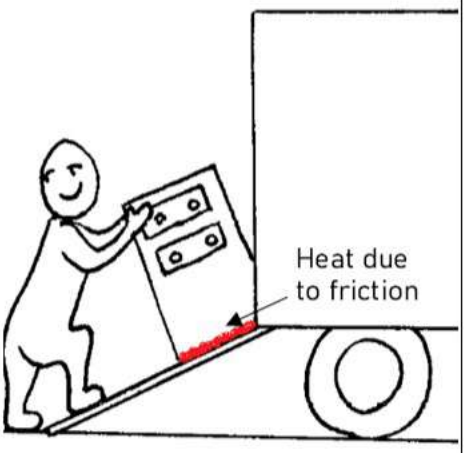
Heat Dissipation During Energy Transfer

What is Dissipation of Energy?

The term **dissipation** is commonly used to describe ways in which energy is wasted. When we use mechanical systems, there is often energy wasted, meaning some of the energy lost was not used for the intended purpose of the machine.

Dissipation by Friction

Many sim achines have to deal with friction causing a dissipat ergy. For example, when you push a box up e, the work might be easier than picki per the frictional force resisting the mo ent of



If the tw the and the ramp are made out of ma hat in ction, the box will not slide as well. Th will energy created, as the mechani y use ve the box will result in movement of and thermal energy. Examples of these surfaces include sandpaper an ubbe

If materials are used to reduce , like d grease, there will be less wasted thermal energy. Ice is an exam e of a s e wi friction. If you were sliding a box along ice, there would not be as dissi mal energy.

Body Heat Dissipation

We need energy to move our bodies. We get this ener the ve e t. When we eat food, we are using chemical energy. If you do vigo s ex ing, you will transfer the chemical food energy to mechanical (move

Unfortunately, there will be wasted thermal energy during this transfer as your body will heat up. The heating of your body is an unintended of the energy. You may find yourself getting tired more quickly if you tried running in a winter snowsuit, as you will heat up faster, wasting more energy.

Thermal Pollution

Some industries use water to cool their overworked machines. The cold water becomes hot as the machine heats it up. As the water heats up, it needs to be discarded because it isn't helpful any longer. It is often sent into bodies of water, where it increases the temperature of the water. This affects aquatic ecosystems as living things are affected by the increased temperature.

The transfer of heat from the machine to the water is unwanted. It is wasted and eventually causes harm to the aquatic ecosystems it is released into.

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Name: _____ 146

Curriculum Connection
E1.1

Questions

Answer the questions below using evidence from the text.

1) How is energy wasted when we run?

2) How do[illegible]tion cause dissipation of energy? Give an example.

PREVIEW

Explain

How is the t[illegible]cre[illegible]



True or False

Is the statement true or false?

1) Friction often causes unintended wasted energy.	True	False
2) Some materials create more friction, which creates dissipation.	True	False
3) Machines in factories can heat up water, which is unwanted heat.	True	False
4) We can use materials like grease to reduce friction and wasted heat.	True	False
5) Dissipation is a result of wasted and unintended thermal energy.	True	False

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Curriculum Connection
E1.1

Experiment – Energy Efficiency

Research Question

What are we learning about?

What does efficiency mean? How can one lightbulb be more efficient than another light bulb? How much heat do inefficient light bulbs produce? Do light bulbs that give more light produce more wasted heat?

PREVIEW

Materials

What will you need for the experiment?

- ❑ Lamp
- ❑ Thermometer
- ❑ 25-watt Incandescent bulb
- ❑ 100-watt Incandescent
- ❑ 2 fluorescent bulbs that produce light comparable to the incandescent b



Incandescent Bulb

Procedure

Complete the steps below to finish the experiment.

1) Put a 25-watt incandescent light bulb into the lamp and turn it on

2) Hold the thermometer about 5-10 cm above the bulb for one minute and record the temperature

3) Turn off the lamp

4) Let the bulb cool and then take it out

5) Repeat the procedure above using the 100-watt incandescent bulb. Record the temperature

6) Repeat the process above using the fluorescent bulbs. Record the temperatures for both bulbs.



Fluorescent Bulb

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Curriculum Connection
E1.1

Observations | What happened?

Light Bulb	Temperature
Temperature with light off	
25-watt Incandescent Bulb	
100-watt Incandescent Bulb	
Fluorescent Bulbs	
Fluorescent Bulbs	

Results | Answer the questions below.

1) Which type of light dissipates the most heat?

2) Does a light that produces more light dissipate more heat? Explain.

3) Which lightbulb is more efficient? Explain using the terms work, energy, and dissipation.

PREVIEW

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Name: _____ Date: _____

Unit Test – Heat in the Environment

Multiple Choice /10

1. Which has the highest albedo? a) Ice b) Water c) Black shi d) Wood	2. The sun provides which type of heat transfer? a) Convection b) Radiation c) Conduction d) Evaporation
3. When ted, they move... a) Fa b) Slower c) Stay the same d) None of the above	4. When heat transfers from direct contact... a) Convection b) Radiation c) Conduction d) Evaporation
5. Which layer is furthest aw e Earth's surface? a) Troposphere b) Stratosphere c) Mesosphere d) Thermosphere	h form of energy is cleanest between ns below? a) Coa b) O c) ar d) Wood
7. A handle on a pot is hot to touch because of... a) Convection b) Radiation c) Conduction d) Evaporation	8. A sea and t eez use of... a) Convection b) Radiation c) Conduction d) Evaporation
9. Which part of the electromagnetic spectrum does the sun's heat fall under? a) Infrared b) X-ray c) Gamma rays d) Ultraviolet	10) Where does most heat escape in a house? a) Roof b) Walls c) Windows d) Doors

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Definitions – What does the term mean (1 mark each) /3

Term	Definition (what does it mean)
Albedo	
Greenhouse Effec	
Convection	

Short Answer Questions (2 s each) /6

1) How does a travel mug keep liquid

2) Why are some jars really difficult to open? Why is it easier to
heating its lid?

3) How is climate change leading to rising sea levels?

PREVIEW

Long Answer (5 marks each) **/10**

1) How do human activities create greenhouse gases? Why is this a bad thing? Explain by referencing the greenhouse effect.

2) How can we make our homes mor[illegible]y effi[illegible]? Explain how heat escapes our homes and how we can save ene[illegible]by using [illegible]ati[illegible] Where should the insulation be placed? What heating source sho[illegible]e use

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