Grade 8

2nd Term Week 5

TOPIC 7: ENERGY IN THE ATMOSPHERE AND OCEAN

Lesson 2: Patterns of Circulation in the Atmosphere

Pages 352 : 359

OBJECTIVES:

- Students will identify and describe evidence that wind results from:
  1. differences in air pressure from unequal heating of the atmosphere.
  2. the jet stream and ocean currents.

- Students will cite textual evidence to support how unequal heating and Earth's rotation affect wind and weather conditions.

- Students will analyze relationships to describe how:
  1- winds that blow over short distances and affect local weather are called local winds.
  2- winds that occur over large areas and move around the globe are called global winds.
  3- global convection currents and the Coriolis effect interact to make the wind pattern of calm areas and global wind belts around Earth.

WINDS

- **Without wind, there wouldn't be any kite surfing.**

Draw an arrow to show the direction you think the wind is blowing.

Remember!
Both liquids & gases
are fluids!!!

- ✓ The surfer is moving over the top of a fluid, water.
- ✓ But the surfer is also moving through another fluid, called air.
- ✓ Air, like water, flows from place to place and does not have a fixed shape.

Catching the Wind Figure 1 Kite surfers need wind to move across the water.

Connect It!

Without wind, there wouldn't be any kite surfing. Draw an arrow to show the direction you think the wind is blowing.

SEP Construct Explanations What are some ways that you rely on the wind?

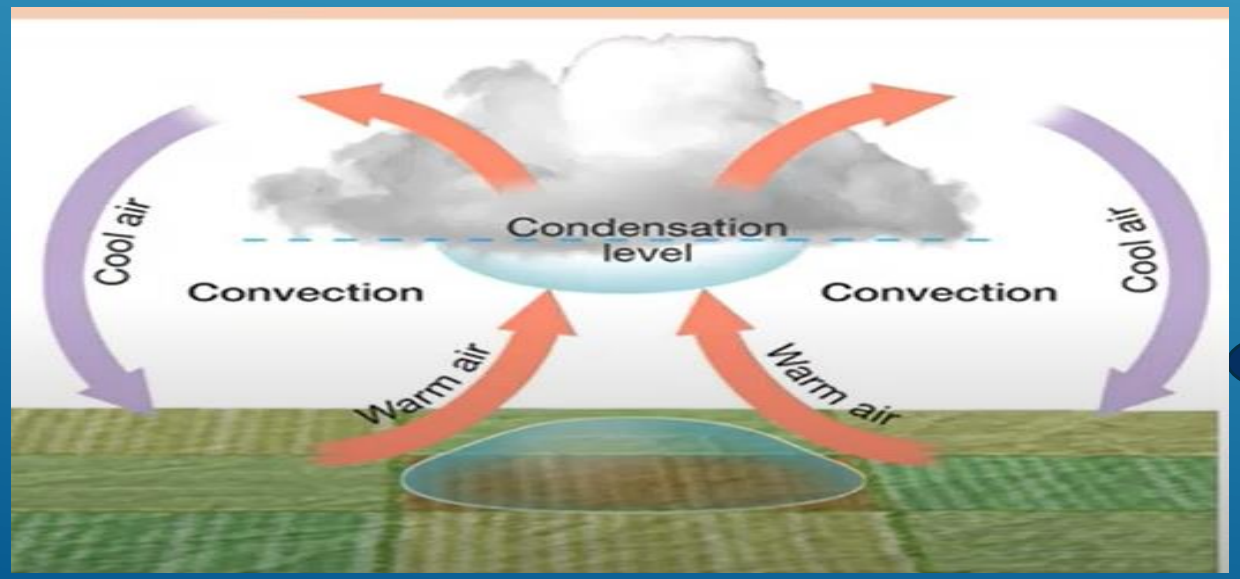
Sample: to have fun with kite flying, windsurfing, and surfing; to fly flags; to get electricity

Introduction to winds
https://www.youtube.com/watch?v=eyjHpbYiRs4

WINDS

- ***Causes of Winds***

- Air moves away from high pressure **areas** to low pressure areas.
- When there is a difference in air pressure, air moves and wind is created.
- ***Wind*** *is the movement of air parallel to Earth's surface.*
- Higher and lower pressure areas are results of the ***unequal heating*** of the atmosphere.



- ✓ Air over the heated surface expands,
- ✓ becomes less dense, and rises.
- ✓ As the warm air rises, its air pressure decreases.

- ✓ if another area is not heated as much, then the air in that area is *cooler and denser*.
- ✓ The denser air sinks and air pressure increases

The cool, dense air with a higher pressure flows underneath the warm, less dense air.
This difference in pressure forces the warm air to rise.

CONVECTION CURRENT

MEASURING WIND
PG. 354

To identify winds, they are named using the direction from which they originate and their speed.

- A ***wind vane*** is helpful in seeing which way the wind is blowing.
  - The arrow on the wind vane points in the direction from which the wind is blowing.

  - Winds can blow from any of the four directions: north, south, east, and west, and they are named by the direction from which they are blowing.

    For example, a north wind blows from the north to the south.

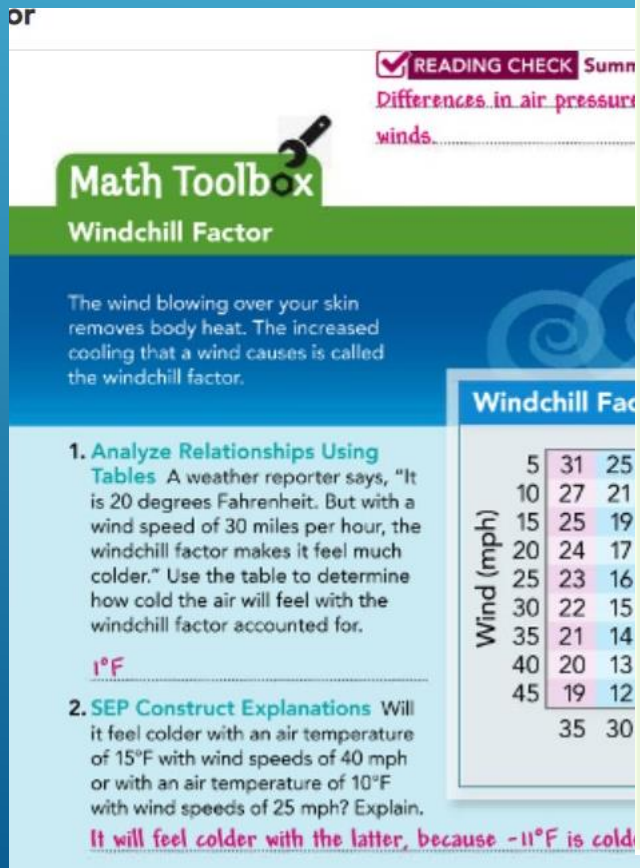
MEASURING WIND PG. 354

To identify winds, they are named using the direction from which they originate and their speed.

- Wind speed and pressure can be measured with an anemometer.
- An ***anemometer*** has three or four cups mounted at the ends of horizontal spokes that spin on an axle. The force of the wind against the cups turns the axle.
- The anemometer tracks the number of rotations, and that number is used to calculate wind speed.

Wired Wind Vane and Anemometer
https://www.youtube.com/watch?v=SHyciX6AcaM

MEASURING WIND PG. 354



READING CHECK Summ

Differences in air pressur

winds.

Math Toolbox

Windchill Factor

The wind blowing over your skin removes body heat. The increased cooling that a wind causes is called the windchill factor.

1. Analyze Relationships Using Tables A weather reporter says, "It is 20 degrees Fahrenheit. But with a wind speed of 30 miles per hour, the windchill factor makes it feel much colder." Use the table to determine how cold the air will feel with the windchill factor accounted for.

1°F

2. SEP Construct Explanations Will it feel colder with an air temperature of 15°F with wind speeds of 40 mph or with an air temperature of 10°F with wind speeds of 25 mph? Explain.

It will feel colder with the latter, because -11°F is cold

Windchill Fac

Wind (mph)	35	30	25
5	31	25	
10	27	21	
15	25	19	
20	24	17	
25	23	16	
30	22	15	
35	21	14	
40	20	13	
45	19	12	

Math Toolbox

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NOTEBOOK

2. **SEP Construct Explanations** Will it feel colder with an air temperature of 15°F with wind speeds of 40 mph or with an air temperature of 10°F with wind speeds of 25 mph? Explain.

NOTEBOOK

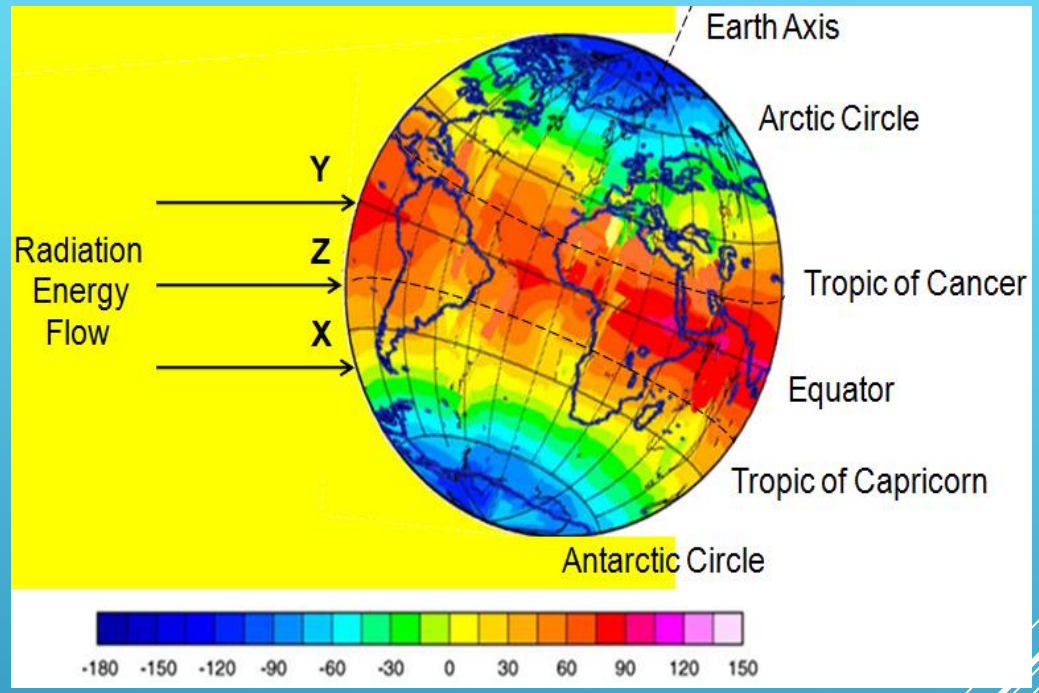
Windchill Factor

Wind (mph)	35	30	25	20	15	10	5	0	−5
5	31	25	19	13	7	1	−5	−11	−16
10	27	21	15	9	3	−4	−10	−16	−22
15	25	19	13	6	0	−7	−13	−19	−26
20	24	17	11	4	−2	−9	−15	−22	−29
25	23	16	9	3	−4	−11	−17	−24	−31
30	22	15	8	1	−5	−12	−19	−26	−33
35	21	14	7	0	−7	−14	−21	−27	−34
40	20	13	6	−1	−8	−15	−22	−29	−36
45	19	12	5	−2	−9	−16	−23	−30	−37

Temperature (°F)

LOCAL WINDS & GLOBAL WINDS PG. 355

➢ **unequal heating** and **Earth's rotation** affect wind and weather conditions on land,

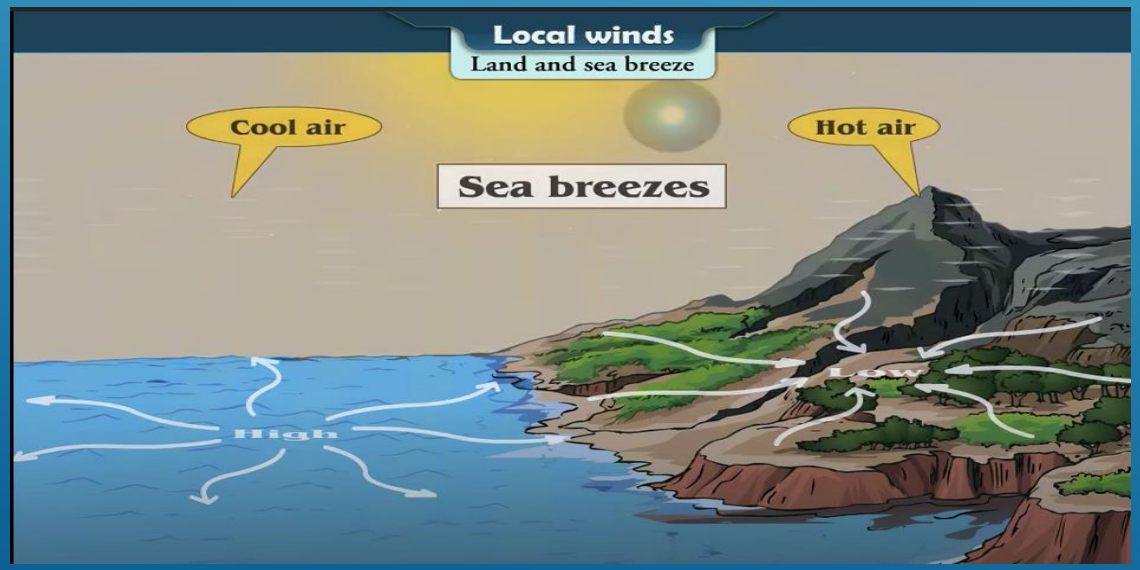


- Because of Earth's **shape**, **surfaces**, and **tilt**, the sun cannot evenly warm all of Earth at the same time.
- Different parts of Earth are warmed at different times and rates.
- This both in local areas and over global regions.
- Scientists use this understanding to make a **model**, such as a diagram or a map, to describe and predict wind patterns and their effects.

LOCAL WINDS & GLOBAL WINDS PG. 355

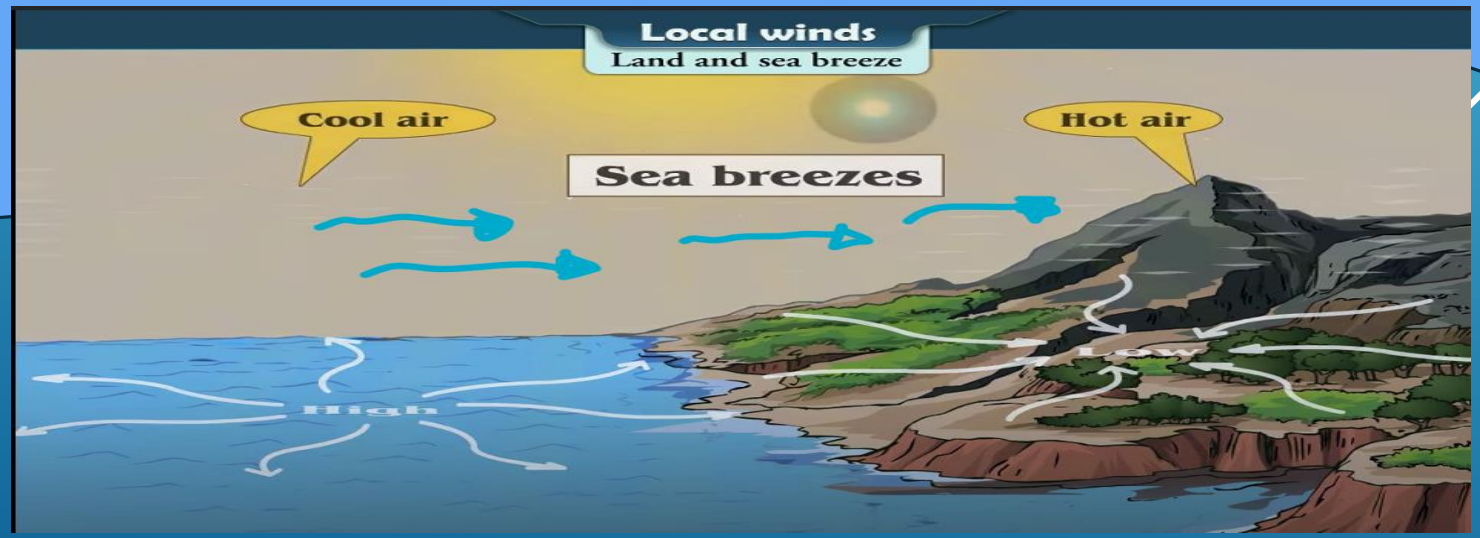
Local Winds

- Winds that blow over short distances and affect local weather are **called local winds.**
- The unequal heating of Earth's surface within a local area causes local winds. These winds form *only when the global winds in an area are weak*.
- Two types of local winds are **sea breezes** and **land breezes**.



LOCAL WINDS & GLOBAL WINDS
PG. 355

- A ***sea breeze*** or a lake breeze is a local wind that blows from an ocean or lake.
- ✓ When sunlight reaches the surface of Earth, land warms up faster than water.
- ✓ The air over the **land gets warmer** than the air over the water.
- ✓ **Warm air** is **less dense**, and **it rises**, creating a **low-pressure area.**
- ✓ Cool air blows inland from over the water and moves underneath the warm air, causing a sea breeze.



Local Wind
https://www.youtube.com/watch?v=Jyz3Vca__IU

LOCAL WINDS & GLOBAL WINDS PG. 355

- At night, the **land cools faster** than water.
- The air above the land begins to cool and **move under the warm air** rising off the water.
- The flow of air from land to a body of water forms a **land breeze**.

Sea Breeze and Land Breeze **Figure 3** Fill in the labels to indicate how a sea breeze and a land breeze develop.

a **land breeze**.

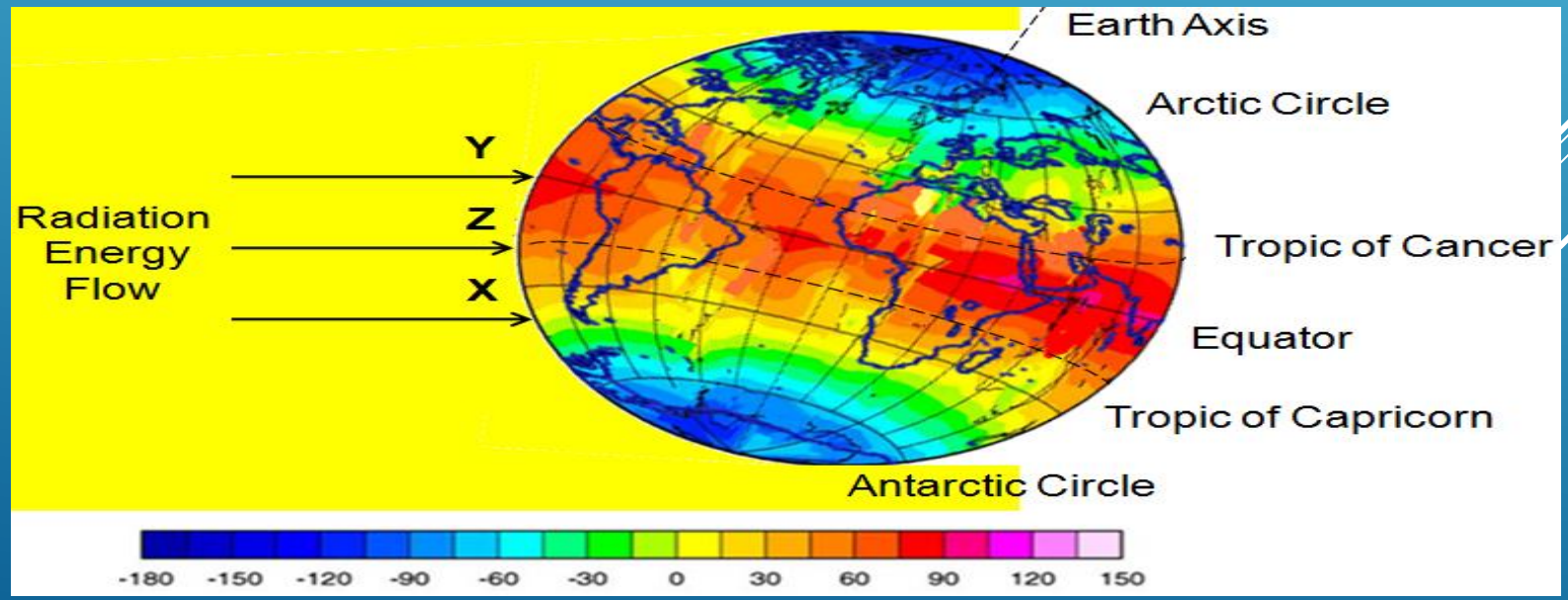
Sea Breeze and Land Breeze

Figure 3 Fill in the labels to indicate how a sea breeze and a land breeze develop.

GLOBAL WINDS PG. 356

- The patterns of winds moving around the globe are called ***global winds***.
- *Like local winds, global winds are created by the unequal heating of Earth's surface.*
- Unlike local winds, global winds occur over a large area.

- Direct rays from **the sun heat Earth's surface** intensely **near the equator** at midday.
- Near the poles, the sun's rays strike Earth's surface less directly. The sun's energy is spread out over a larger area, so it heats the surface less.
- As a result, temperatures near the poles are much lower than they are near the equator.

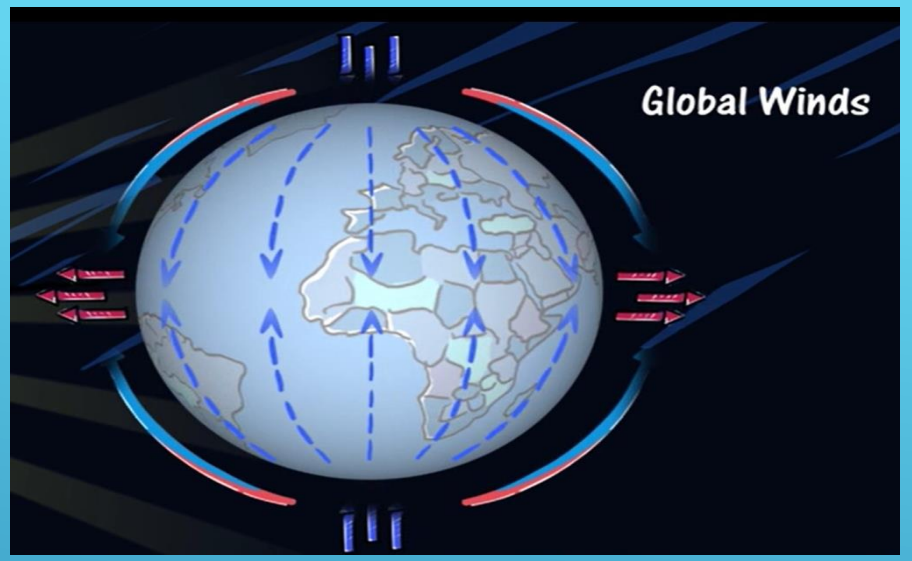


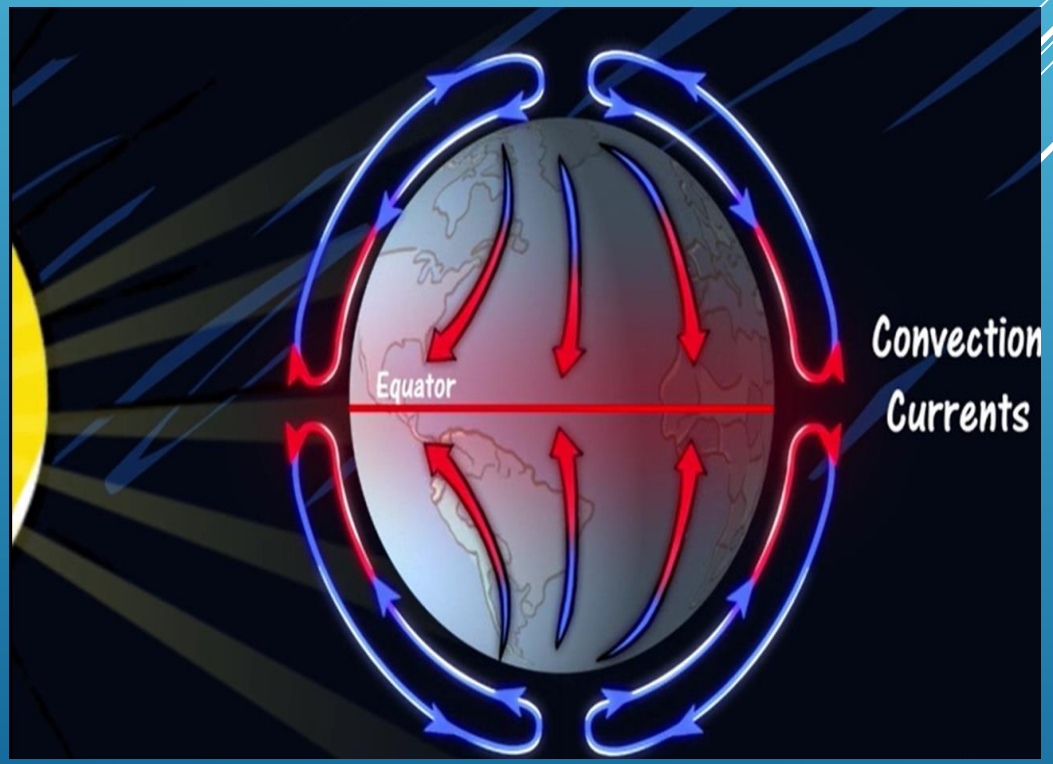
GLOBAL WINDS PG. 356

- Global winds form from temperature differences between the equator and the poles.

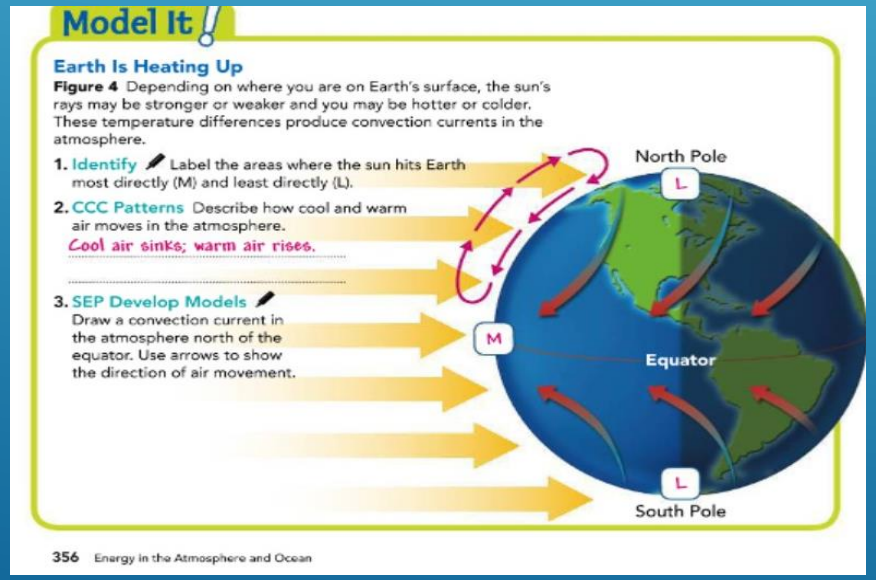
- These differences produce giant convection currents in the atmosphere.
- Warm air rises at the equator, and cold air sinks at the poles.
- Therefore, air pressure tends to be lower near the equator and greater near the poles.
- This difference in pressure causes winds at Earth's surface to blow from the poles toward the equator.
- Away from Earth's surface, the opposite is true. Higher in the atmosphere, air flows away from the equator toward the poles. Those air movements produce global winds.

Global Wind
https://www.youtube.com/watch?v=NQ3Tj-tdQIk





GLOBAL WINDS PG. 356



Model It!

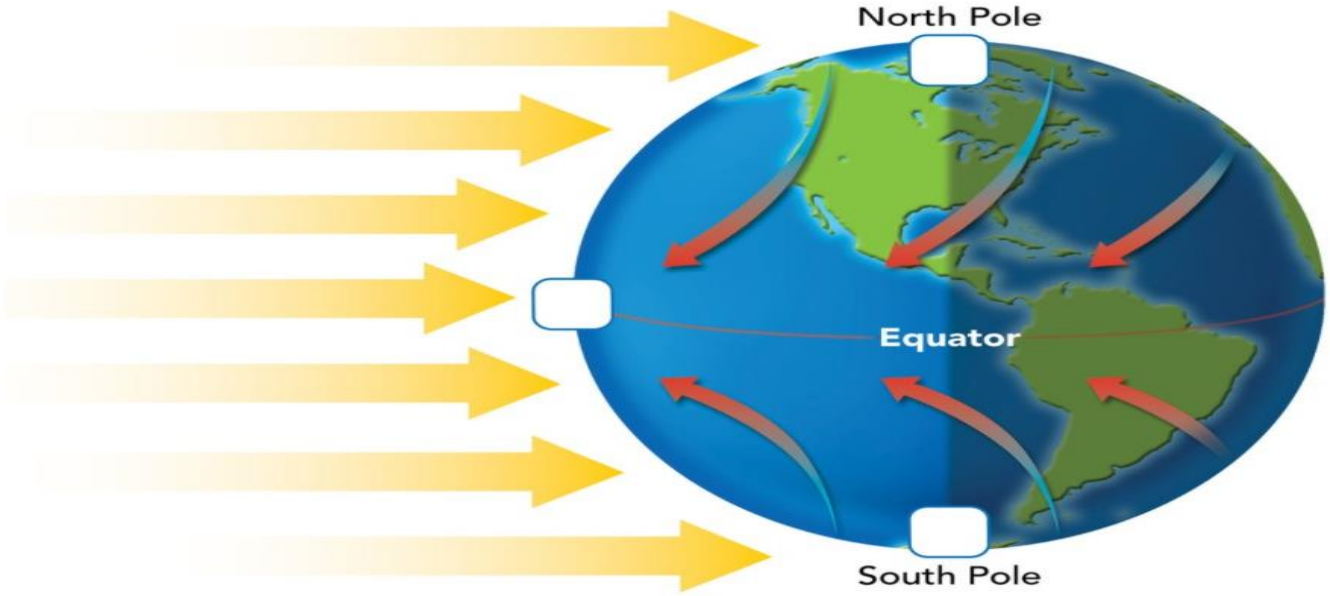
Earth Is Heating Up

Figure 4 Depending on where you are on Earth's surface, the sun's rays may be stronger or weaker and you may be hotter or colder. These temperature differences produce convection currents in the atmosphere.

1. **Identify** Label the areas where the sun hits Earth most directly (M) and least directly (L).
2. **CCC Patterns** Describe how cool and warm air moves in the atmosphere.
3. **SEP Develop Models** Draw a convection current in the atmosphere north of the equator. Use arrows to show the direction of air movement.

Download to complete the activity.

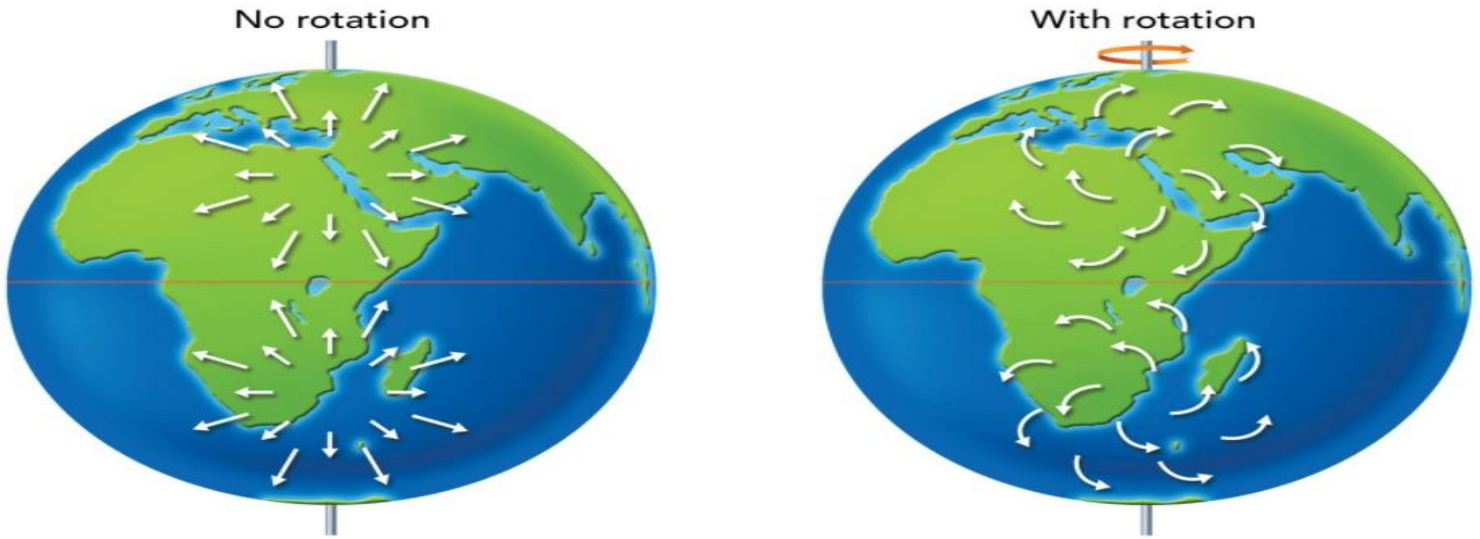
DOWNLOAD



THE CORIOLIS EFFECT PG. 357

Coriolis Effect
https://www.youtube.com/watch?v=PDEcAxfSYaI

Modeling the Coriolis Effect **Figure 5** The Coriolis effect is the result of Earth's rotation. Without it, global winds would travel in straight lines away from their sources. With it, global winds turn to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.



- If Earth did not rotate on its axis, global winds would blow in straight lines.
- Instead, global winds get **deflected or shifted by Earth's rotation**.
- As the winds blow, Earth rotates from west to east underneath them, making it seem as if the winds curve.
- The way Earth's rotation makes winds curve is called the **Coriolis effect** .
- **Because of the Coriolis effect**, global winds in the Northern Hemisphere gradually **turn toward the right**.
- A wind blowing toward the south gradually turns toward the southwest. In the Southern Hemisphere, winds curve toward the left.

GLOBAL WIND PATTERNS PG. 358-359

- The Coriolis effect, global convection currents, and other factors combine to produce a pattern of calm areas and global wind belts around Earth.
- The calm areas where air rises or sinks include the doldrums and the horse latitudes.
- The major global wind belts are the trade winds, the polar easterlies, and the prevailing westerlies.
- These wind belts are not stationary and can shift about from month to month.

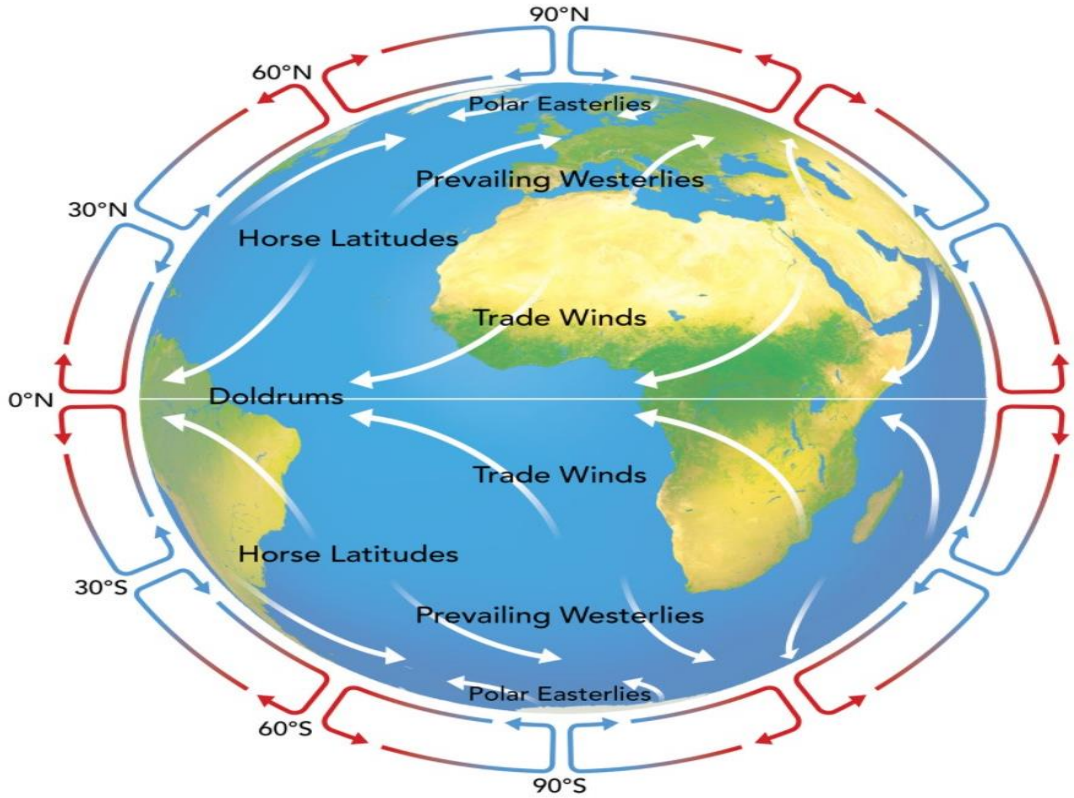
https://www.youtube.com/watch?v=HDsUMqYuUm8
Global Wind Patterns

Global Wind Belts **Figure 6** The combination of global convection currents and the Coriolis effect interact to make the wind pattern shown in the diagram.

SEP Use Models Look at the diagram and circle a place where warm air is rising. Draw a square around a place where cool air is sinking. Draw a triangle on a place that shows winds turning right in the Northern hemisphere. Place a check mark on a place where winds along Earth's surface are calm.

Download to complete the activity.

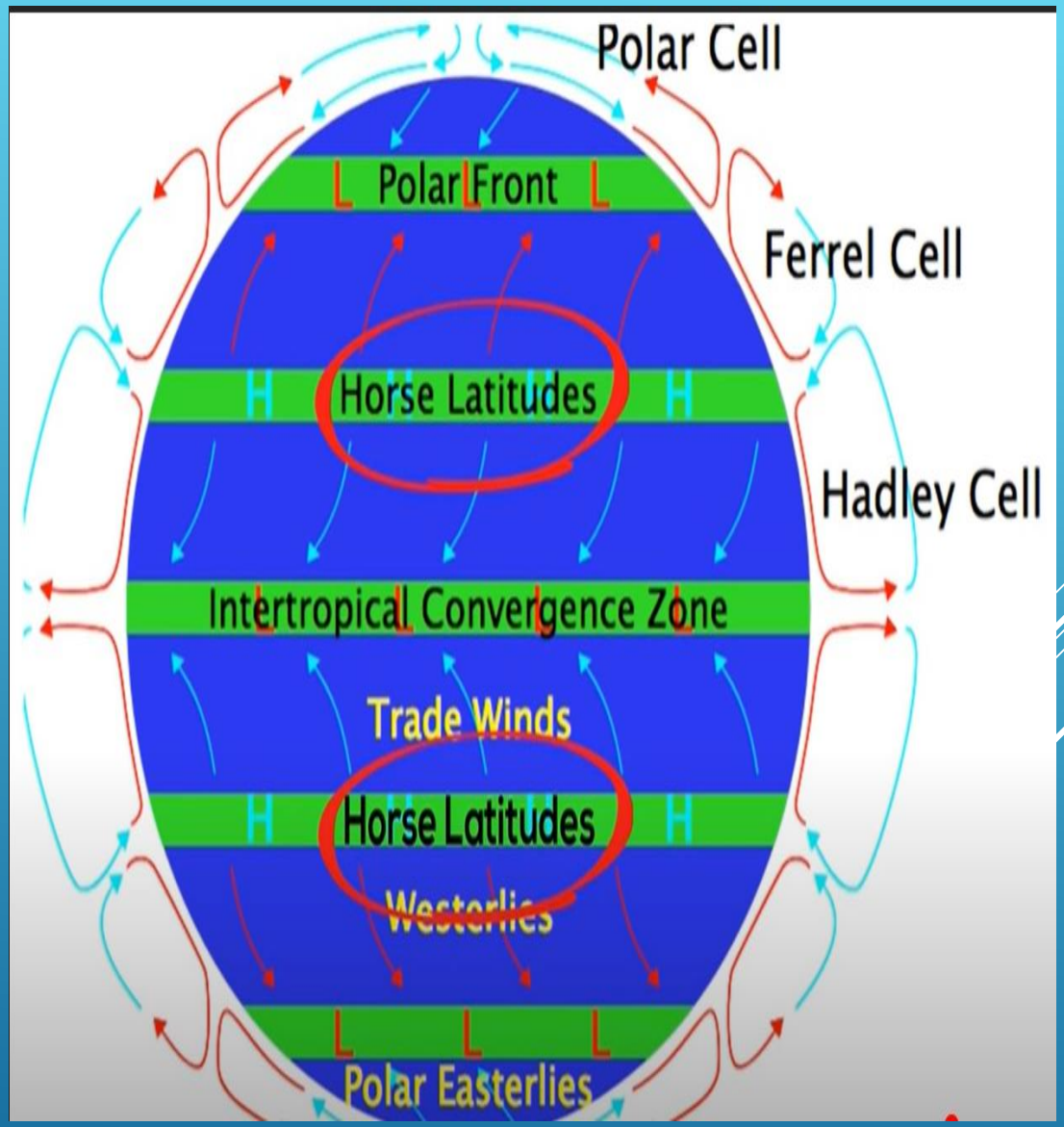
DOWNLOAD



GLOBAL WIND PATTERNS PG. 358-359

Effects of Global Wind Belts

- Global winds affect local weather by moving masses of air from one place to another.
- The air masses affect the temperature, rainfall, and air pressure.
- Overall, the global wind belts move energy away from the equator and toward the poles.
- This helps to equalize the temperature, allowing life to survive in a larger range of latitudes on Earth.



GLOBAL WIND PATTERNS PG. 358-359

Jet Streams

- About 10 kilometers above Earth's surface are bands of high-speed winds called **jet streams**.
- They generally blow from west to east at speeds of 200 to 400 kilometers per hour.
- As jet streams travel around Earth, they wander north and south along wavy paths that vary over time.
- The jet streams greatly affect local weather.
- The jet streams traveling over North America bring a variety of weather conditions.
- Weather forecasters track the jet streams to predict temperature and precipitation.

- If the polar jet stream wanders farther south than usual in winter, it could mean colder temperatures and snowy conditions for areas north of the jet stream.
- If the jet stream wanders farther north than usual, then warmer air moves up from the south and warmer temperatures are predicted for areas south of the jet stream.

Jet Streams

Figure 7 The changing positions of the jet streams over the United States influence local weather, particularly in winter. The map shows the position of the polar jet stream on a winter day.

1. SEP Use Models The weather in Boise, Idaho, is most likely (colder/warmer) than usual.
2. SEP Use Models The weather in Cheyenne, Wyoming, is most likely (colder/warmer) than usual.

LESSON 2 Check

Standards

01:08

1. SEP Communicate Information What is wind?

   NOTEBOOK

2. CCC Patterns What pattern occurs in the prevailing westerlies and polar easterlies of the Northern Hemisphere because of the Coriolis effect?

   NOTEBOOK

3. SEP Construct Explanations How is the sun's energy related to winds?

   NOTEBOOK

4. SEP Develop Models Describe how you could use a globe and your hand to model the path of a global convection current in the atmosphere.

   NOTEBOOK

5. CCC Cause and Effect How might the jet stream affect the weather in your town this winter? Explain your prediction.

   NOTEBOOK

LESSON 2 Check

MS-ESS2-6

1. **SEP Communicate Information** What is wind?
The movement of air between areas of different pressure.

2. **CCC Patterns** What pattern occurs in the prevailing westerlies and polar easterlies of the Northern Hemisphere because of the Coriolis effect?
In the Northern Hemisphere, these global winds turn to the right.

3. **SEP Construct Explanations** How is the sun's energy related to winds?
The sun heats Earth's surface unevenly. This causes differences in temperature, which cause differences in air pressure. Winds then form.

4. **SEP Develop Models** Describe how you could use a globe and your hand to model the path of a global convection current in the atmosphere.
Sample: I would let my hand represent winds and raise my hand up from the globe's equator. I would move my hand high in the atmosphere toward the North Pole, let it sink to Earth's surface, and move it south along the surface toward the equator again.

5. **CCC Cause and Effect** How might the jet stream affect the weather in your town this winter? Explain your prediction.
Sample: If the jet stream wanders south of my town, cold air would move down from the north. Then we would get colder temperatures.

Quest CHECK-IN

In this lesson, you learned what causes winds. You also learned about the effects of local and global winds.

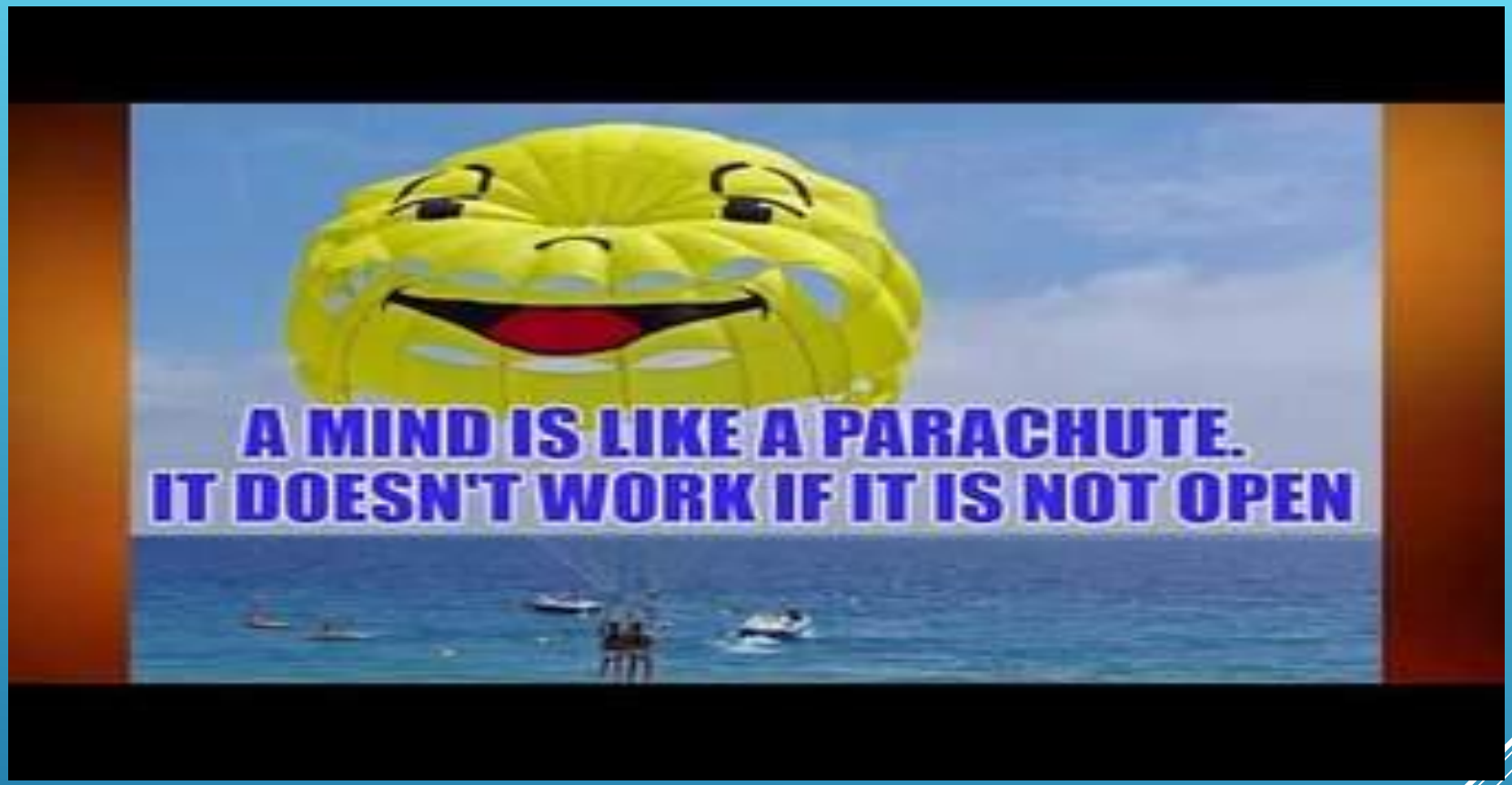
CCC Cause and Effect Think about how global winds move. How might they affect a large object such as a ship?

Sample: Winds would push and possibly move a ship as it travels over great distances along with the wind.

INTERACTIVITY

Wind at Your Back

Go online to explain why a container ship's captain might want to travel in the direction the wind is blowing rather than against the wind.



THANK YOU…