Wind & Climate

- ***The student will be expected to demonstrate an understanding of the cause of winds and how winds affect climate.***

Wind & Climate

- In this lesson you will:
  - 2.3.1 Define the term prevailing winds. (k)
  - 2.3.3 State the impact of the Coriolis effect on wind direction. (k)
  - 2.3.2 Describe conditions that result in land breezes and sea breezes. (k)
  - 2.3.4 Infer how wind systems relate to major pressure belts. (a)

Defining Winds

- **Winds Blow From High Pressure to Low Pressure**
  - Winds blow **from areas of high atmospheric pressure to areas of low atmospheric pressure**.
  - Atmospheric pressures have local variations but there are **world pressure belts** that we will explore.

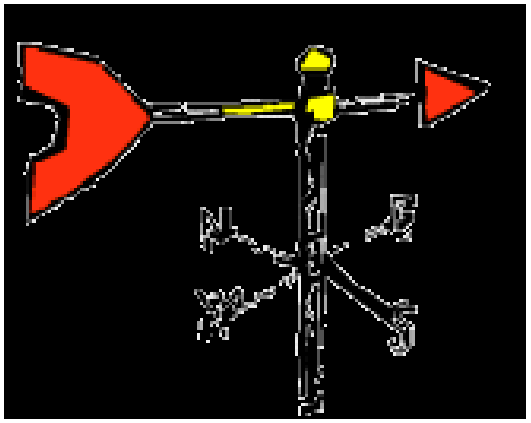
Defining Winds…Practical Examples

- Ex. 1…Air inside a balloon:
  - If left untied the air will escape the high pressure of the balloon and create a wind blowing from high pressure inside the balloon to relatively low pressure outside the balloon.
- Ex. 2…Exhaling:
  - When you exhale the air leaves your lungs because you create a high pressure inside your chest cavity when you inhale.
  - Wind is created from high pressure inside your chest to a lower pressure outside your chest.

Prevailing Winds

- **Definition:** Regular, predictable, normal wind direction.

- They are caused by global ***convection cells*** in the earth's atmosphere.
  - See figure 4.10 on page 63
  - Bill Nye: Wind

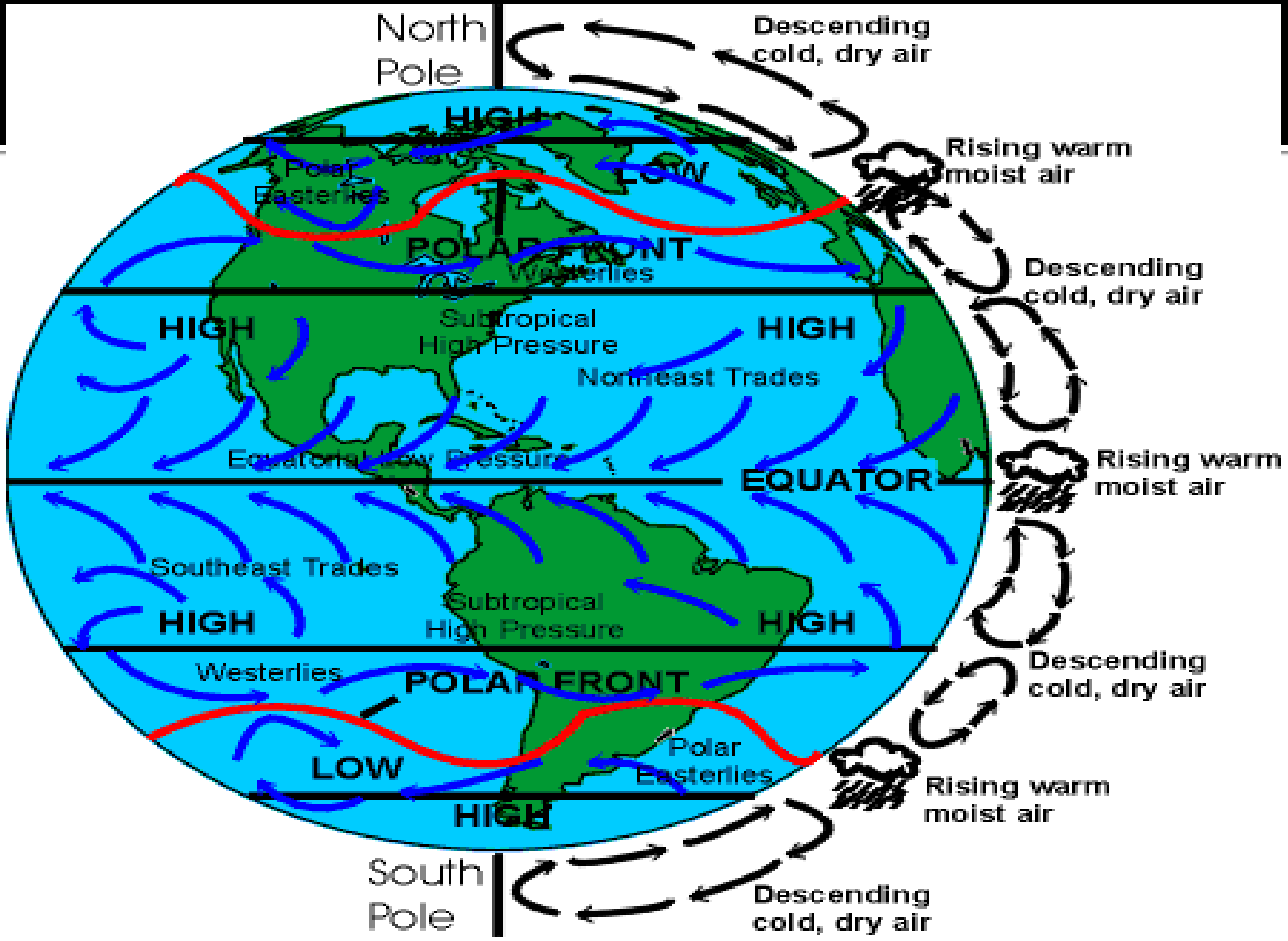


Prevailing Winds…Convection Cells

- The global convection cells are created because of the uneven heating of the earth's surface we saw in the last lesson.
- As the equatorial regions heats the air it rises creating a low pressure at the equator.
- The air falls to earth at 30° North and south creating high pressures.
- The other lows and highs can be predicted every 30° of latitude.

Prevailing Winds…Convection Cells

- Alternating high and low pressures result from the convection cells.
  - **LOW pressure belts** are created at the equator and at 60° N and 60° S
  - **HIGH pressure belts** are created at 30° N and 30°S and at the poles.
- Prevailing winds form global patterns because of these global pressure belts.
- Winds blow from the high pressure belts to the low pressure belts.

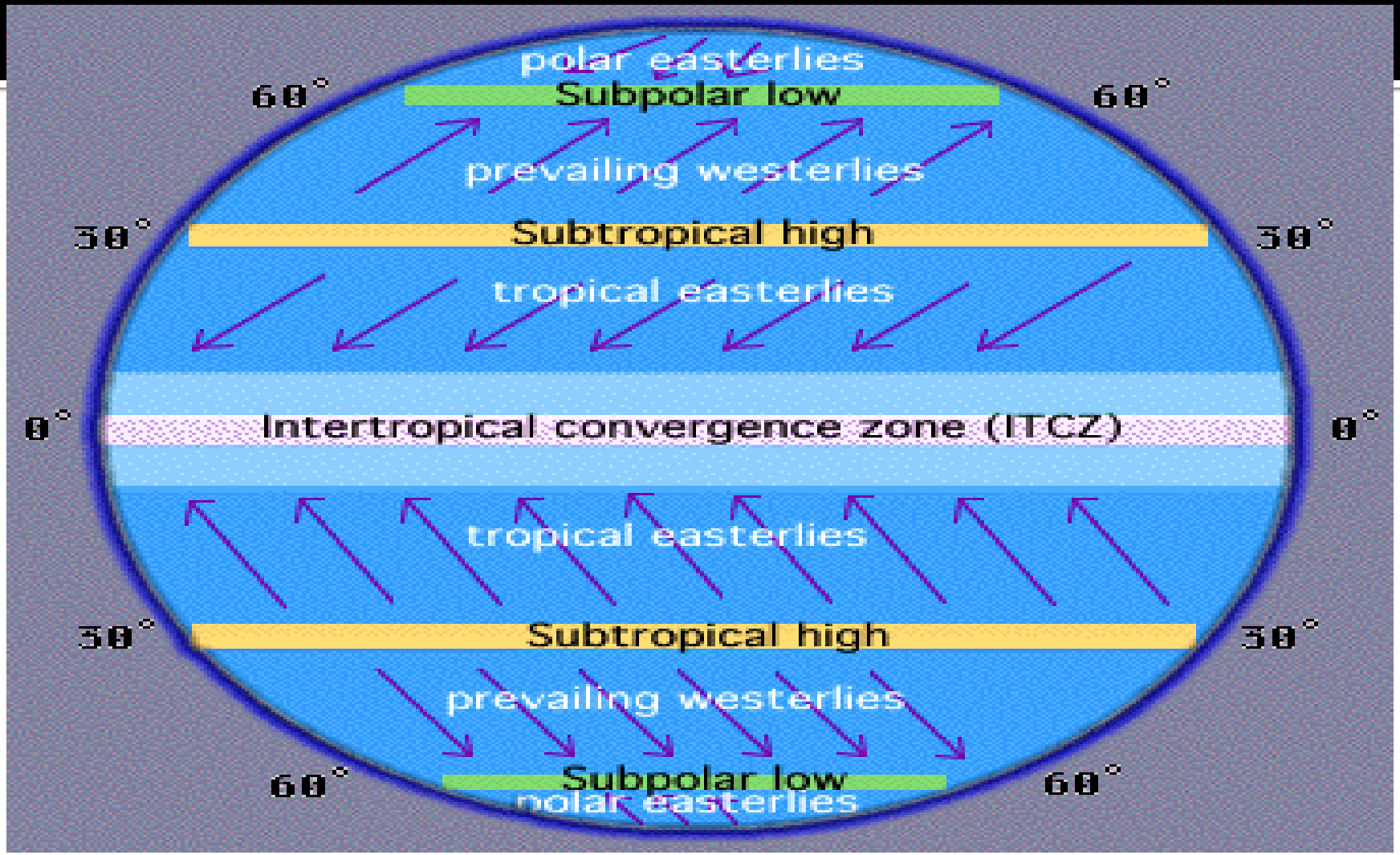

North Pole
Descending cold, dry air
HIGH
Polar Easterlies
LOW
Rising warm moist air
POLAR FRONT
Descending cold, dry air
HIGH
Subtropical High Pressure
HIGH
Northeast Trades
Equatorial Low Pressure
EQUATOR
Rising warm moist air
Southeast Trades
HIGH
Subtropical High Pressure
HIGH
Descending cold, dry air
Westerlies
POLAR FRONT
Polar Easterlies
LOW
Rising warm moist air
HIGH
South Pole
Descending cold, dry air

The Coriolis Effect

- The **Coriolis Effect** is a law of physics that states:

"Objects in motion in the northern hemisphere are deflected to the right while in the southern hemisphere they are deflected to the left."

- Therefore winds in the north are deflected right and the winds in the south are deflected left.
- YouTube - Coriolis Effect (2-11)
- NOVA- Coriolis Effect


polar easterlies
60°
Subpolar low
60°
prevailing westerlies
30°
Subtropical high
30°
tropical easterlies
0°
Intertropical convergence zone (ITCZ)
0°
tropical easterlies
30°
Subtropical high
30°
prevailing westerlies
60°
Subpolar low
60°
polar easterlies

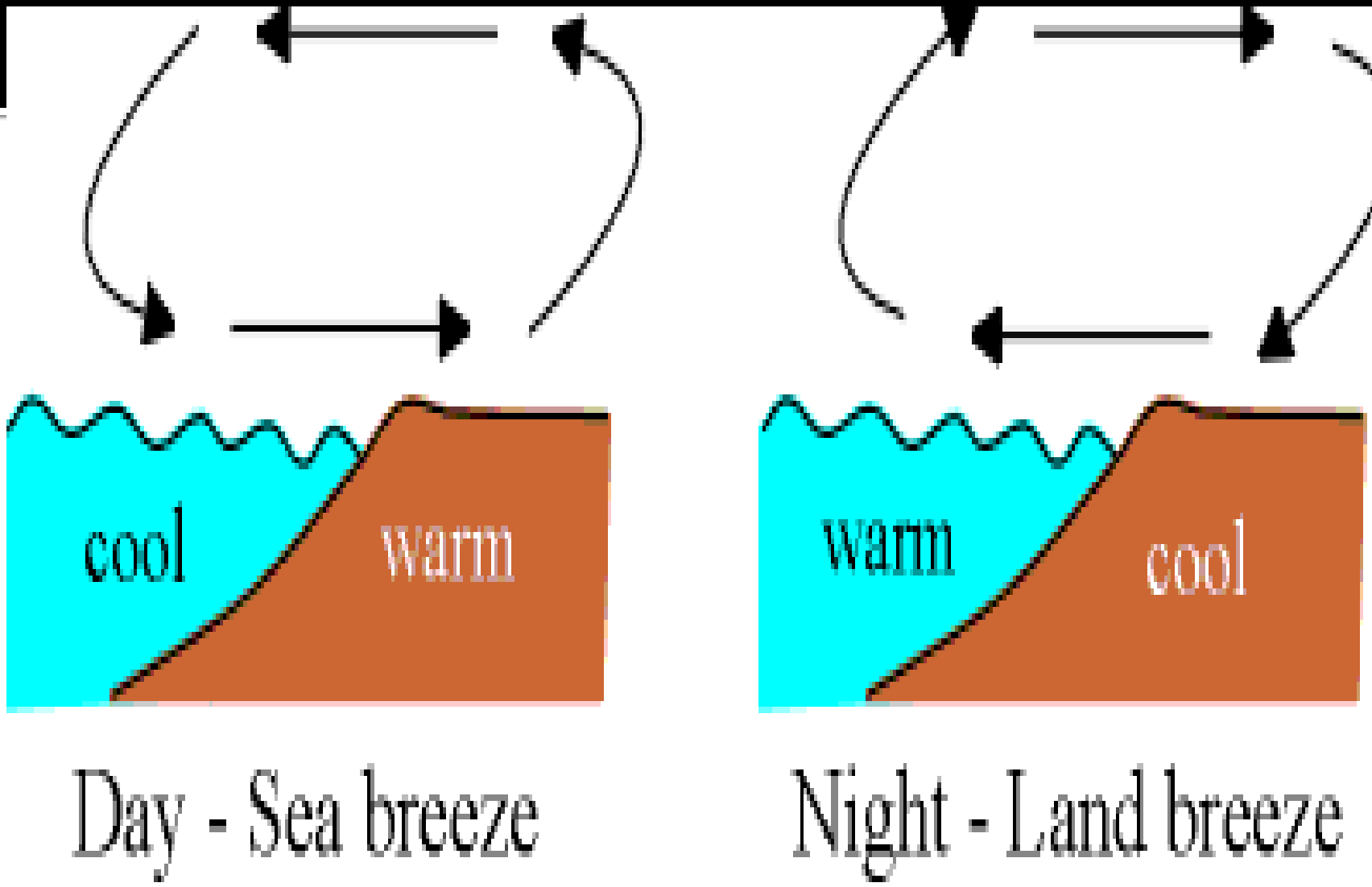
Names of Prevailing Winds

- 0-30° N = Northeast trade winds
- 0-30° S = Southeast trade winds
- 30-60° N and 30-60° S = Westerly winds
- 60-90° N = North Polar easterlies
- 60-90° S = South Polar easterlies

Sea Breezes

In the day time the land heats much faster than the water, so the air over the land heats and rises. (**convection currents**)

- The rising air over the land creates a relatively low pressure while the air pressure over the water/sea is relatively high;
- **Wind blows from the high pressure over the sea to the low pressure over the land**.
- Hence the name '**sea breeze**'—the wind is **blowing off the sea**.
- Remember—winds are named for where they come from; Easterly winds come out of the east; southerly winds come out of the south; sea breezes come from the sea.



Day - Sea breeze

Night - Land breeze

Types of Rain

- In this lesson you will:
  - 2.3.6 Define the terms windward, leeward, and rain shadow. (k)
  - 2.3.7 Examine how the type of rainfall (i.e., orographic, frontal, and convectional) is related to the nature of location. (a)
  - 2.3.8 Explain how wind systems and precipitation are related. (k)

What is precipitation?

- **WHAT: Precipitation** is any form of moisture which falls to the earth. This includes rain, snow, hail and sleet.

- **HOW:** Precipitation occurs **when water vapour cools**. When the air reaches **saturation point** (also known as condensation point and **dew point**) the water vapour condenses and forms tiny droplets of water. These tiny droplets of water form **clouds**.

Types of Rain

- Relief Rainfall
- Frontal Rainfall
- Convectional Rainfall

Relief Rainfall

1. Moisture laden air blows off the sea
2. it is forced up by mountains (high **relief**)
3. air cools at higher altitudes
4. cool air holds less moisture
5. clouds condense and rain falls

- most rain falls on the **windward side** of the relief;
- **leeward side** is often in a dry **rain shadow** because the moisture has all been lost.

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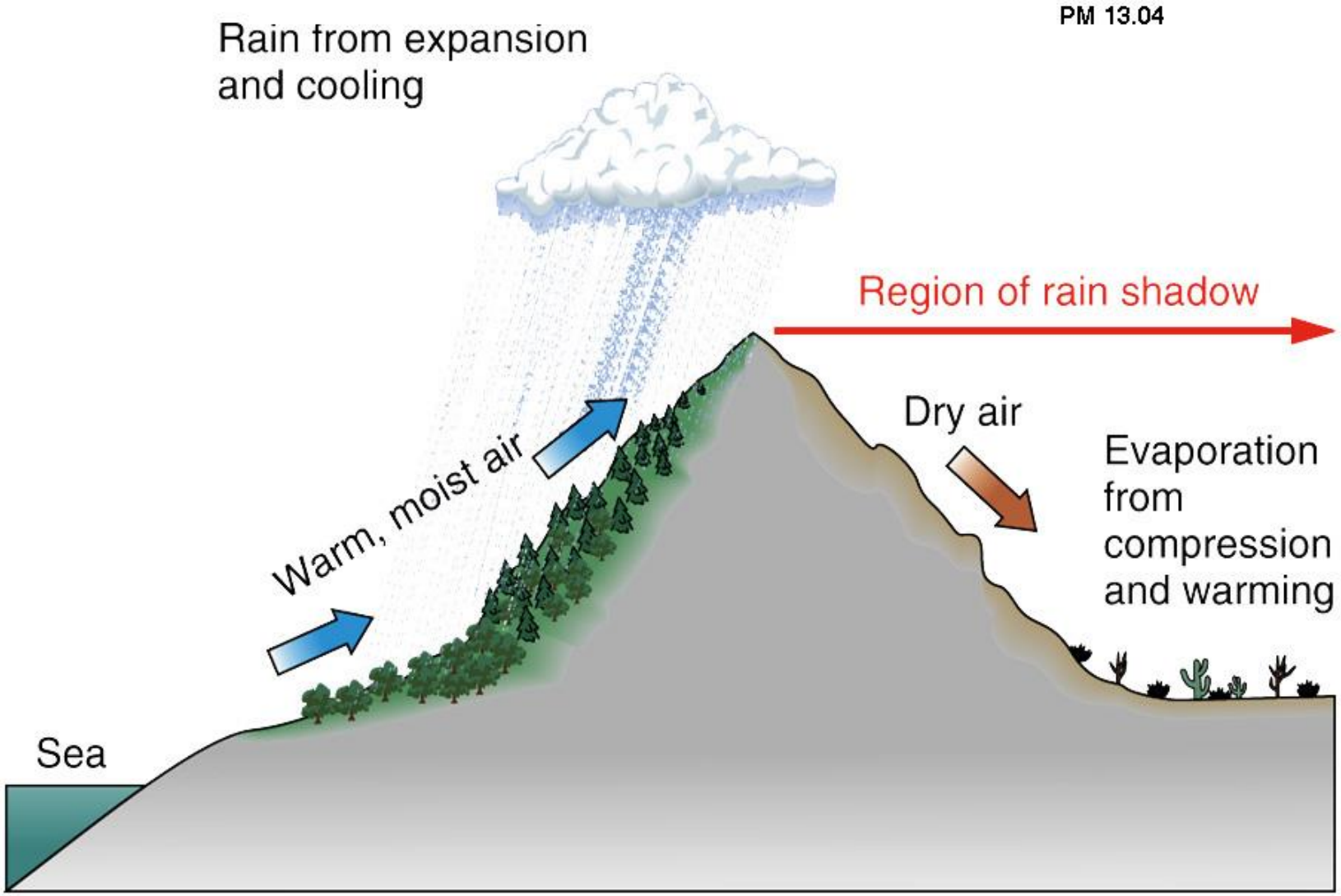
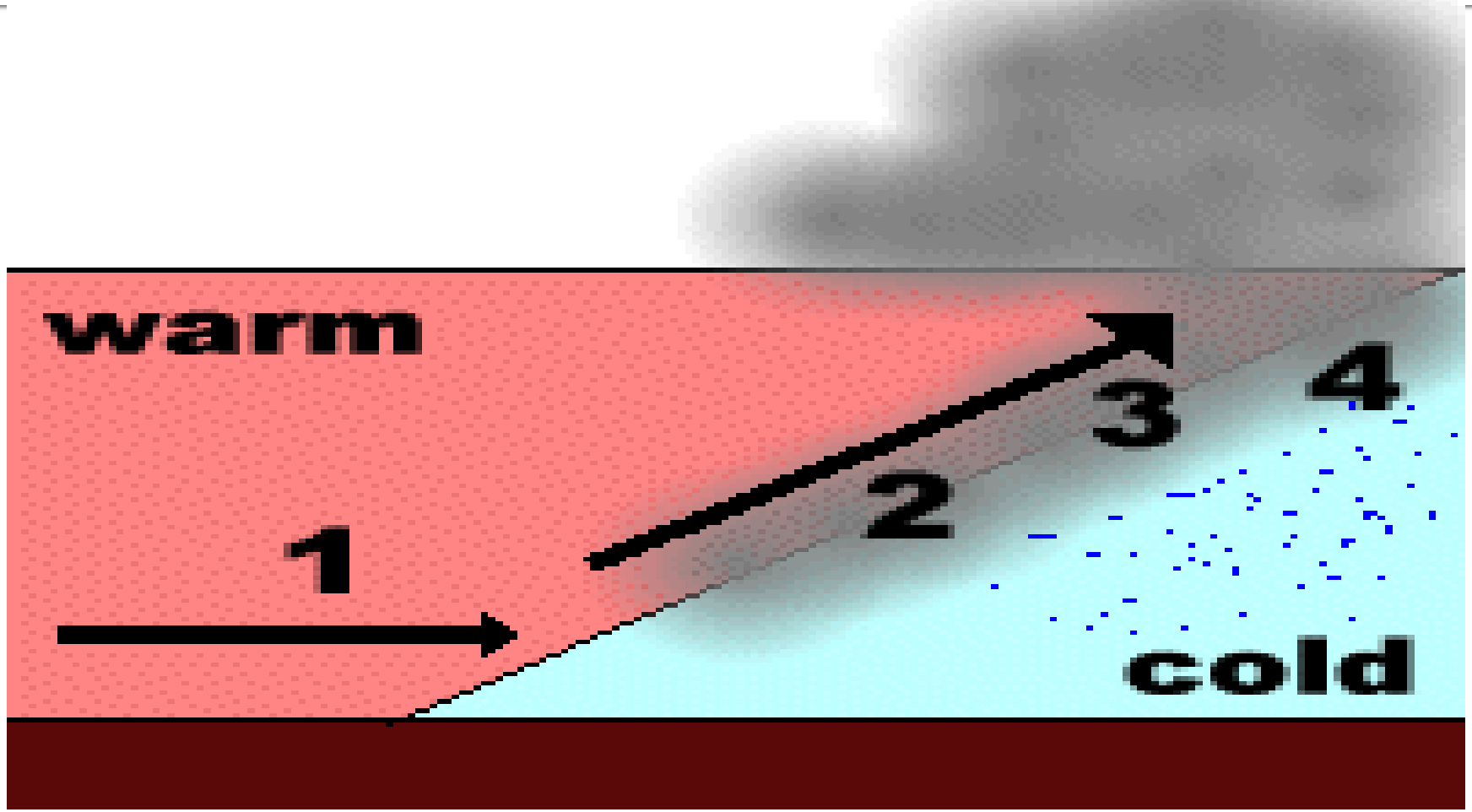

Rain from expansion and cooling
Region of rain shadow
Dry air
Evaporation from compression and warming
Warm, moist air
Sea

Frontal Rainfall

1. Warm moisture-laden air meets cold air
2. warm air is less dense & is forced up over the cooler, more dense air
3. warm moisture-laden air cools at higher altitude
4. cool air holds less moisture
5. clouds condense and rain falls.

frontal rainfall

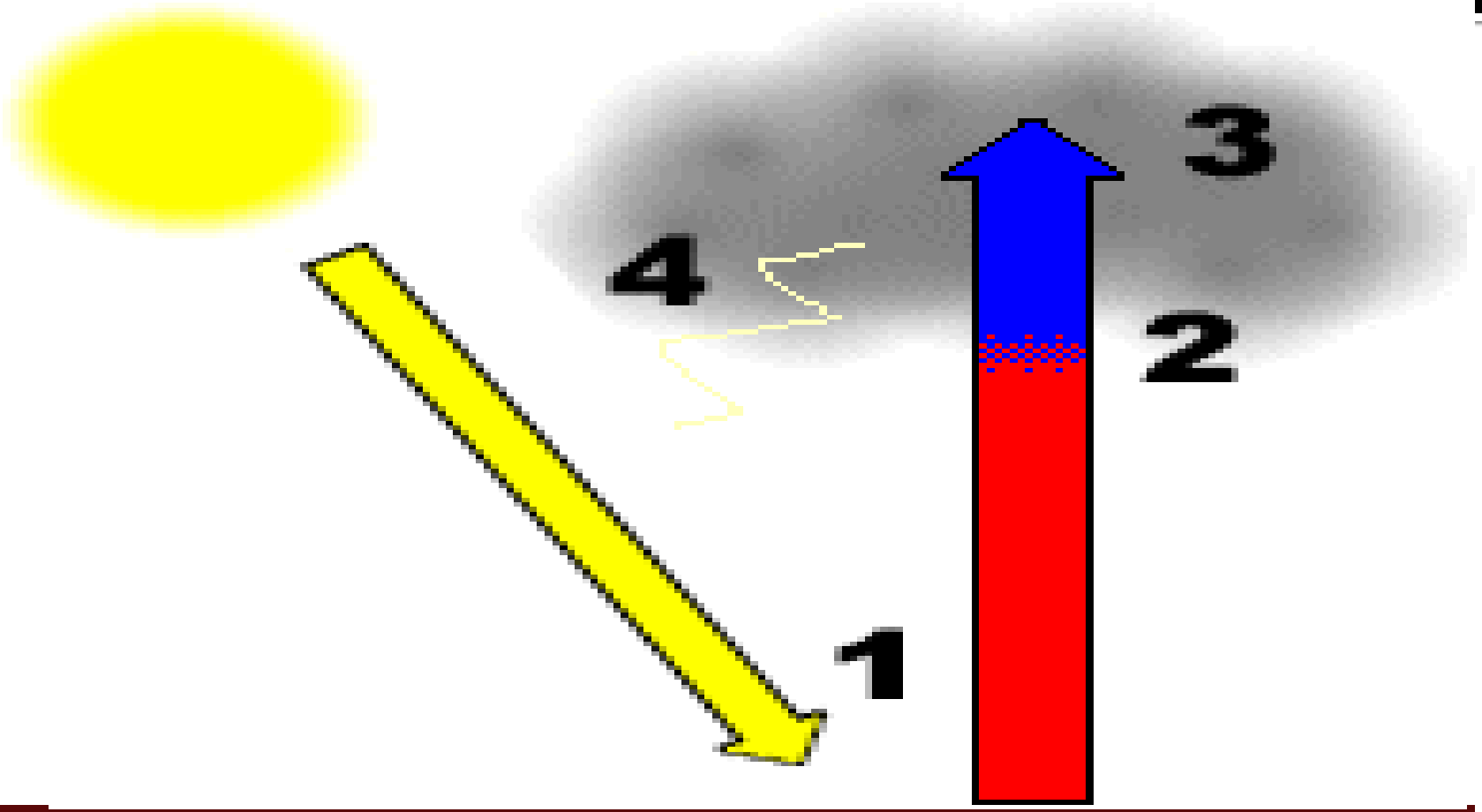


Convectional Rainfall

- Usually occurs in hot areas like tropics or continental summer

1. sun heats the earth, causing large amounts of water to evaporate
2. hot air rises forming **convection currents** (hence the name)
3. warm moisture-laden air cools at higher altitude;
4. cool air holds less moisture
5. consequently clouds condense and rain falls.

Convectional Rainfall



Wind & Climate

- In this lesson you will:
  - 2.3.5 Explain how wind systems and temperature are related. (k)

Wind & Precipitation

- Looking at the prevailing wind maps on pages 64 & 65 in your text, you can see that some prevailing winds blow off the ocean and onto the land.
- This is a recipe for high precipitation, especially if the wind is blowing off a warm ocean like the Indian ocean or the south Pacific.

Wind & Precipitation

- On the other hand if the wind in a location is coming off the land then there is very little moisture in it…lower precipitation.
- Knowing the direction of winds over mountains is also important in predicting precipitation.
  - The windward side of a mountain is going to receive the greatest rainfall while the leeward side will find itself in a rain shadow.

Wind & Temperature

- Looking at the prevailing wind maps on pages 64 & 65 you can see that **some prevailing winds bring warm air from the south toward the north**, for example the **westerly winds**.
- On the other hand **some winds, like the north polar easterlies, bring cold air from the north toward the south**.

Wind & Temperature

- The affect on temperature varies with seasons as well.
- Wind off the land in summer is a recipe for heat. Land heats up faster than water and therefore the wind blowing over it will pick up the heat.
- However, in the winter wind off the land is a recipe for cold. Land also cools down faster than water, winds blowing over the frozen cold interior will lose its heat.