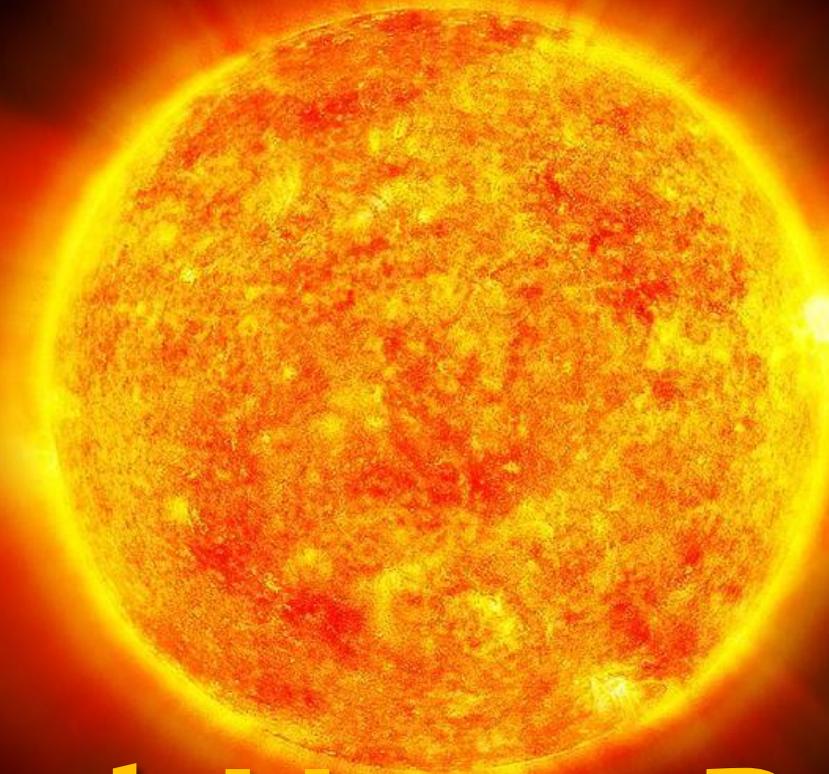


CfE Higher Geography
Physical Environments



Global Heat Budget

What is the Global Heat Budget?

- *The earth receives radiation from the sun. However, of all the radiation that arrives at the edge of the atmosphere, only a small proportion actually reaches the earth's surface.
- *Can you think of any reasons for this? What might happen to the radiation on its journey through the atmosphere to the earth?
- *Also, of the radiation that reaches the earth, not all regions receive the same amount of radiation.
- *Which regions do you think will receive more radiation? Why?



The global heat budget

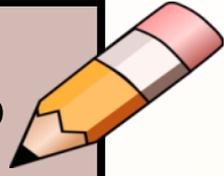
- *The atmospheric system involves inputs and outputs.
- *In broad terms, incoming **solar** energy is balanced by outgoing **terrestrial** (Earth based) energy.
- *The balance between input and output is usually referred to as the heat budget.

Lets see how it
all works!



The atmospheric system

Copy the diagram into your notes



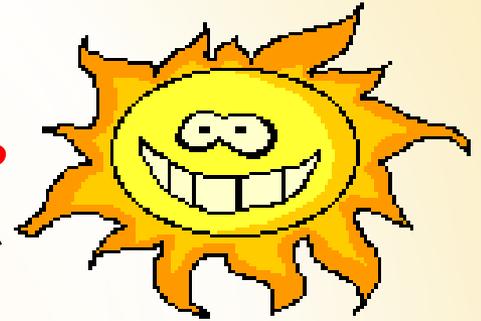
26% reflected by clouds, gases and dust

18% absorbed by atmosphere

50% absorbed by the surface

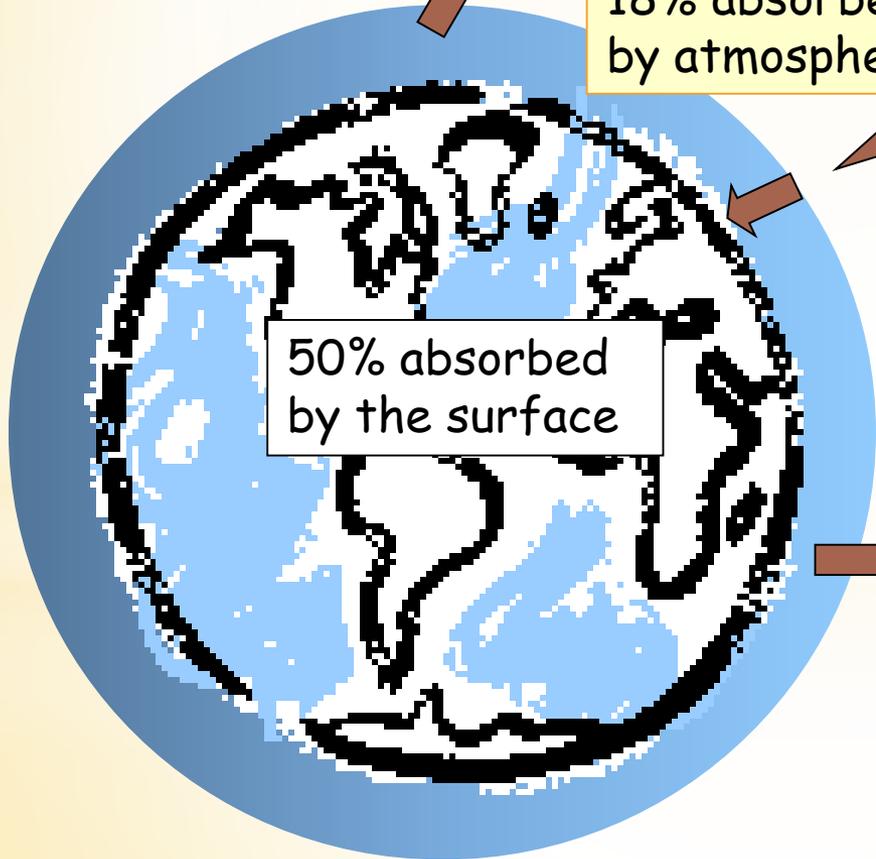
Solar Energy (short wave)

100%

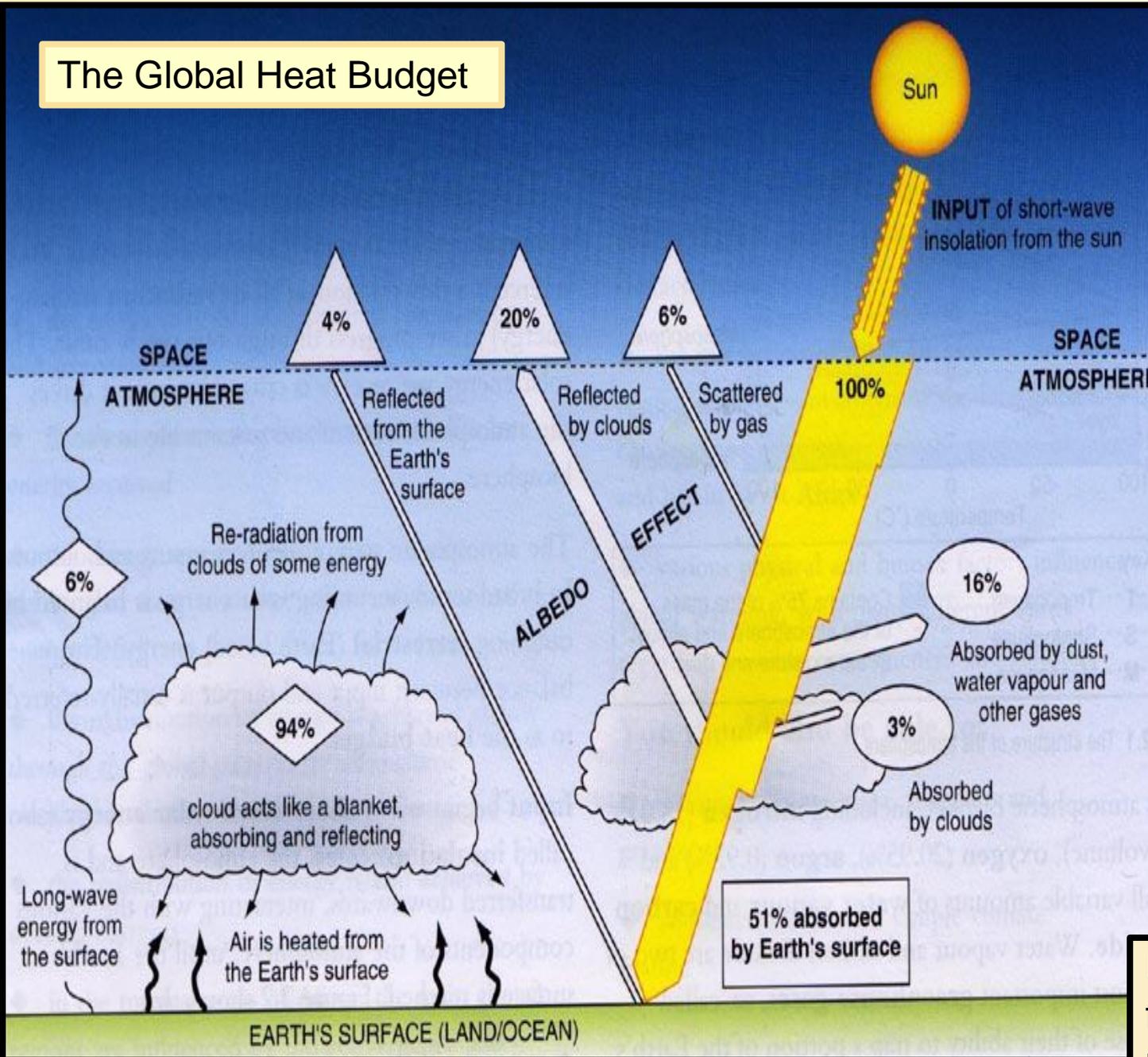


Inputs

6% reflected by surface



The Global Heat Budget



Using the diagram you have drawn, explain in your own words why the earth receives only about 50% of the solar energy emitted from the sun? (4)

Note: Diagrams will show different statistics.

Use the writing frame on the next slide to help

*Writing Frame!

To help you, use the following structure.

Say where the earth's energy comes from and name it.

Briefly explain what the earth's heat budget is.

Describe what happens to the insolation giving values;

- Atmospheric absorption (clouds, water vapour, gases)
- Atmospheric reflection (clouds, gases, dust)
- Surface absorption (land)
- Surface reflection (albedo)

Check your answer

The earth's energy comes from solar radiation. This incoming heat energy is balanced by the amount of heat escaping back into space. This balance is called the earth's heat budget. (1)

Incoming solar heat (insolation) from the sun is absorbed and reflected meaning not all the heat reaches the earth's surface. 26% of the energy is reflected back into space by the earth's atmosphere (1) and 18% of the heat is absorbed by the atmosphere due to dust particles retaining the heat.

This leaves 56% which travels to the earth's surface. (1) Not all of this is absorbed, 6% is reflected from the earth's surface by polar ice caps & water, and this makes up part of the earth's Albedo. (1) This means only 50% reaches the earth's surface and is balanced out by the long wave radiation escaping back into the atmosphere.



What is the role of location (latitude)?

- * **Insolation** means the sun's (solar) radiation which is received by the Earth's surface.
- * In reality, of all the solar energy that reaches the earth's surface, there is a net gain at the **Tropics** and a net loss of energy at the **Poles**.
- * In other words, the **Tropics** receive more of the sun's radiation than the Poles.
- * Therefore, there are distinct variations in global insolation.

What is the role of location (latitude)?



Glue a copy of this graph into your notes.

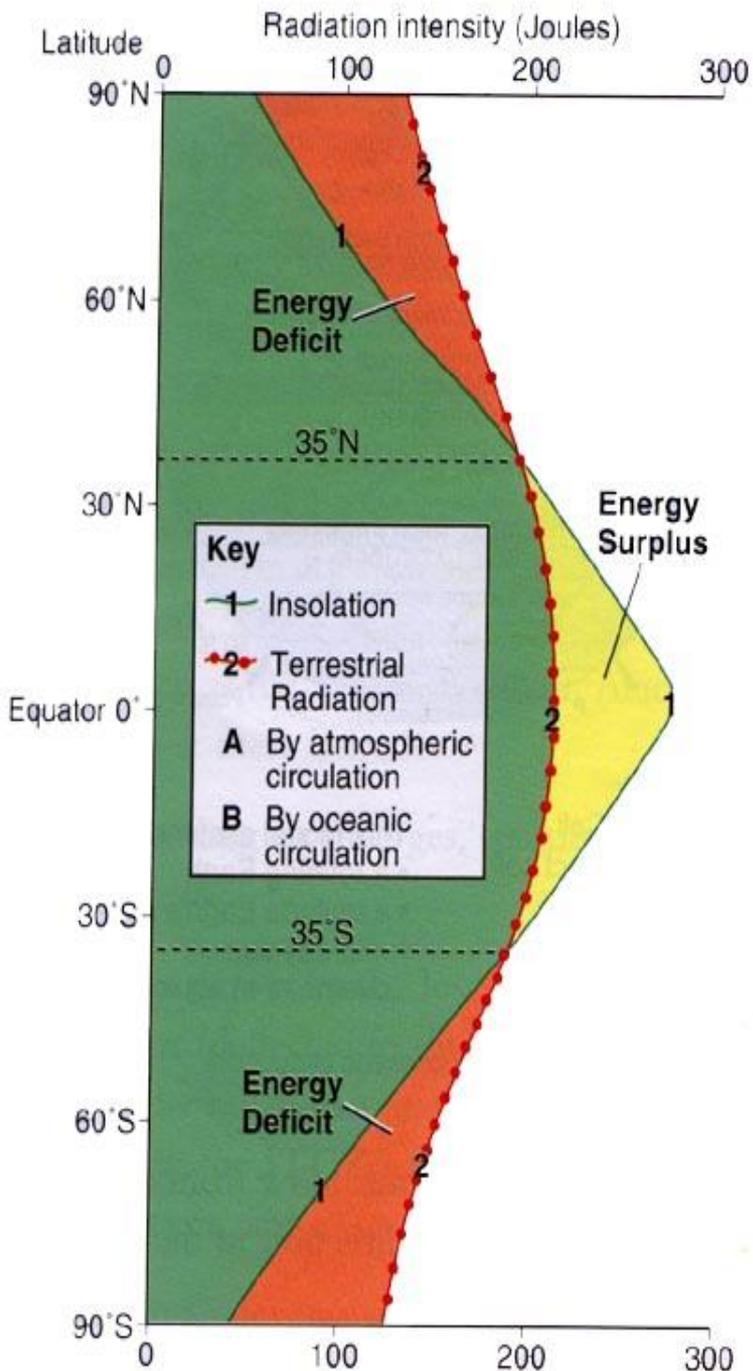
1) What does the graph suggest is the main difference in level of insolation between the poles (90 degrees North and South) and the Equator / tropics (0 to 35 degrees north and south)?

2) Write definitions for
a) Energy Surplus
b) Energy Deficit

3) Annotate your graph to show the following:

“There is a net gain (surplus) of energy in Tropical areas because incoming radiation exceeds outgoing radiation”

“In polar areas there is a net loss (deficit) of energy because outgoing radiation is greater than incoming radiation”

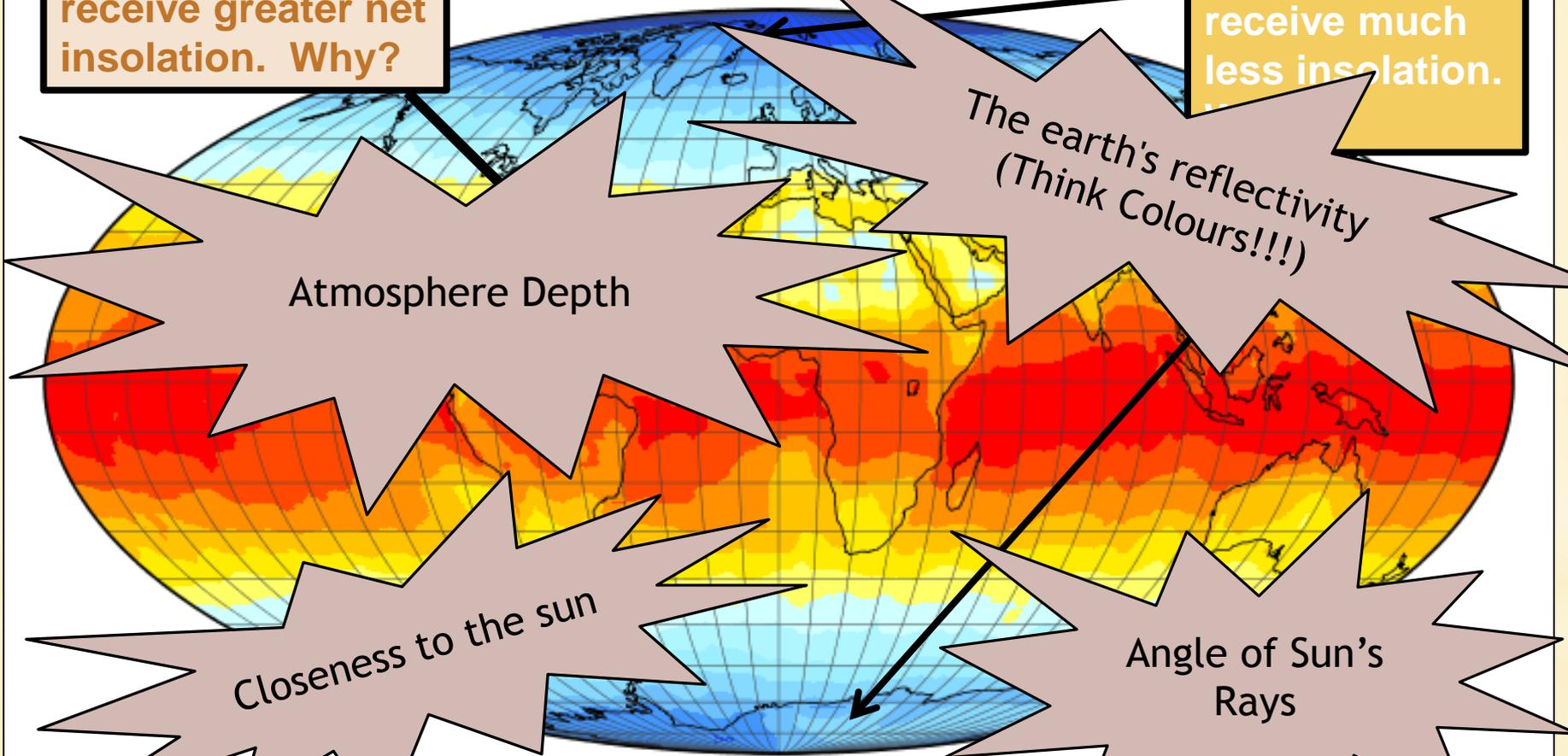


Explaining Why there is an imbalance

Tropical regions receive greater net insolation. Why?

Polar regions receive much less insolation.

Net Radiation: Insolation - LW Emission
March Avg. 1981 - 1989

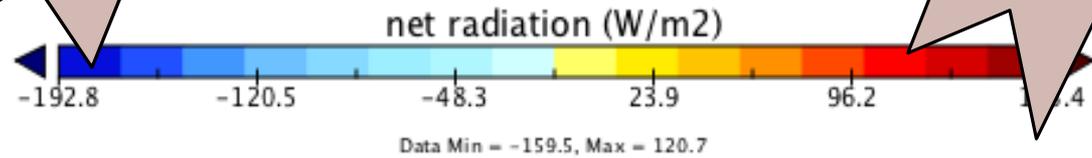


The earth's reflectivity
(Think Colours!!!)

Atmosphere Depth

Closeness to the sun

Angle of Sun's Rays



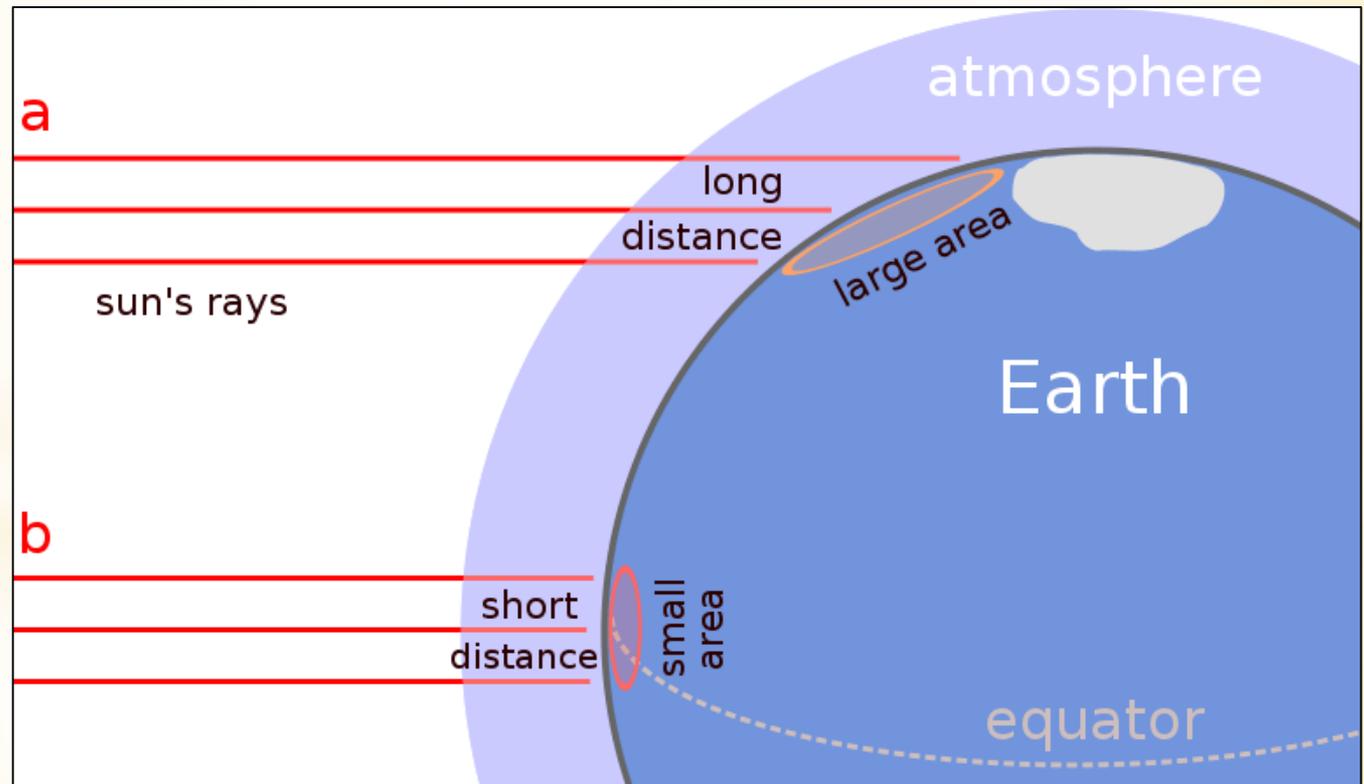
Explaining Why there is an imbalance

Reason 1: Closeness to the sun

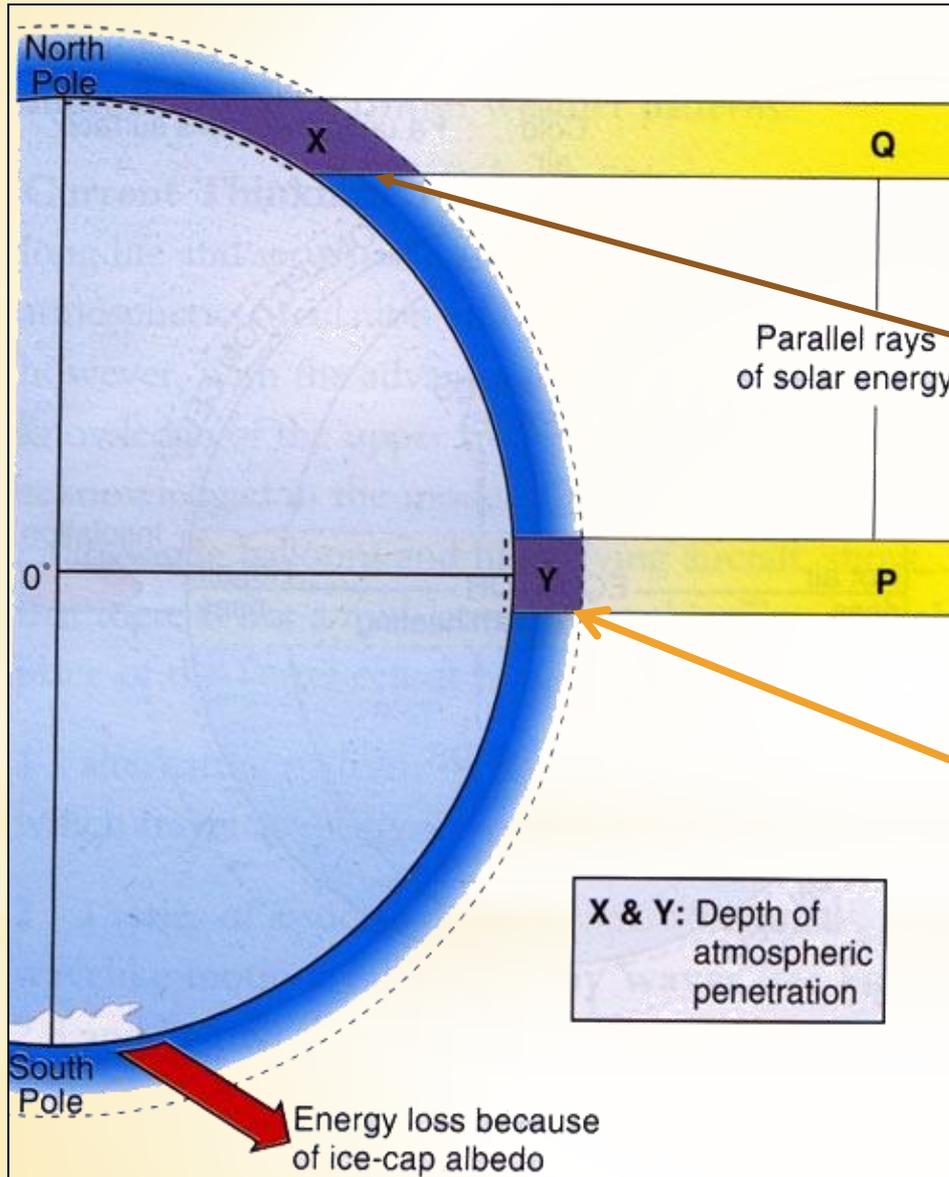
Tropical latitudes are closer to the sun than polar latitudes due to the curve of the earth. The sun's rays have a larger distance to travel before they reach polar latitudes.

Sun's rays have a larger distance to travel to reach the poles

Sun's rays have a shorter distance to travel to reach the equator and tropics



Reason 2: Depth of Atmosphere

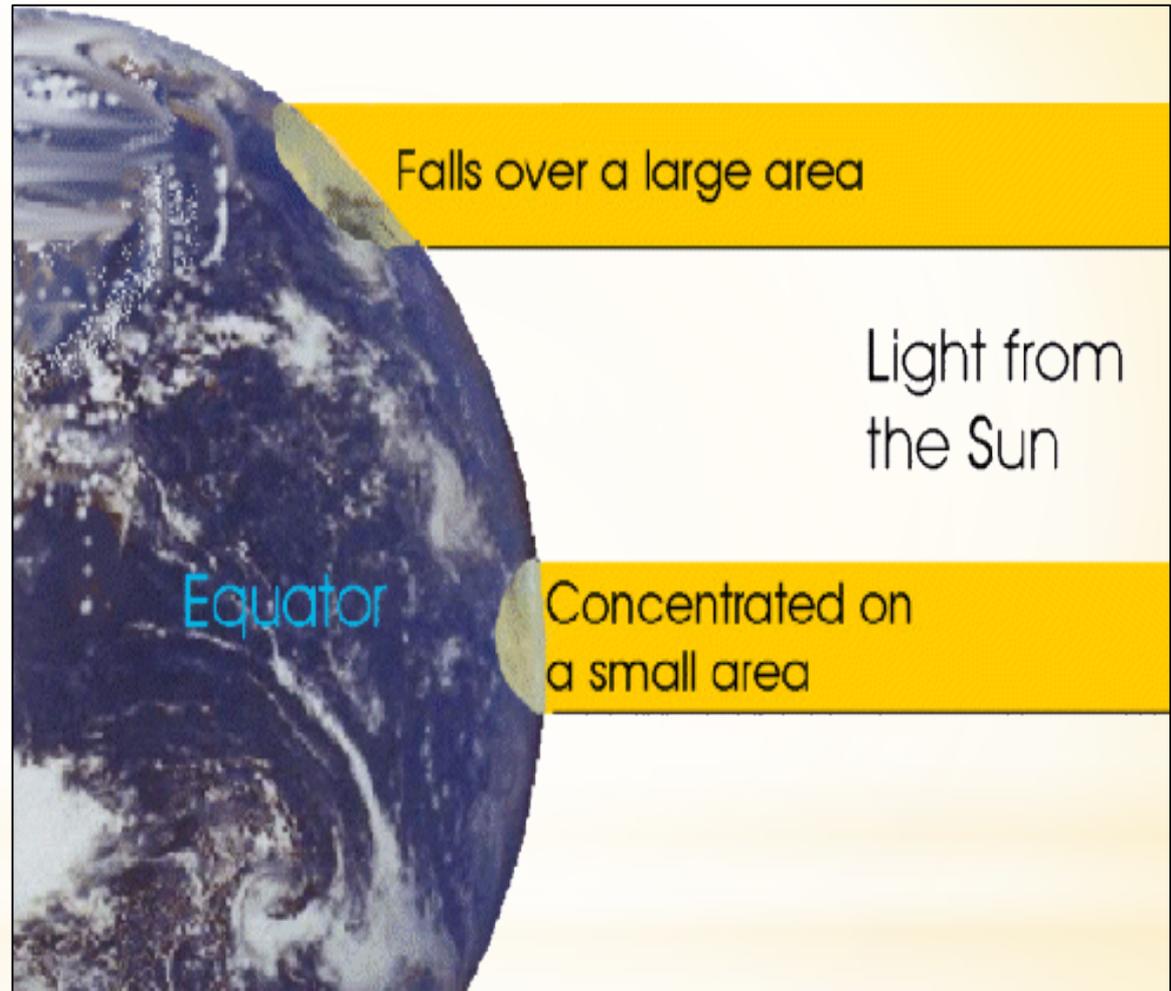


Solar energy has much more atmosphere to pass through at the Poles. This means greater chance of reflection and absorption by gases and dust

At the Tropics the sun's rays do not have as much atmosphere to pass through when compared to the Poles. This means that there is a lower chance of the insolation being absorbed by clouds, gases and dust.

Reason 3: Angle of Rays

Due to the curve of the earth, the sun's rays strike the Poles at an angle. This means that the energy received is dispersed over a wider area than the Tropics, where the sun hits directly, giving much more concentrated, intense insolation



Reason 4: Albedo Effect



This is the earth's reflectivity. Light colours give a higher albedo than darker colours, which absorb sunlight. Polar latitudes are covered in snow and ice and therefore have a higher albedo as more radiation is reflected. The Tropics have a dark vegetation cover (rainforest) so will absorb more energy, resulting in a low albedo.

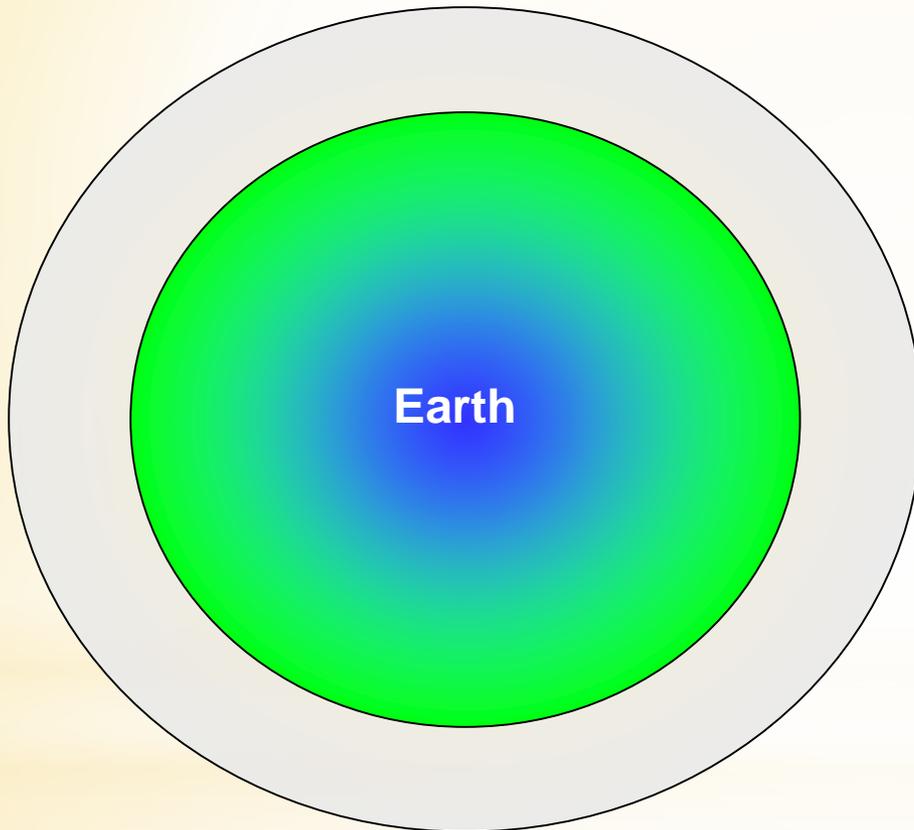
The white snow and ice at the Poles is highly reflective of the sun's radiation

The darker vegetation of the tropics absorbs more of the sun's radiation, causing a lower albedo



Your Turn

Draw a copy of the diagram below



Annotate it to show the **4 reasons** why tropical latitudes receive more solar insolation than Polar regions. You will need to add:

- 1) Labels to show the latitudes (North and South Pole, Equator)
- 2) Lines to show the sun's rays
- 3) Detailed notes for the 4 reasons:
 - Closeness to sun
 - Depth of atmosphere
 - Angle of rays
 - Albedo Effect(explain them on the diagram)

