



Earth Science Lesson 4
Dynamic Earth Processes (Grades 8-12)

Instruction 4-1
Internal and External Energy; Energy Budget

The Earth needs energy to make its systems run.

These systems are the Lithosphere, the Biosphere, the Atmosphere and the Hydrosphere. They interact with each other and work together as one.

The *Lithosphere* is Earth's rocky crust -- its land and its mountains.

The *Biosphere* is Earth's living organisms -- its plants and its animals.

The *Atmosphere* is Earth's winds and air.

The *Hydrosphere* is Earth's water -- its waves and its currents.

The Earth gets its energy from two different sources.

It gets *internal energy* from *itself*.

And it gets *external energy* from *the Sun*.

Internal Energy

The Earth's *internal energy* comes from the decay of radioisotopes and from gravitational energy released when the Earth was formed.

This includes:

chemical energy associated with atmospheric oxygen, biomass and fossil fuels (most of this is sunlight stored and released through photosynthesis)

nuclear energy associated with naturally occurring unstable atomic nuclei

geo-thermal energy from hot rocks and steam, and

rotational energy from the Earth's core (the least usable form of internal energy)

Internal energy is used to renew the surface of the Earth and to drive the movement of plates in the Lithosphere.

It is also emitted as *radiation*.



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Radiation *from the Earth* occurs at *long wavelengths*, in the infrared (IR) and near-infrared bands.

As it radiates out from the Earth, it is absorbed by certain gasses in the atmosphere. These gasses include water vapor, carbon dioxide, nitrous oxide and methane.

These gasses are known as "greenhouse gasses."

That's because they absorb radiation from the Earth and reflect a lot of it back again, like the glass roof of a greenhouse. They also trap energy from the Sun, which causes a rise in the Earth's temperature.

This is known as *the greenhouse effect*, which is how the atmosphere keeps the Earth warm -- and makes life possible.

We'll tell you more about the greenhouse effect in our next Instruction. Without it, the average temperature on Earth would be about 60 degrees Fahrenheit colder than it is now.

External Energy

Most of the Earth's *external energy* comes from the Sun.

Radiation from the Sun is very hot -- about 6000 degrees Celsius.

Most of this radiation is emitted at *short* wavelengths, in the visible part of the spectrum. The rest is radiated at even shorter (ultraviolet) wavelengths.

The Sun radiates its energy in all directions, which means that -- after a journey of 150 million kilometers -- only a fraction of it can be intercepted by the Earth.

But it is still enough to drive Earth's surface processes.

The climate of the Earth constantly tries to maintain a balance between *energy radiated out* and *energy radiated in*.

This is what scientists call *The Energy Budget*.

To see a classic diagram of the Earth's Energy Budget, click:

<http://eosweb.larc.nasa.gov/EDDOCS/images/Erb/components2.gif>



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The Energy Budget

Over the course of a year, the amount of energy that leaves the Earth must be equal to the amount of energy that comes into it.

Otherwise the Earth would get too hot or too cold to support life.

But the regulation of this process is complicated.

Especially when it comes to the solar energy that radiates in.