

Climate Change

**WHAT IS IT?
WHERE IS IT GOING?
AND HOW DO WE KNOW?**

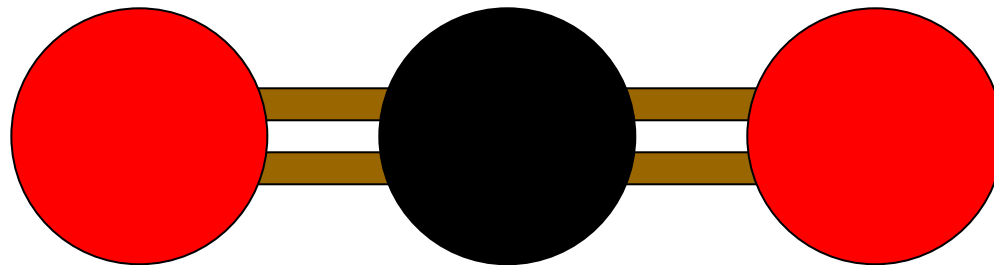
CHAPTER X

**How the Greenhouse
Works
(Just Descriptive –
No Math)**

By Thomas C. Gibbons



WHAT IS IT THAT CARBON
DIOXIDE DOES TO WARM THE
WORLD?

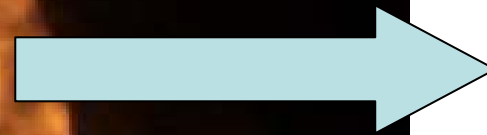


SOMETHING AS HOT AS THE SUN EMITS SEVERAL KINDS OF LIGHT

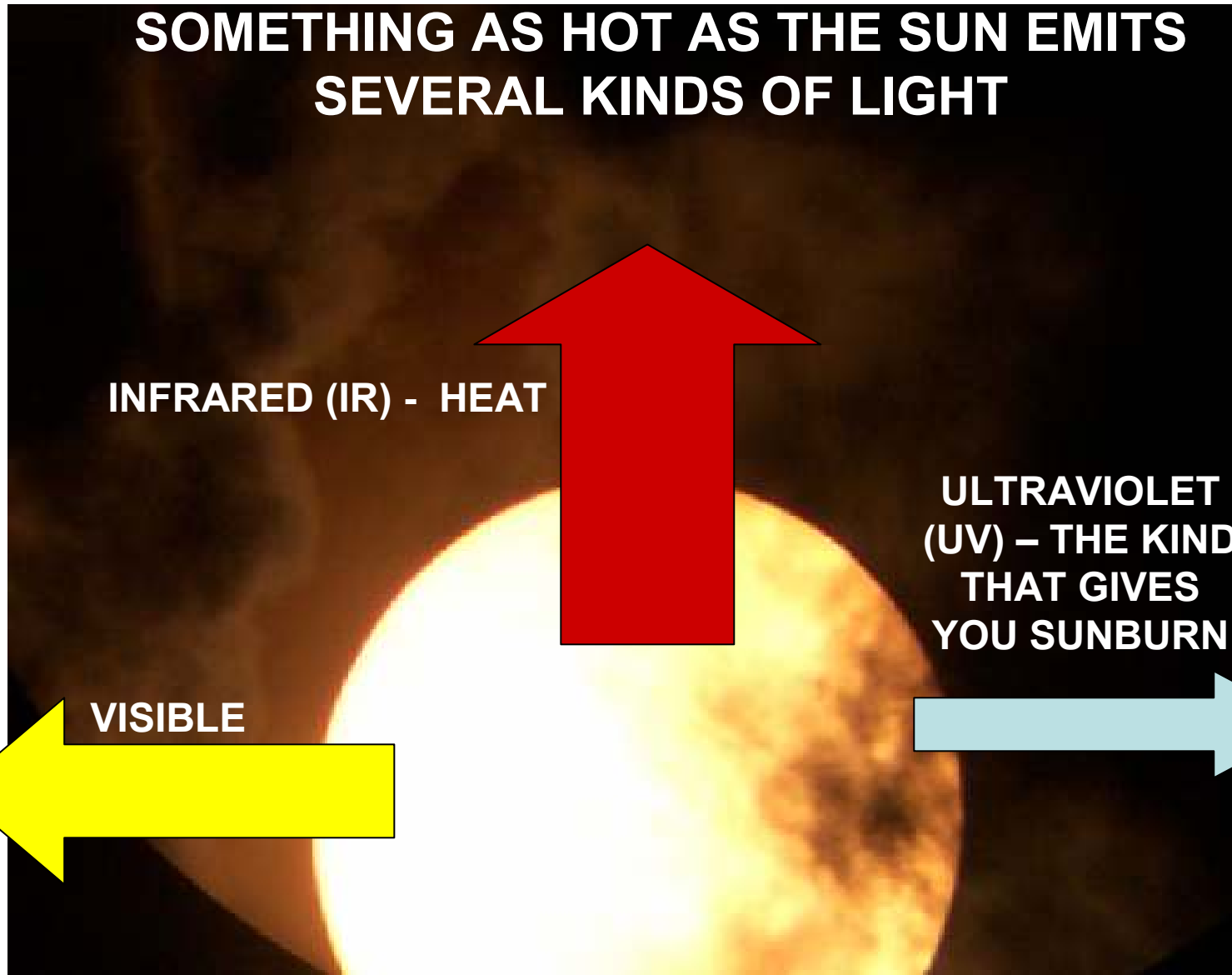
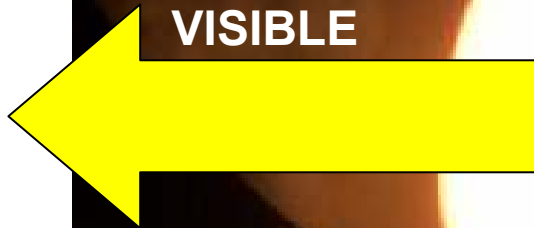
INFRARED (IR) - HEAT



ULTRAVIOLET (UV) - THE KIND THAT GIVES YOU SUNBURN



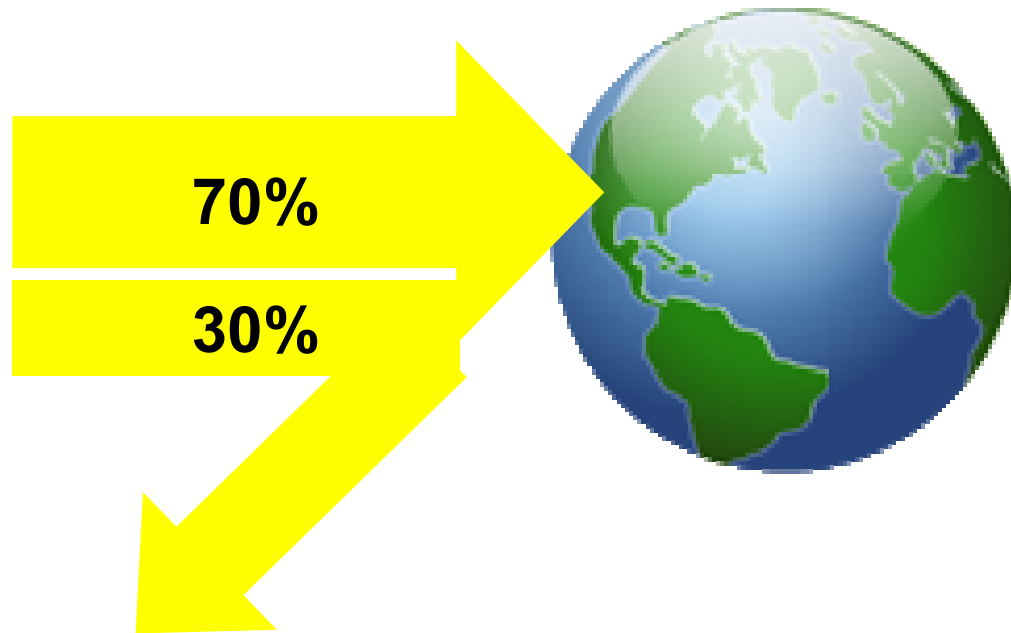
VISIBLE



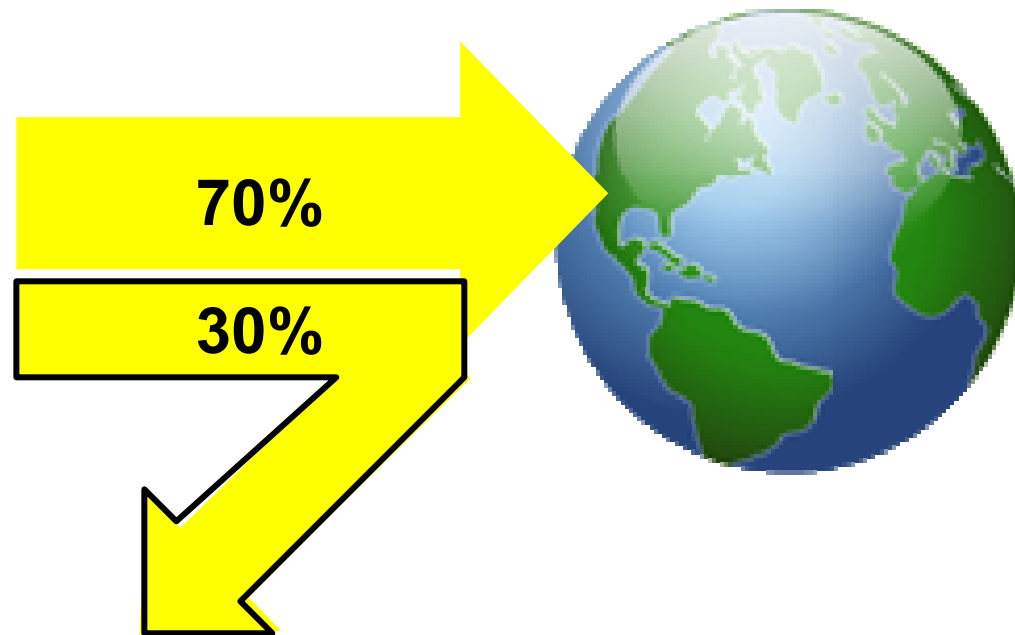
BUT THE EARTH IS MUCH COOLER – NO
VISIBLE LIGHT GIVEN OFF



WHAT YOU SEE IS REFLECTED
SUNLIGHT. ABOUT 30% OF THE
INCOMING SUNLIGHT IS REFLECTED BY
WATER, CLOUDS, GROUND, AND SO ON.

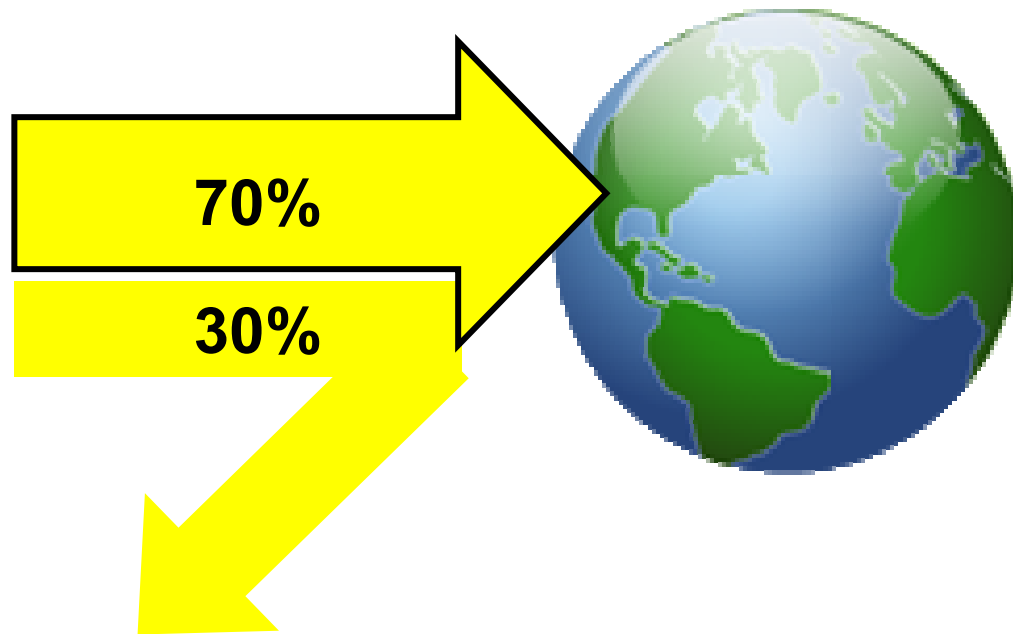


WHAT YOU SEE IS REFLECTED
SUNLIGHT. ABOUT 30% OF THE
INCOMING SUNLIGHT IS REFLECTED BY
WATER, CLOUDS, GROUND, AND SO ON.



The 30% reflected light plays no role in determining the earth's temperature. It is just in and out and forgotten, except it is what you see the earth by.

WHAT YOU SEE IS REFLECTED
SUNLIGHT. ABOUT 30% OF THE
INCOMING SUNLIGHT IS REFLECTED BY
WATER, CLOUDS, GROUND, AND SO ON.



The 70% absorbed rattles around in there, bounces the molecules, and does determine the earth's temperature, as you will see in the following slides.

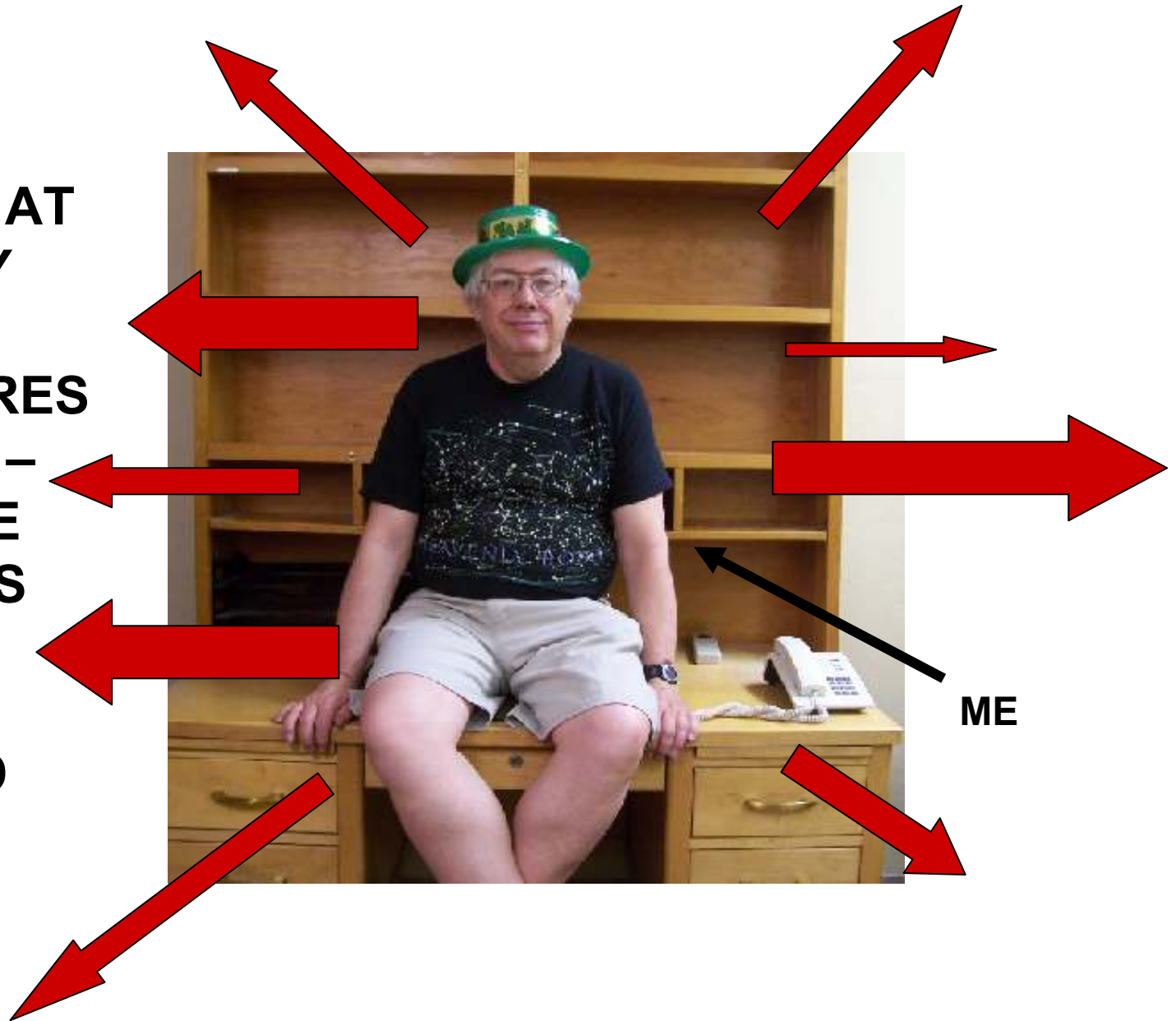
**SO THE EARTH IS MUCH COOLER THAN
THE SUN – NO VISIBLE LIGHT GIVEN
OFF**

**TO PUT THAT
ANOTHER WAY,
MOST THINGS
ON THE EARTH
ARE NOT HOT
ENOUGH TO
GLOW.**

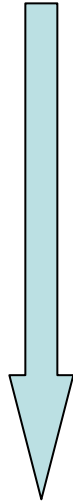


ME

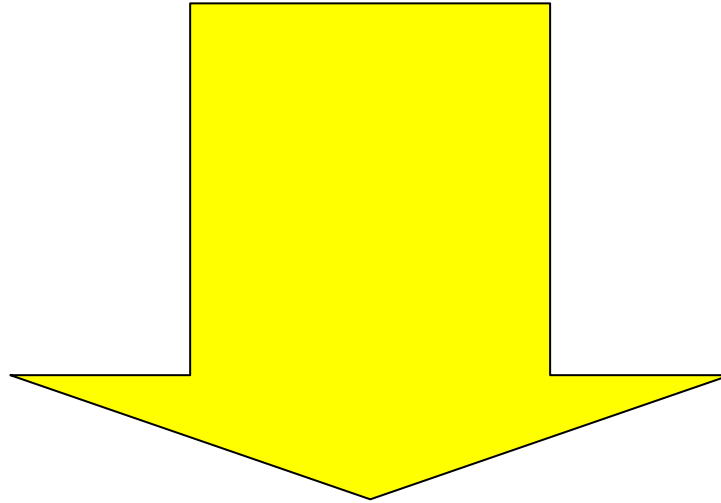
**BUT THINGS AT
ORDINARY
EARTH
TEMPERATURES
EMIT HEAT –
WHICH THE
SCIENTISTS
INSIST ON
CALLING
INFRARED**



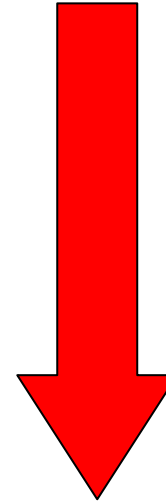
Ultraviolet (uv)



Visible

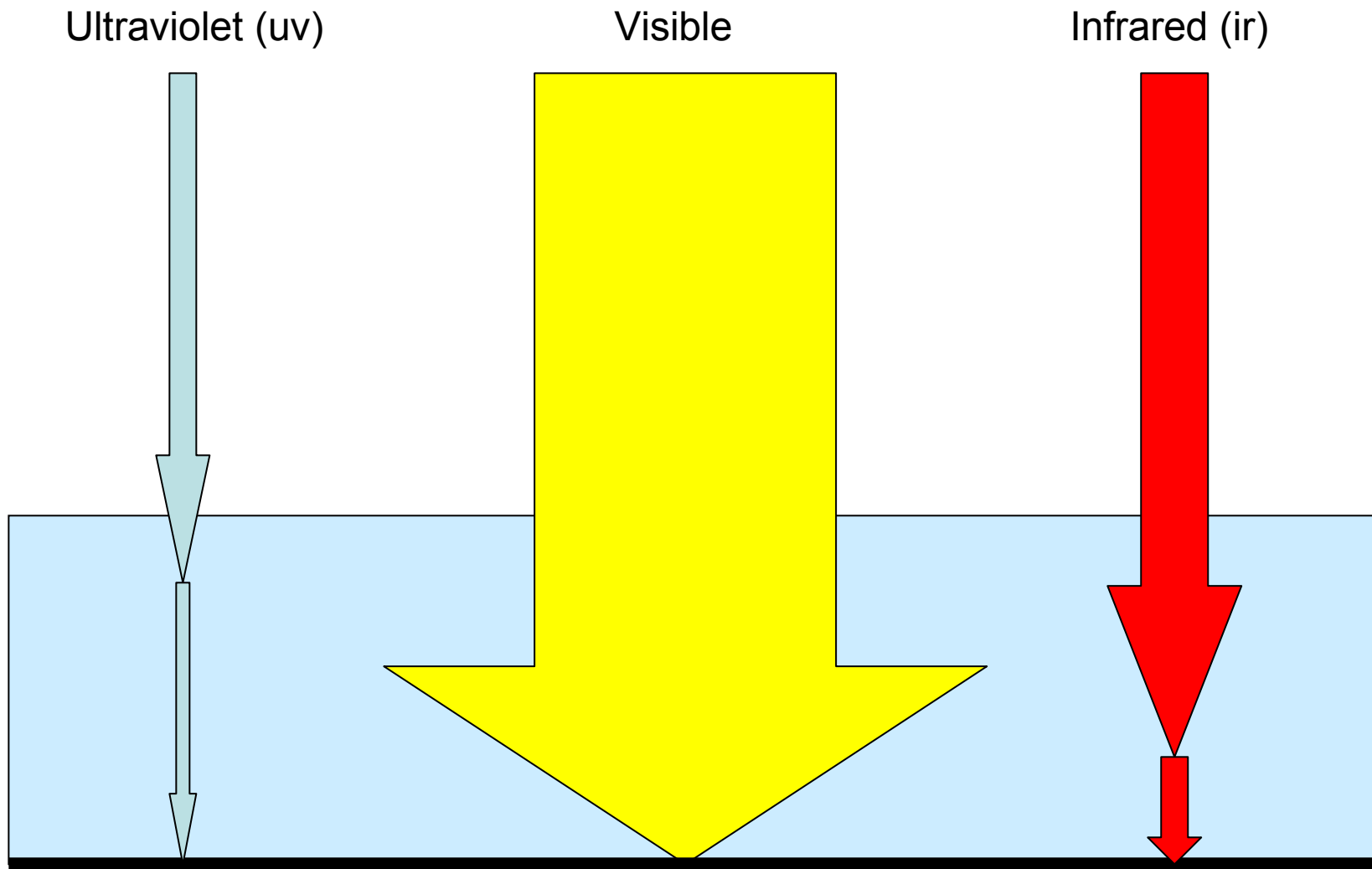


Infrared (ir)

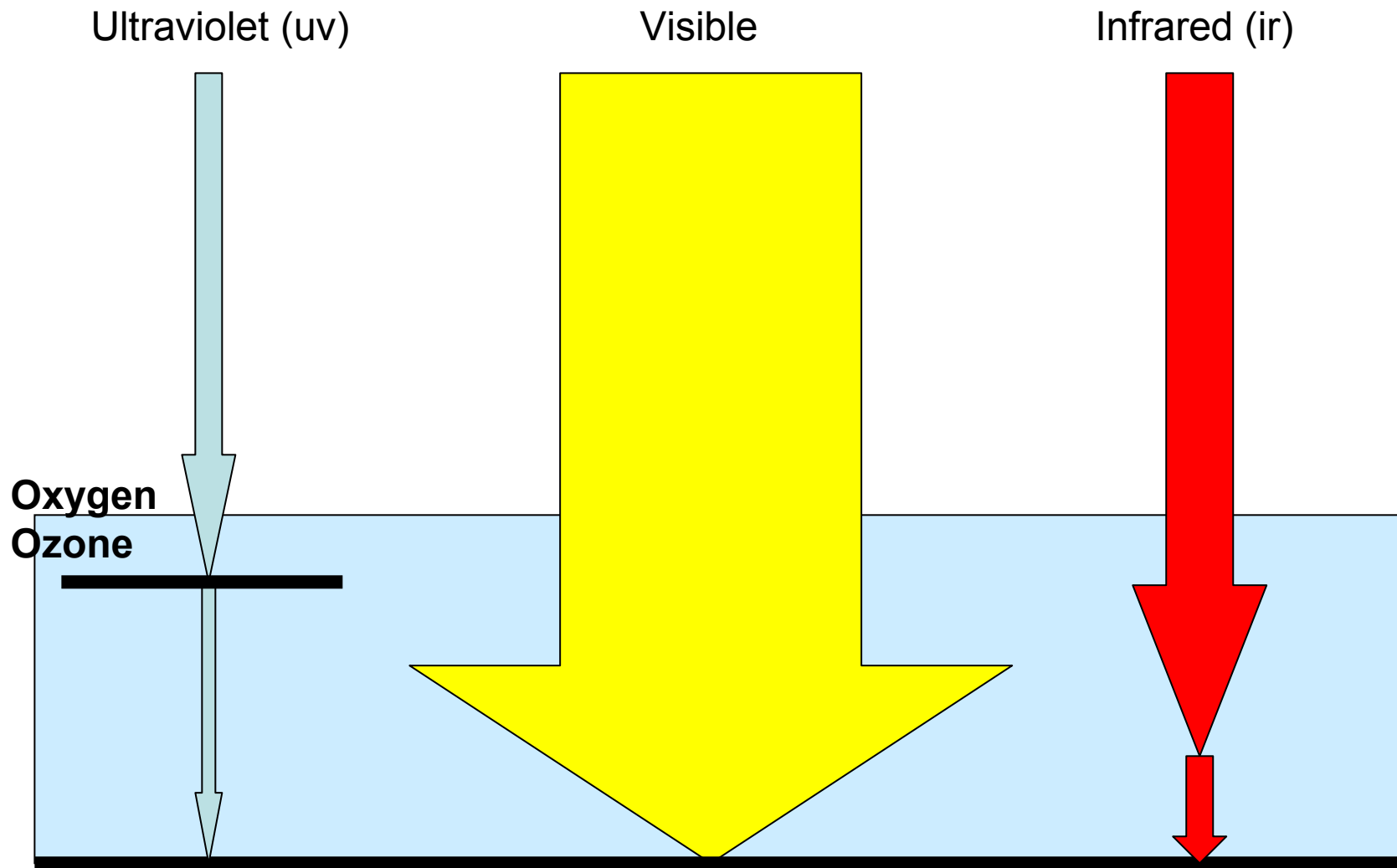


Most of the sunlight reaching the earth from the sun is visible light – just a little bit is ultraviolet or infrared.

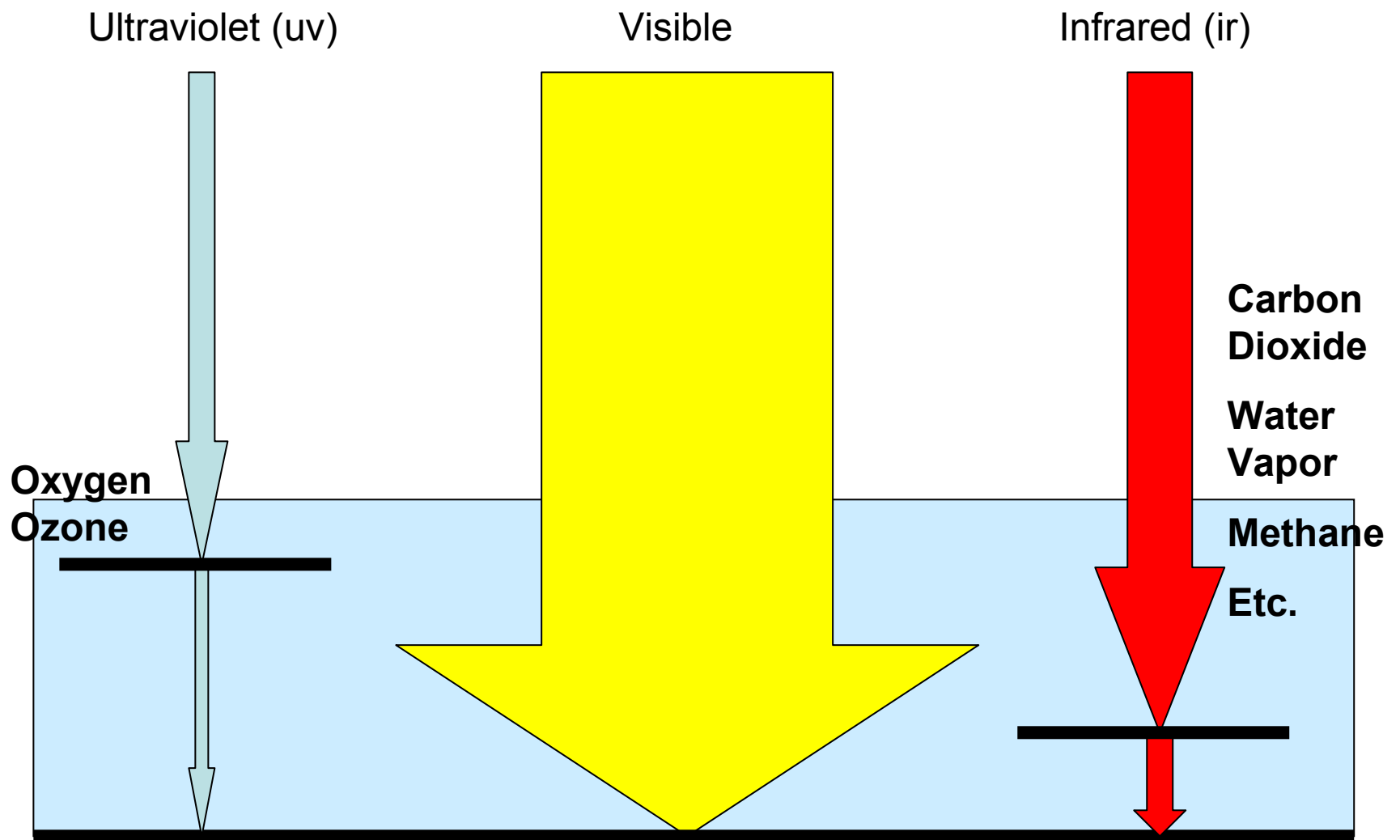
NOTE: HERE AND IN THE REST OF THE CHAPTER, WE ARE NOT TALKING ABOUT THE REFLECTED LIGHT, JUST THE PART THAT GETS ABSORBED.



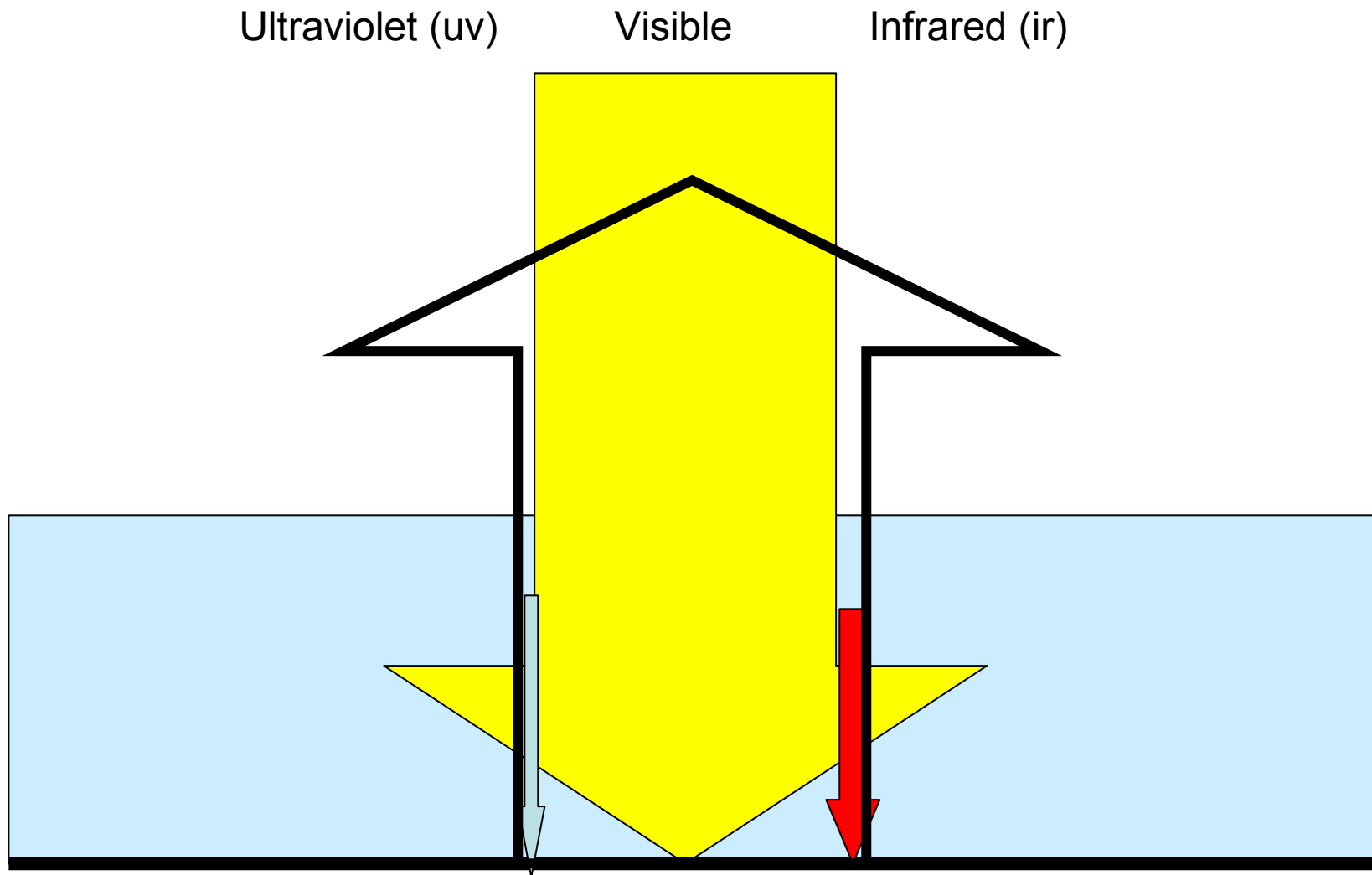
Most of the visible light gets through the atmosphere to the surface. However, only part of the ultraviolet and infrared make it all the way.



The oxygen and ozone in the upper atmosphere that filter out much of the ultraviolet are another story – but a related one, and also an interesting one.

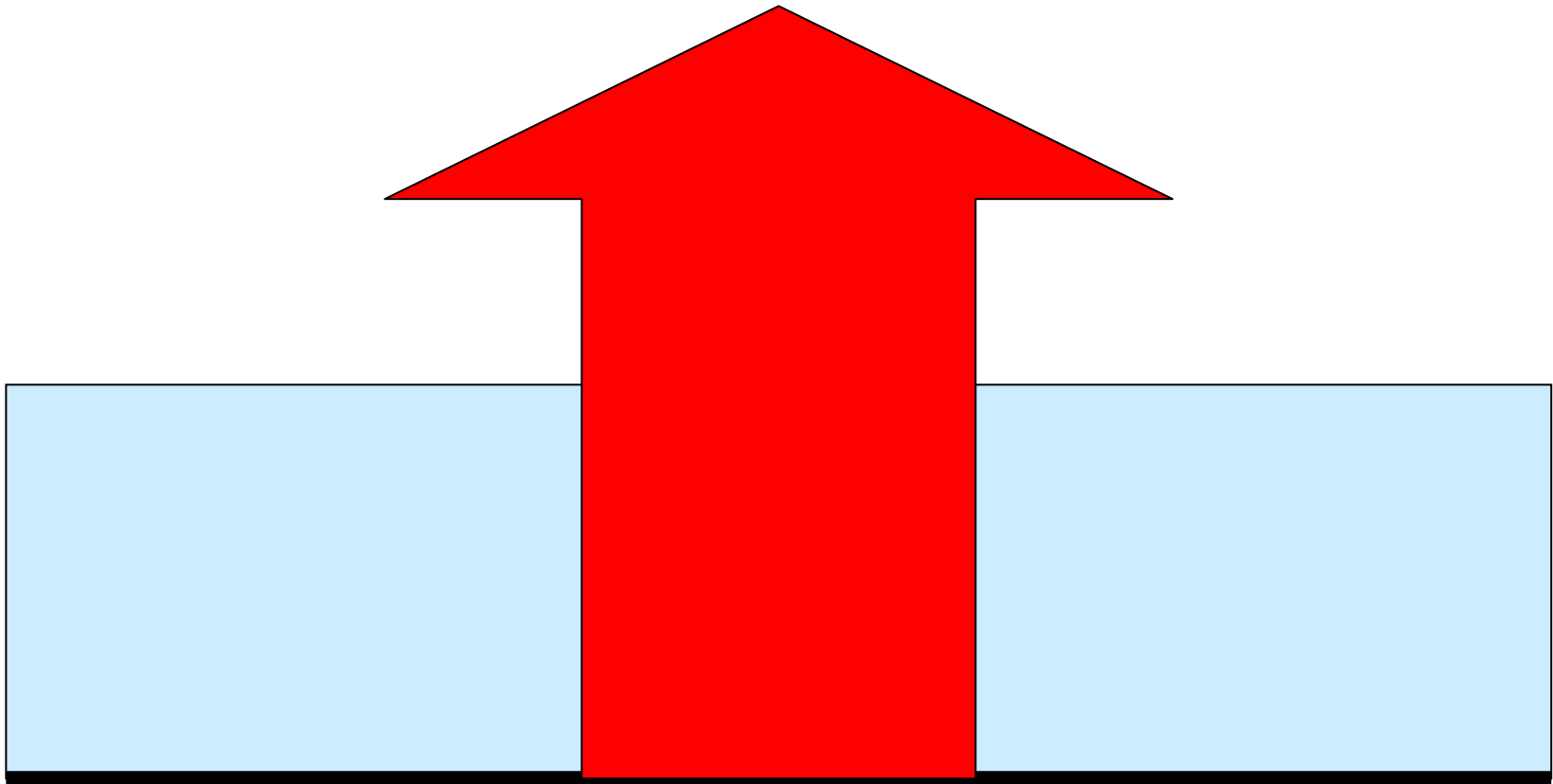


The Carbon Dioxide, Water Vapor, Methane, and other molecules that filter out the infrared are a major part of this story.



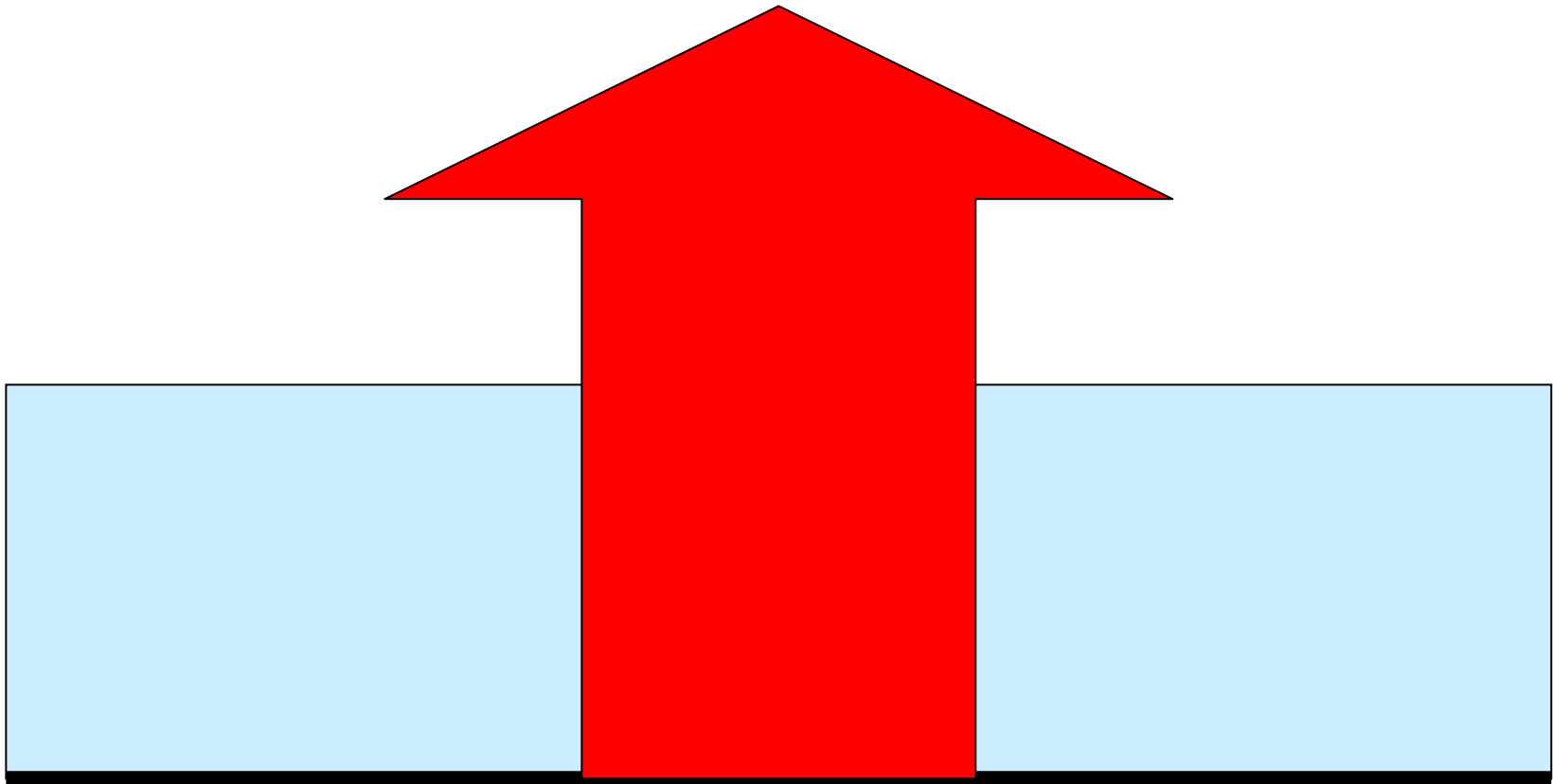
The Earth has to reemit the energy it receives at least on the average in the long term (although this can be out of balance for a while if energy is building up somewhere).

Infrared (ir)



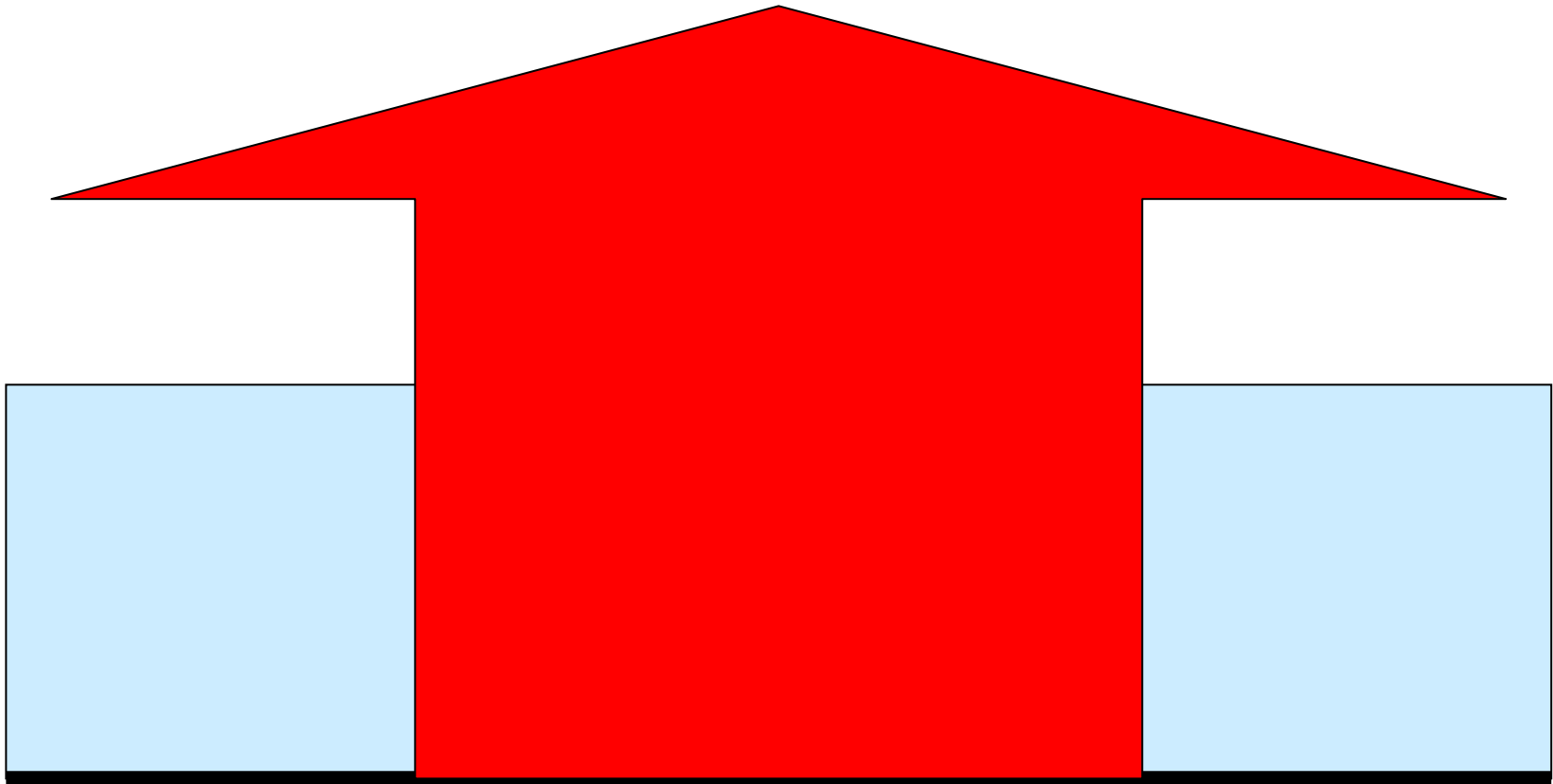
But what the earth emits is infrared - heat – remember, the earth is not hot enough to glow (lucky for us).

Infrared (ir)



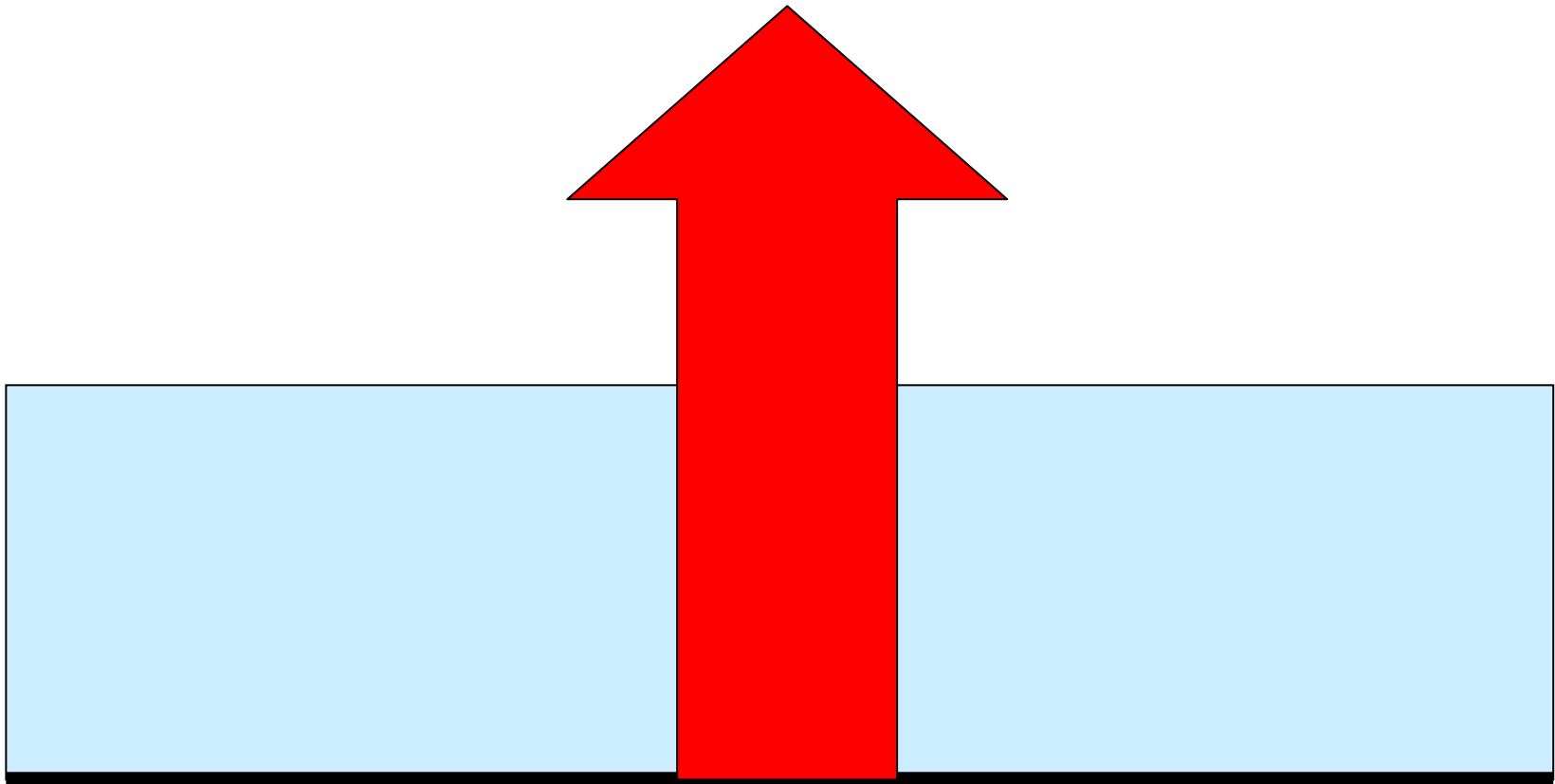
The average temperature of the earth depends on how much of this energy it absorbs and reemits.

Infrared (ir)



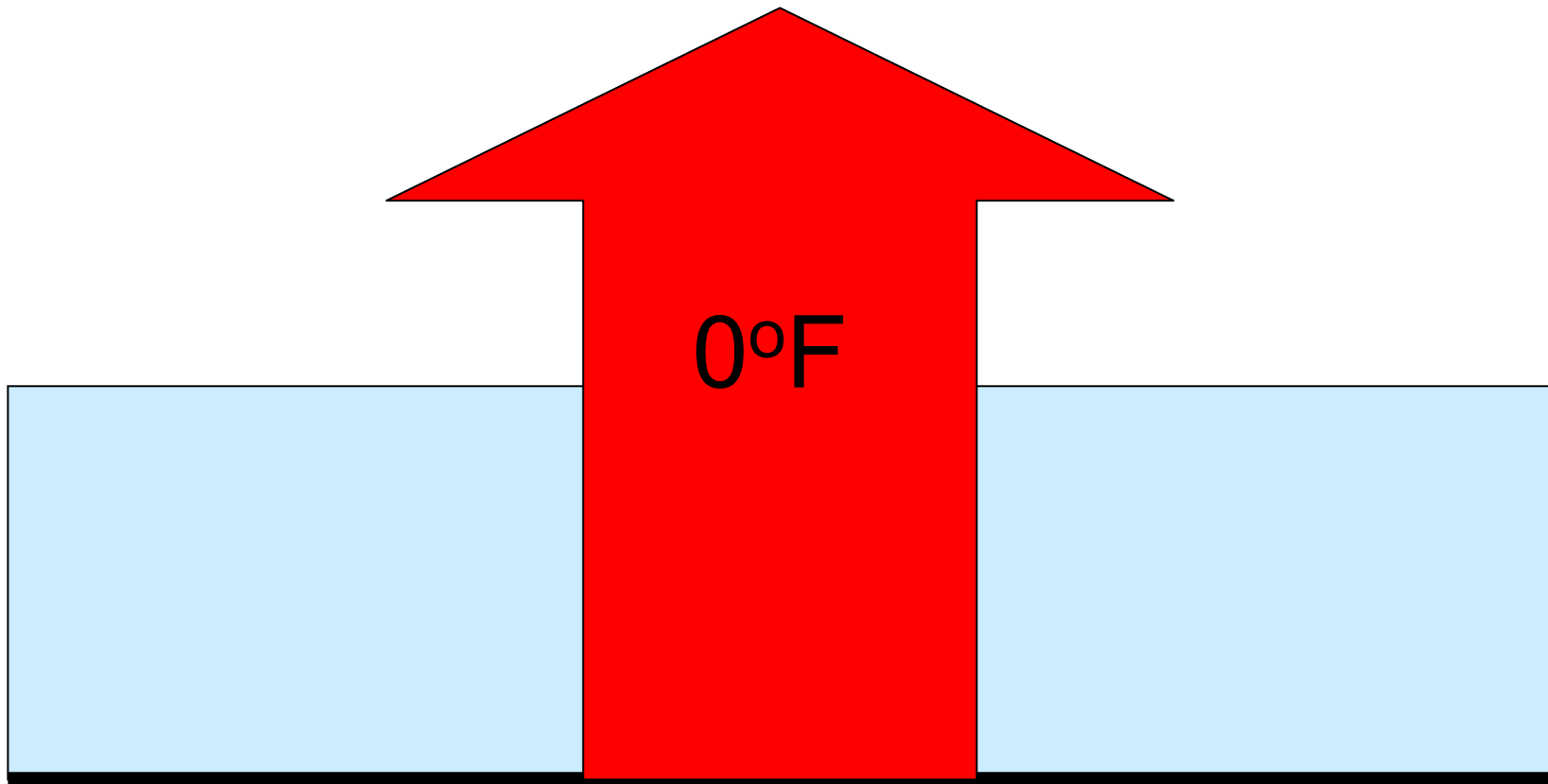
**If we could increase this energy - say, by finding an extra sun
– the earth would be warmer.**

Infrared (ir)



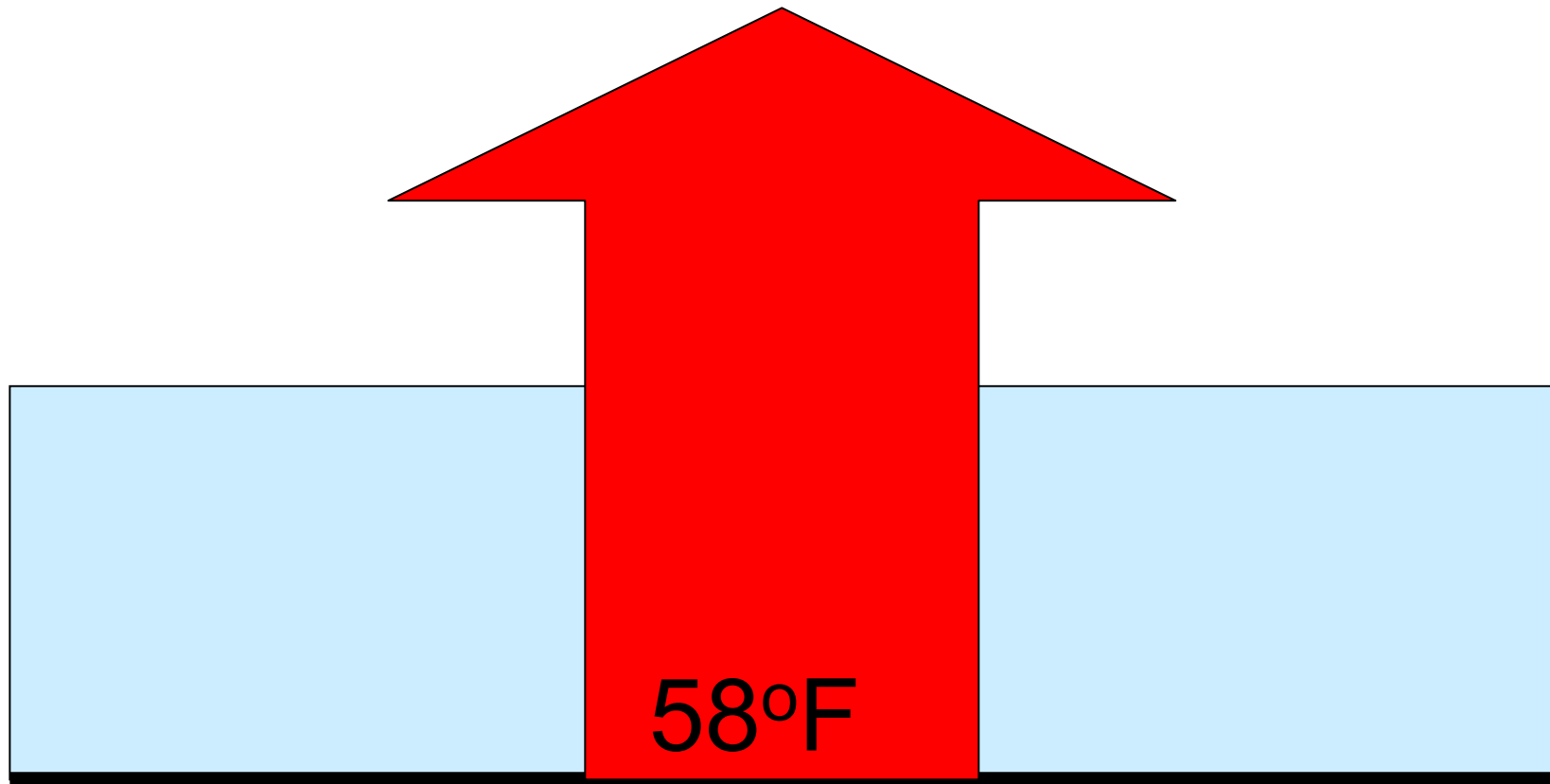
If we could decrease it - say, by finding more cloud cover to reflect more sunlight - the earth would cool.

Infrared (ir)



By absorbing and emitting its actual amount of energy, the earth reaches an average temperature of very close to zero degrees Fahrenheit.

Infrared (ir)



But, as pointed out in Chapter 2, the average temperature of the earth's surface is very close to 58°F (as of the early 2000's). That is actually pretty lucky, because I would hate for my average 58 degree day to suddenly turn into an average 0 degree day.

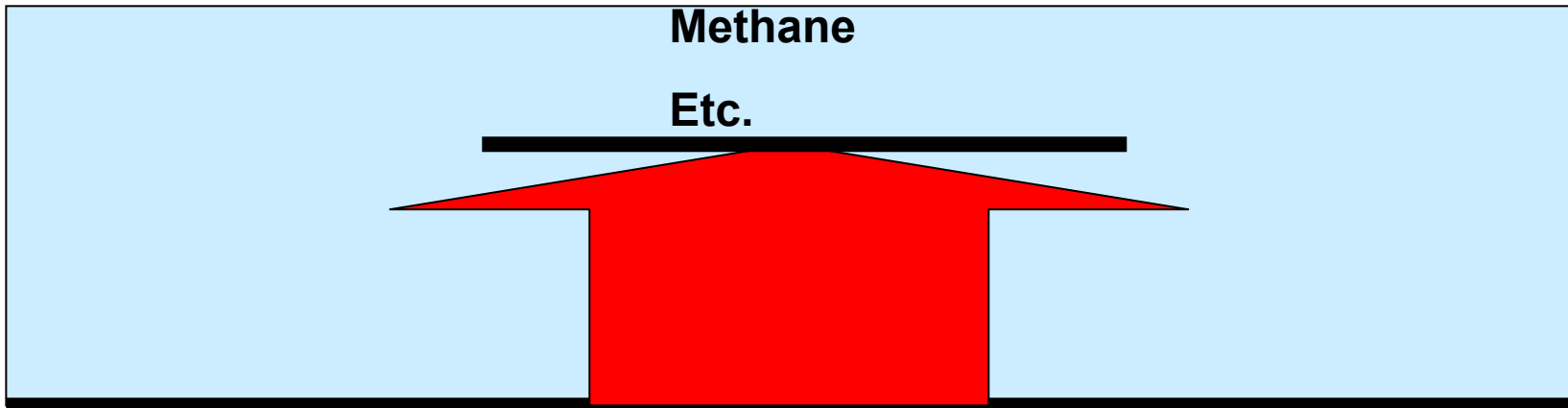
Infrared (ir)

Carbon Dioxide

Water Vapor

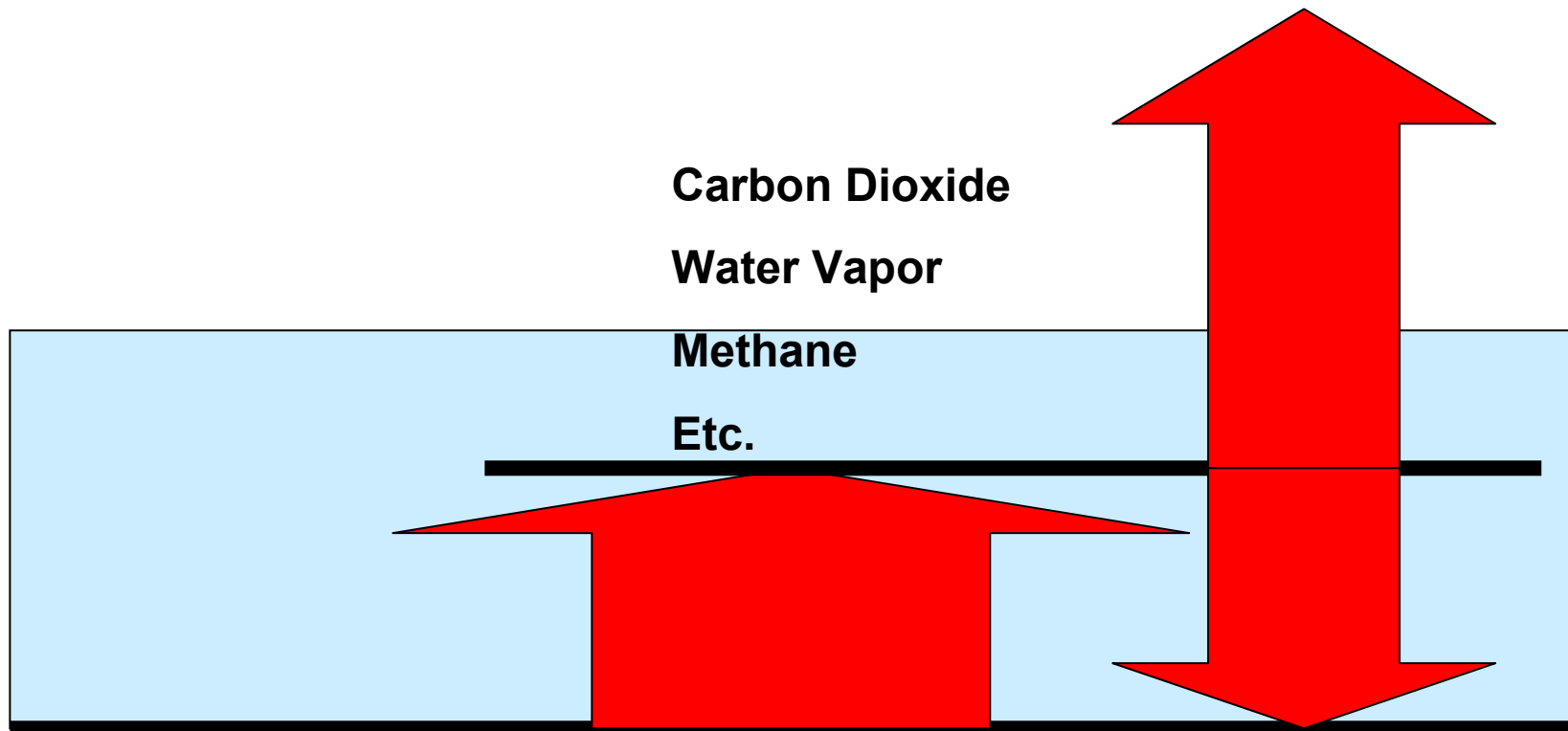
Methane

Etc.

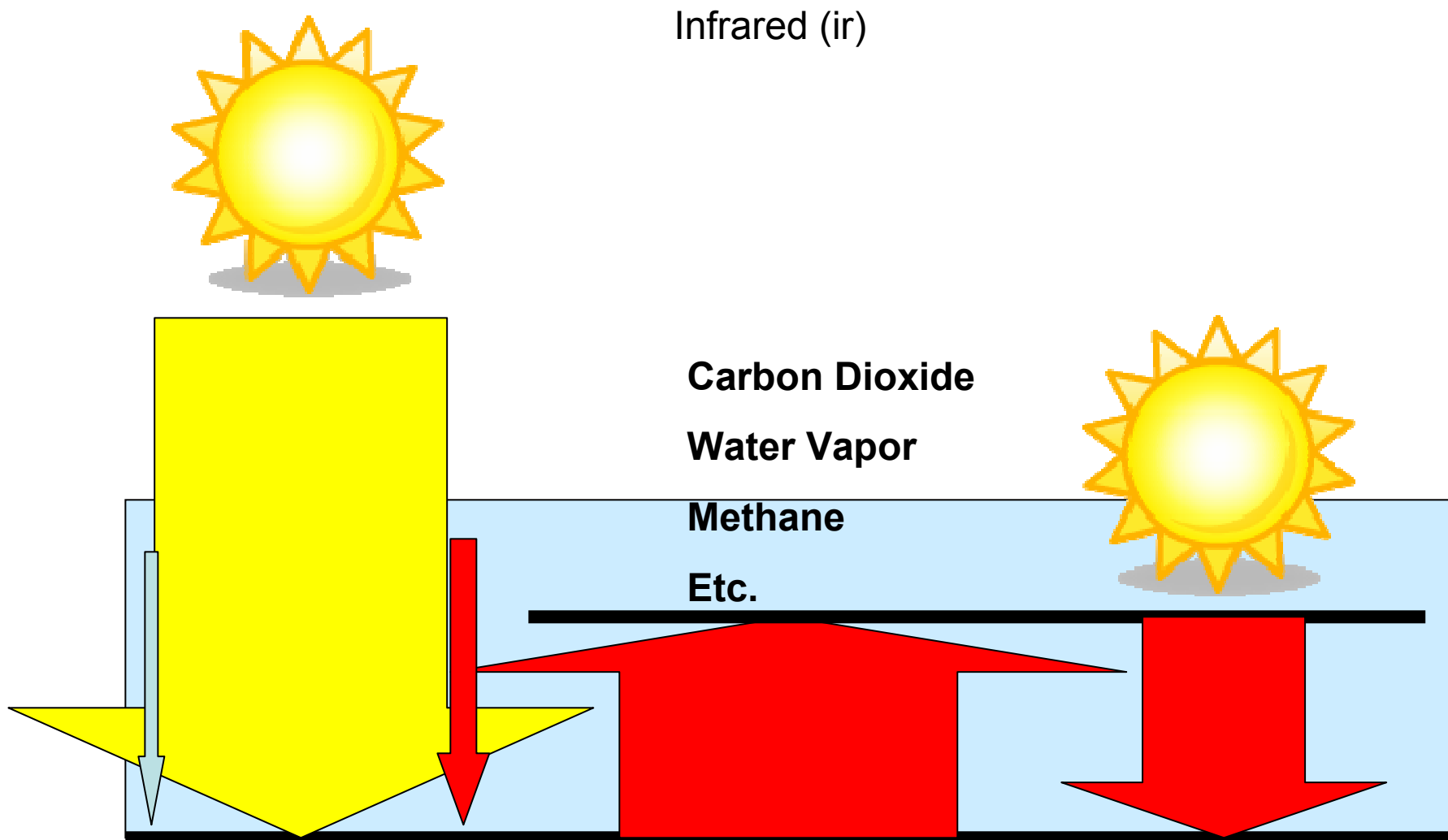


The reason for this difference is that the outgoing infrared radiation is pretty effectively absorbed by the atmosphere on the way up (not all of it, really, but a lot).

Infrared (ir)



The atmosphere has to give up what it absorbs. So it reemits the infrared that it received – part up and part down.



Infrared (ir)

Carbon Dioxide

Water Vapor

Methane

Etc.

So the atmosphere plays the role of that “extra sun” shining down on the earth with extra energy in addition to what we get from the actual sun.

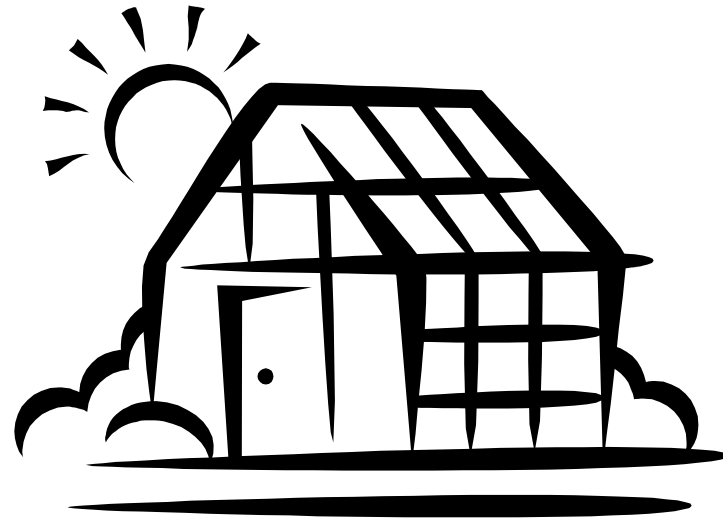
Carbon Dioxide

Water Vapor

Methane

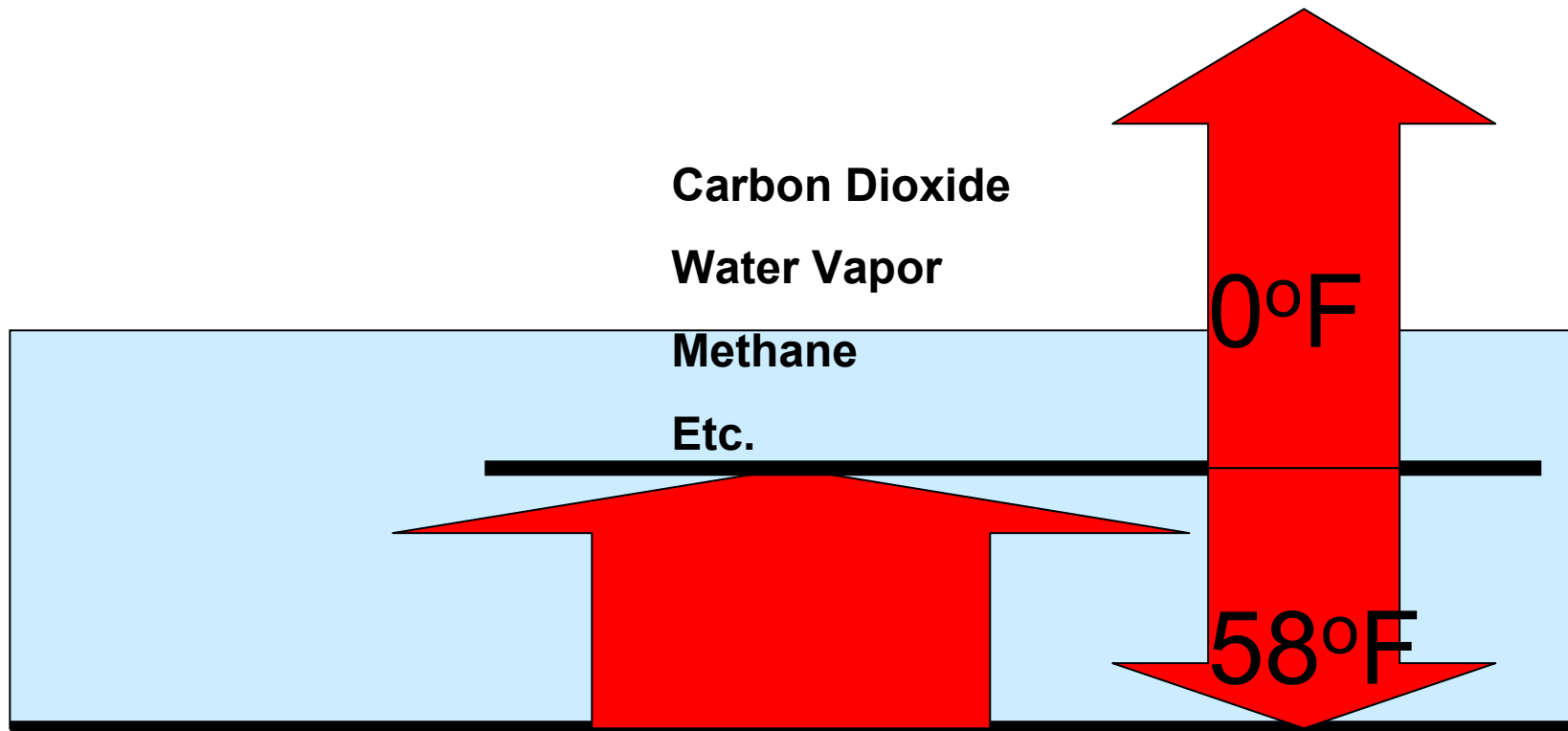
Etc.

Greenhouse Gasses

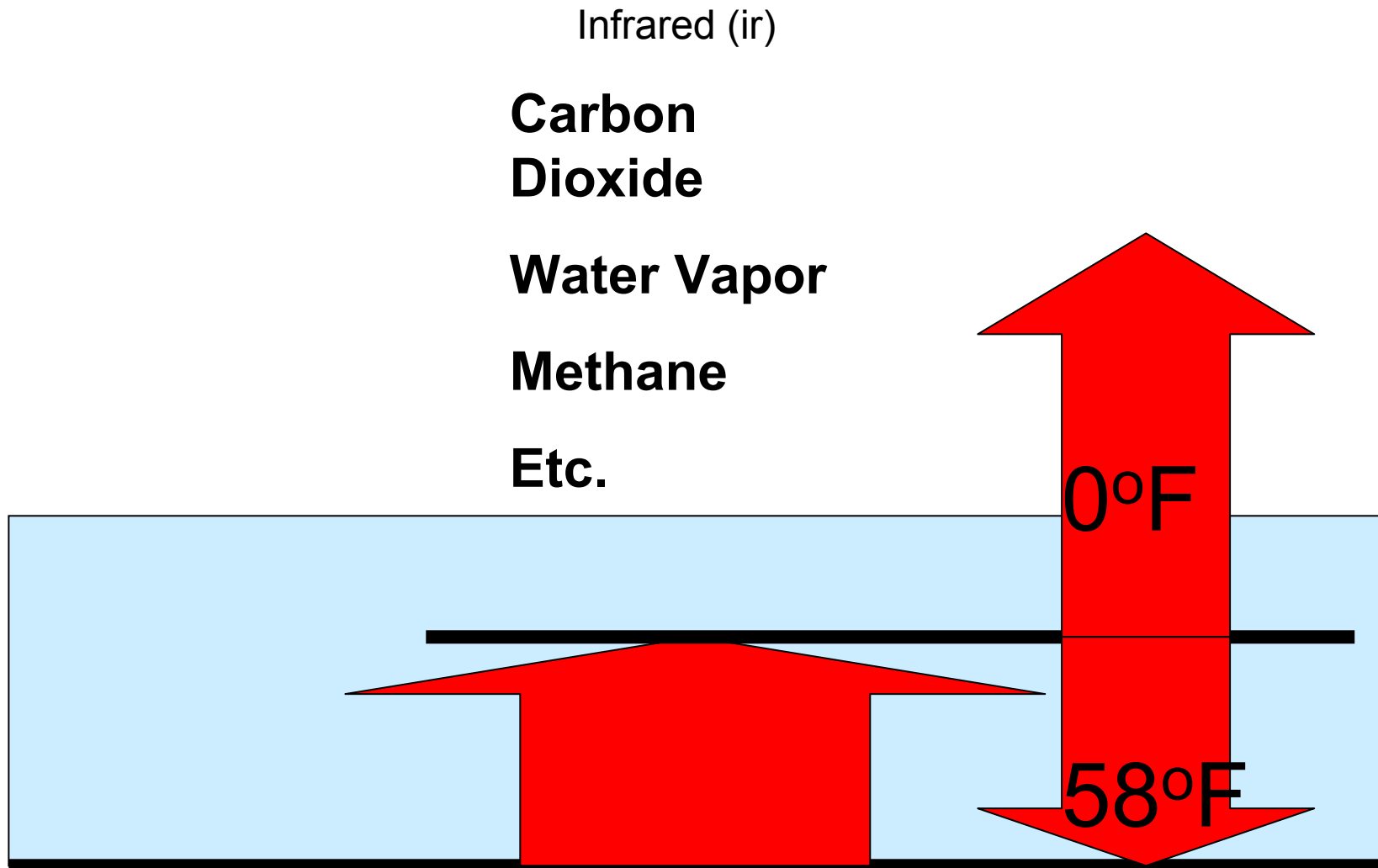


This is often called the “Greenhouse Effect” and those gasses that trap the infrared light are called “Greenhouse Gasses”. This is true even though an actual greenhouse also keeps the hot air in and the cold air out, a different method of operation.

Infrared (ir)



All this is enough to heat the surface up to 58°F while the upper atmosphere, which actually does the radiating into space, is the part of the earth that averages about 0°F.



But what happens if the concentration of one or more of those greenhouse gasses increases? It is sometimes said that, since the atmosphere is already absorbing all it can, such an increase can do no more to the earth.

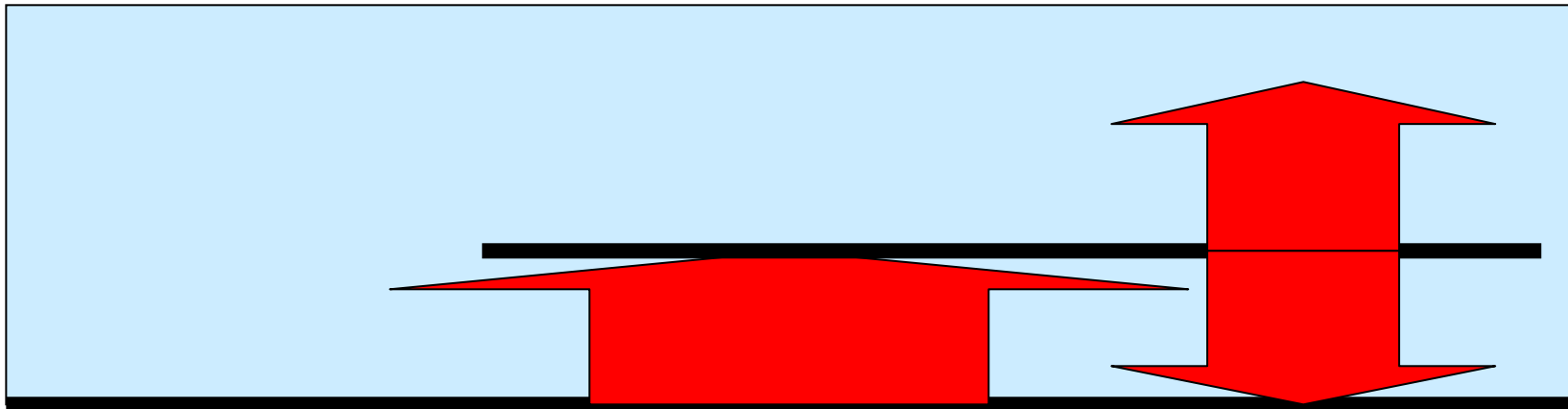
Infrared (ir)

**Carbon
Dioxide**

Water Vapor

Methane

Etc.



**But that is wrong. What it can do is absorb the infrared light
at a lower altitude.**

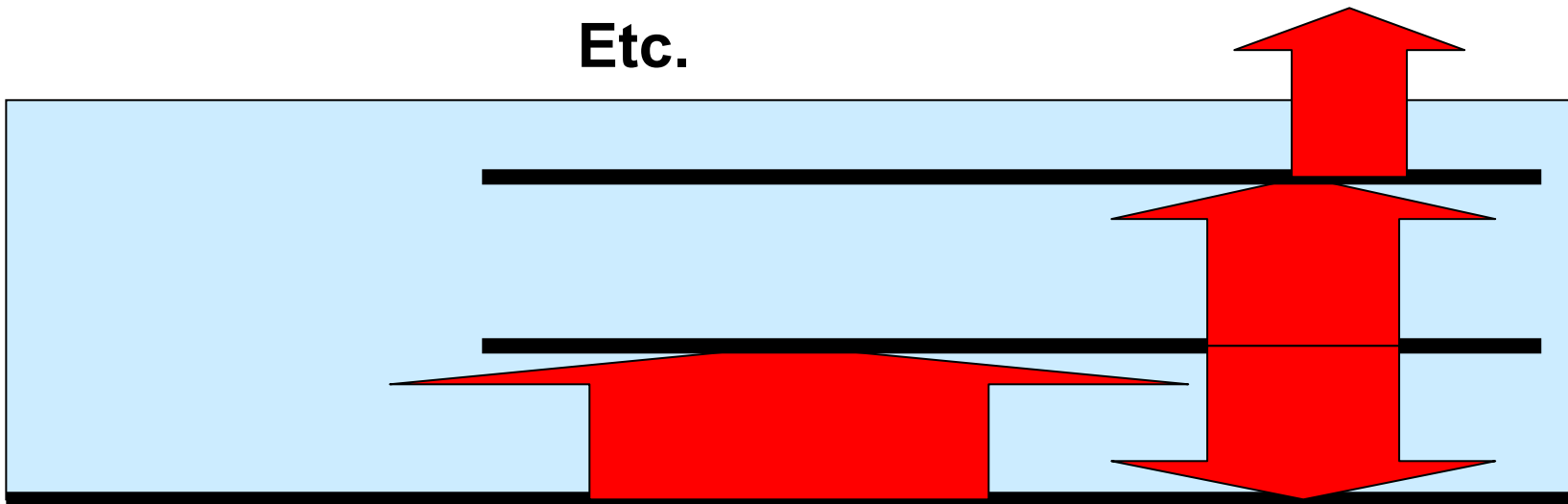
Infrared (ir)

**Carbon
Dioxide**

Water Vapor

Methane

Etc.



**Then there is room to absorb at least some of the radiation
again higher in the atmosphere.**

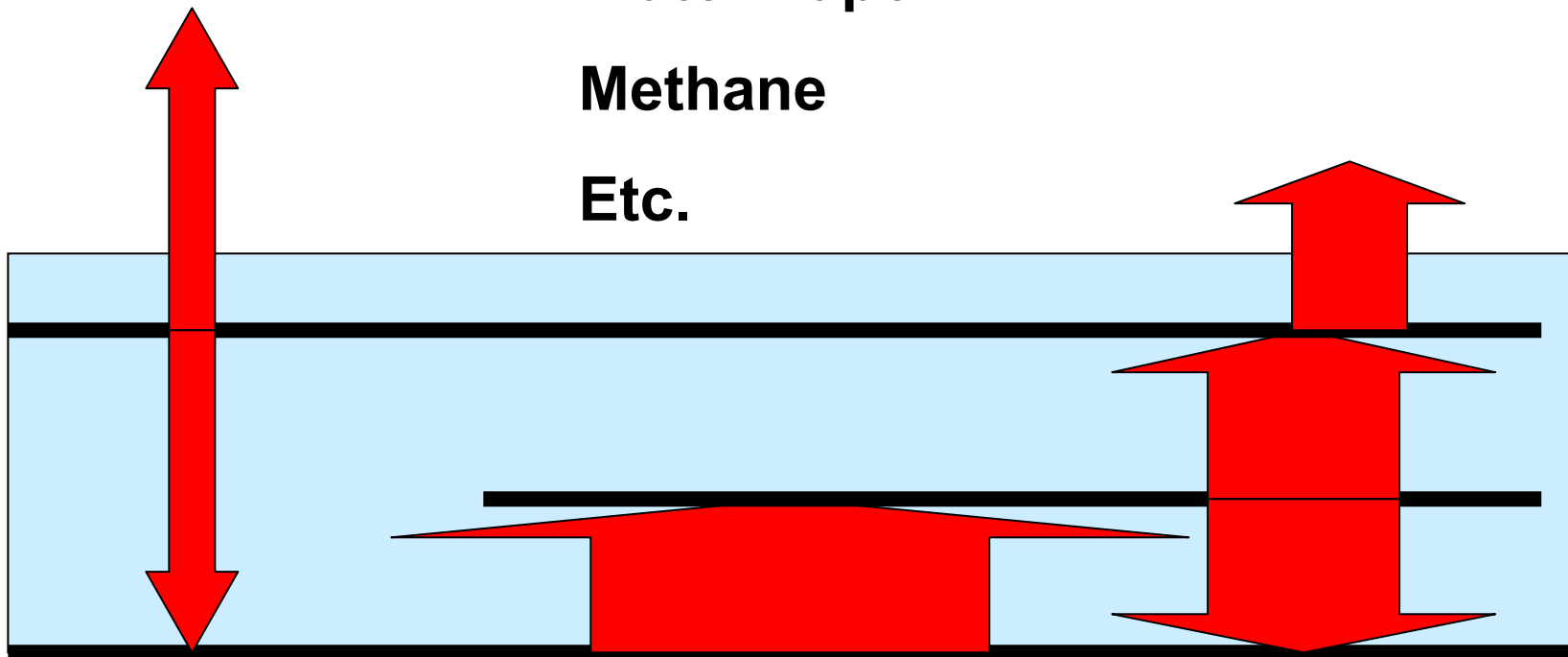
Infrared (ir)

**Carbon
Dioxide**

Water Vapor

Methane

Etc.



But the upper atmosphere still has to reemit what it absorbs, so there is even more coming down to the surface. So extra greenhouse gas can raise the temperature more.

It is possible to go into this in much more detail than in this, mathematical detail even.

However, there is no need for that right now. That is the general idea.

The greenhouse gasses in our atmosphere warm it up from a 0°F average temperature to something livable. We should be happy about that.

**But if we overdo it and pump too much greenhouse gas in the atmosphere?
Well, read the other chapters on this web site.**

**CONTINUE ON AND RETURN TO
THE GLOBAL WARMING MENU**

**THEN LOOK AT
CHAPTER
X + 1**