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# GLOBAL WARMING



# Introduction

- Is the world getting warmer?
- If so, are the actions of mankind to blame for earth's temperature increases?
- What can/should be done about these issues?





# History of Earth's Climate

- Earth formed ~4.6 billion years ago
- Originally very hot
- Sun's energy output only 70% of present
- Liquid water present ~4.3 billion years



# History of Earth's Climate

- Life appeared ~3.8 billion years ago
- Photosynthesis began 3.5-2.5 billion years ago
  - Produced oxygen and removed carbon dioxide and methane (greenhouse gases)
  - Earth went through periods of cooling (“Snowball Earth”) and warming
- Earth began cycles of glacial and interglacial periods ~3 million years ago



# Earth's Temperature

**Solar**

Sun

**Energy**

**Solar**

**Energy**

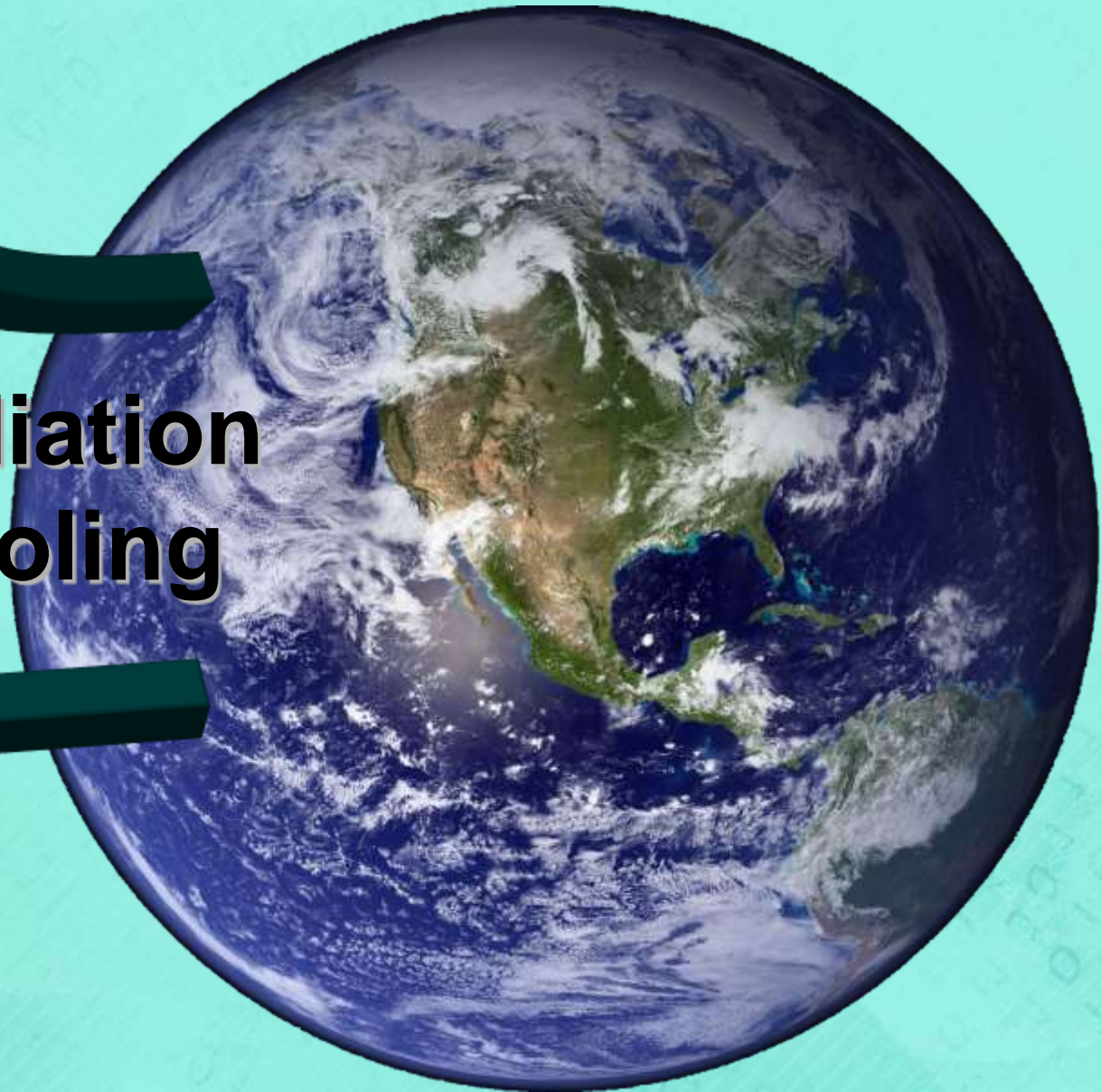


# Earth's Temperature

Sun

Solar  
Energy

Radiation  
Cooling

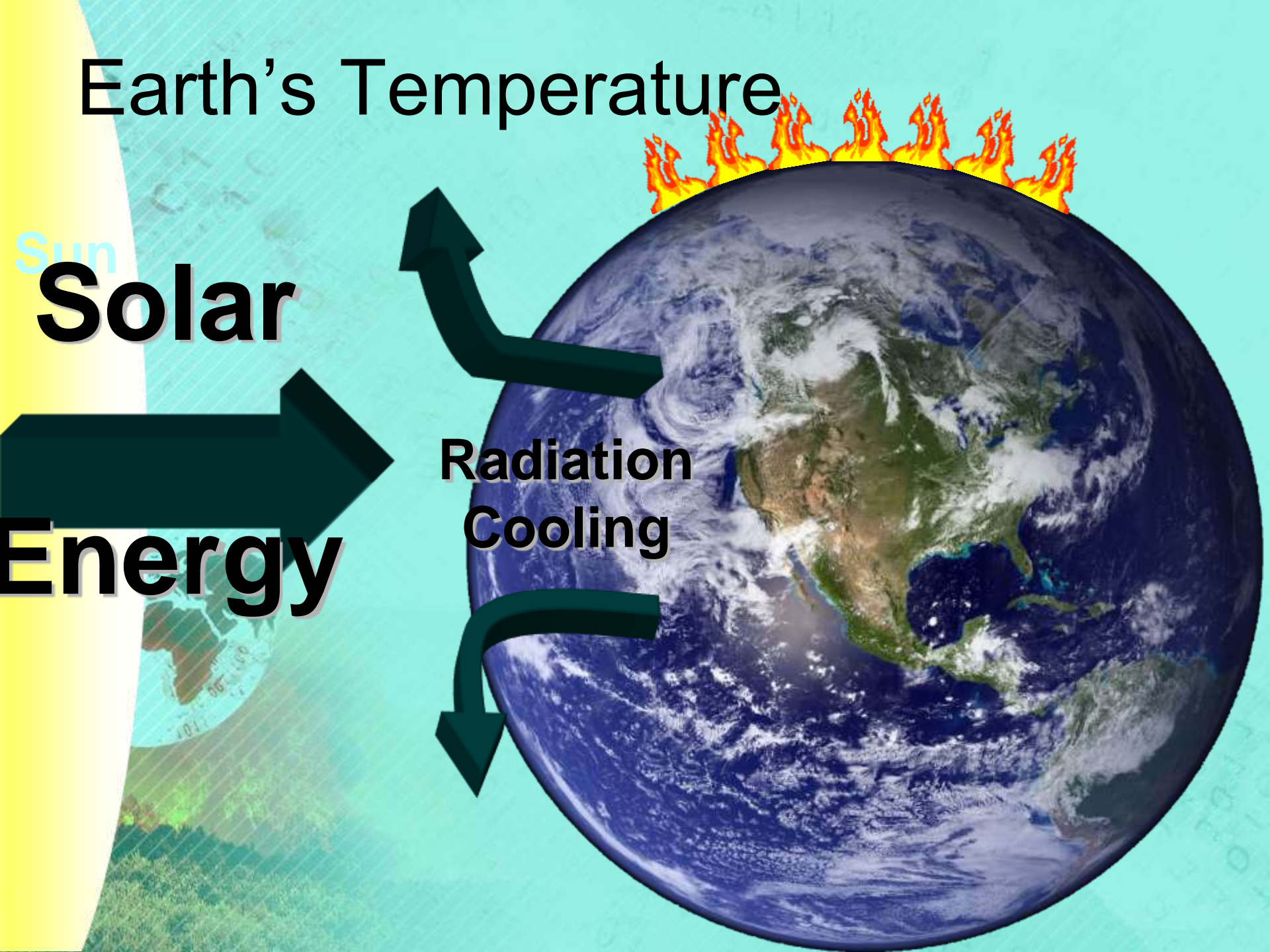




# Earth's Temperature

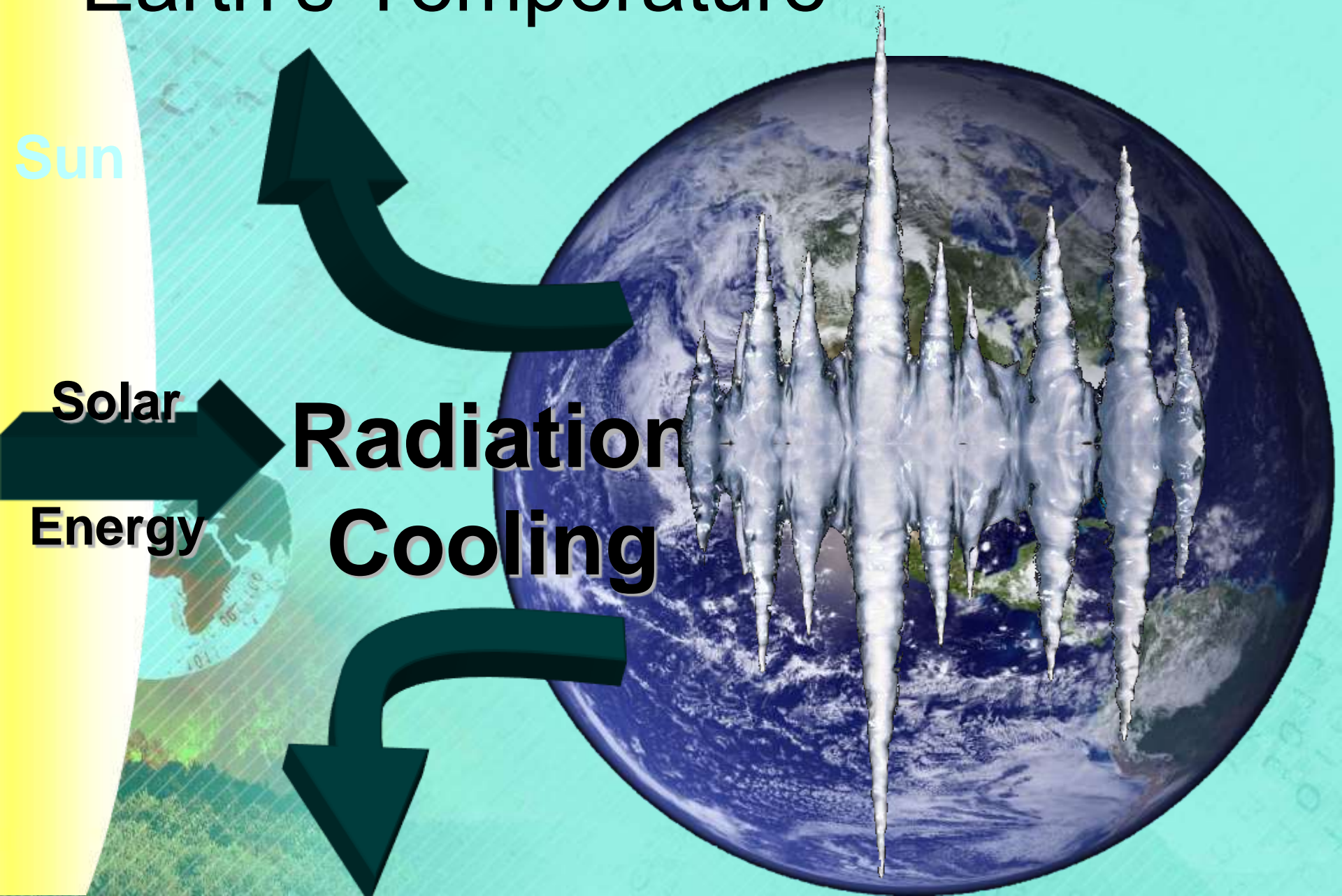
Sun  
**Solar**  
**Energy**

**Radiation**  
**Cooling**





# Earth's Temperature



Sun

Solar

Energy

**Radiation  
Cooling**



Sun

# Greenhouse Effect



# Earth's Atmospheric Gases

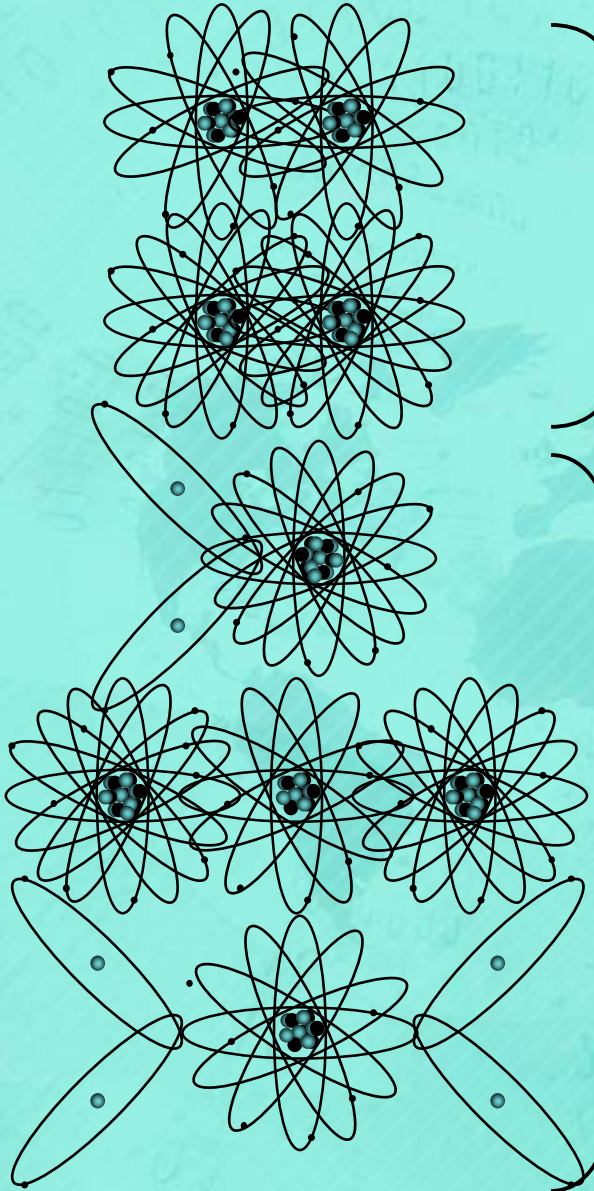
Nitrogen ( $N_2$ )

Oxygen ( $O_2$ )

Water ( $H_2O$ )

Carbon Dioxide ( $CO_2$ )

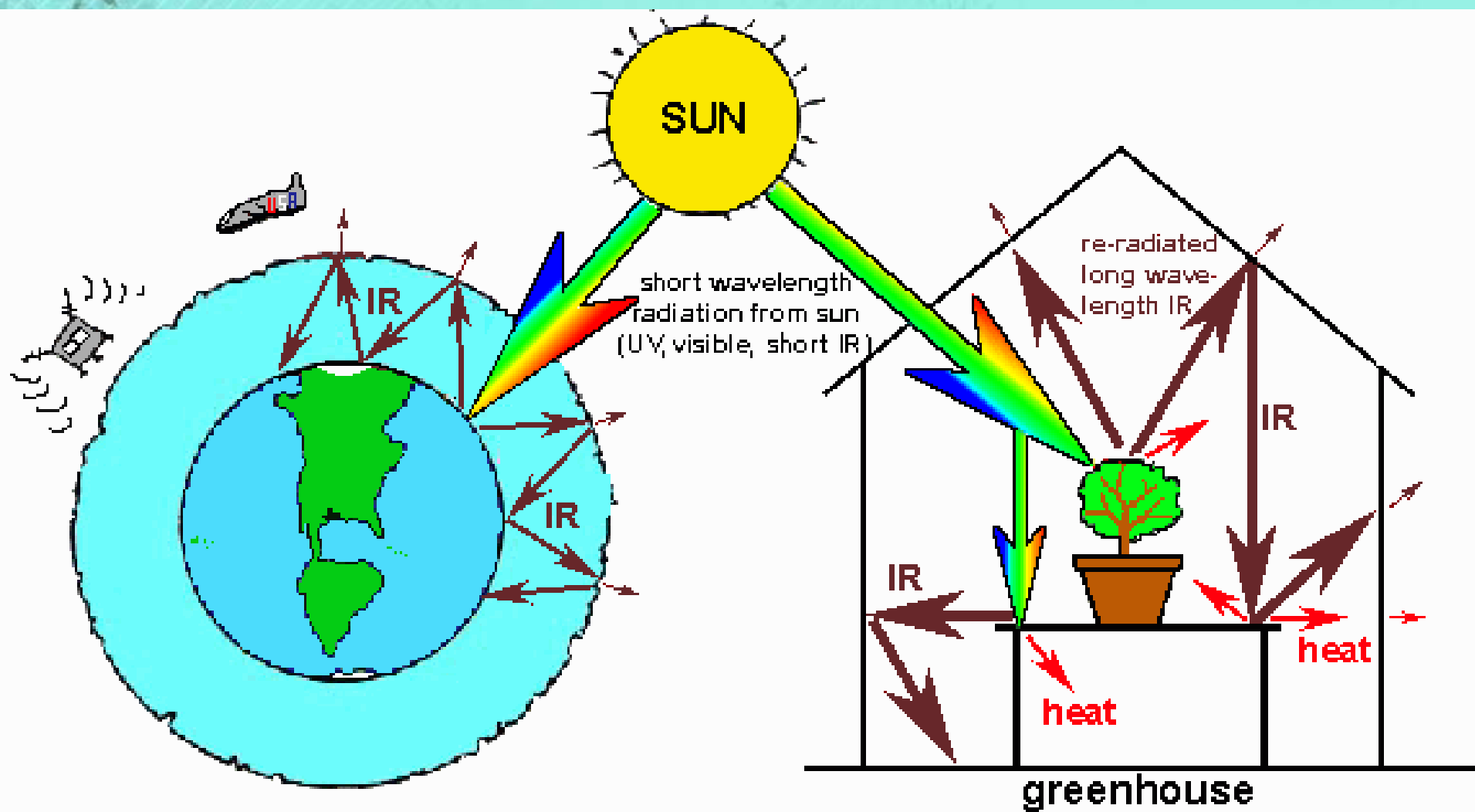
Methane ( $CH_4$ )



**Non-  
Greenhouse  
Gases  
99%**

**Greenhouse  
Gases  
1%**





**The U.S. emits about 6.4 billion metric tons of greenhouse gases annually, 25% of the world's total.**

**These greenhouse gases last a long time...**

**Carbon dioxide stays in the atmosphere for approximately 100 years, methane lasts about 12 years. Other greenhouse gases last even longer.**

**Warming begets more warming...**

**As these gases continue to raise surface temperatures, they trigger the release of even greater quantities of carbon dioxide and methane that are currently trapped in frozen Arctic permafrost and tundra soils, further increasing temperatures.**

**A feedback mechanism ensues...**

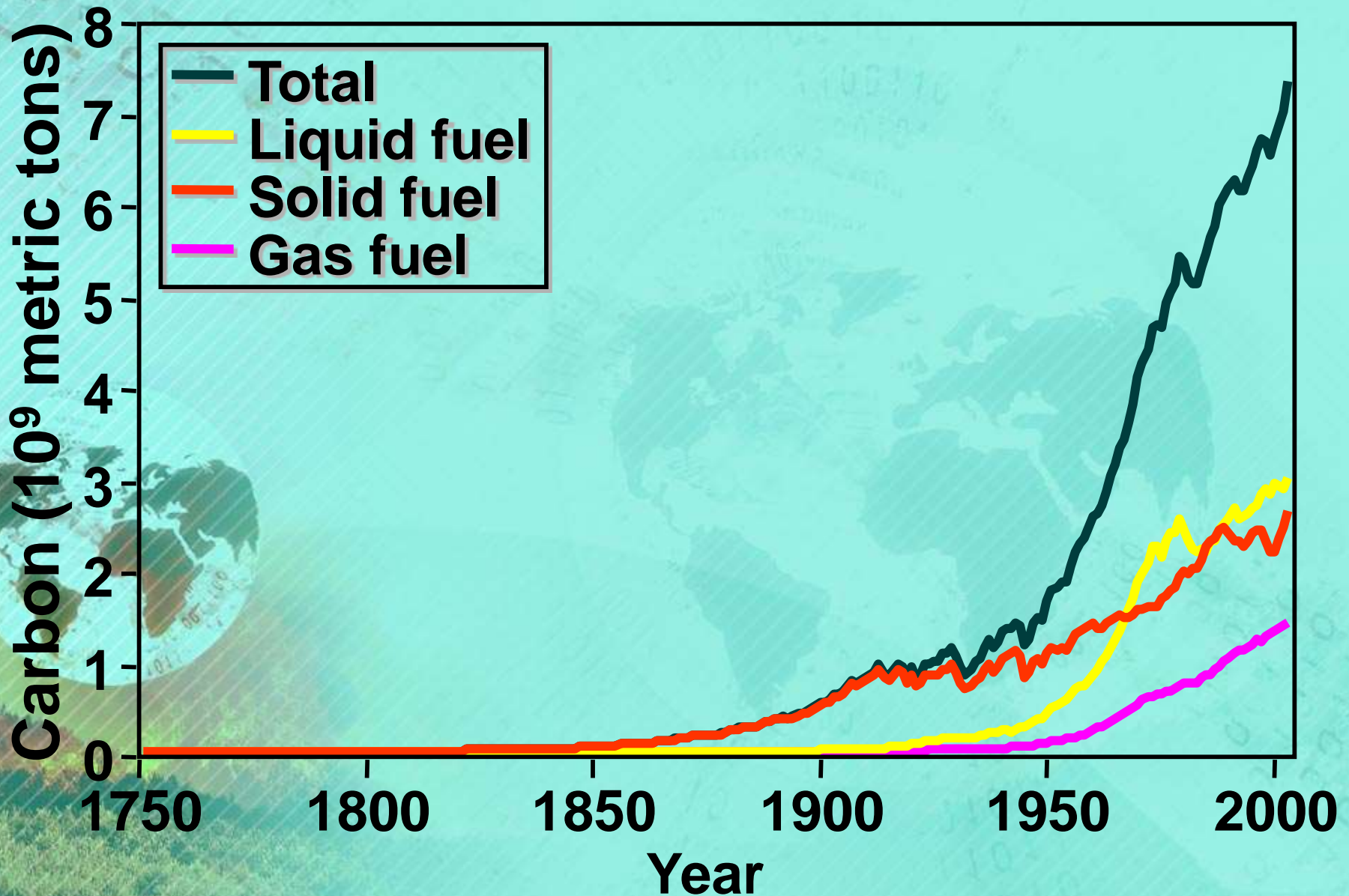
**...potentially causing "runaway global warming".**

**6.4 billion metric tons  
CO<sub>2</sub>/yr**

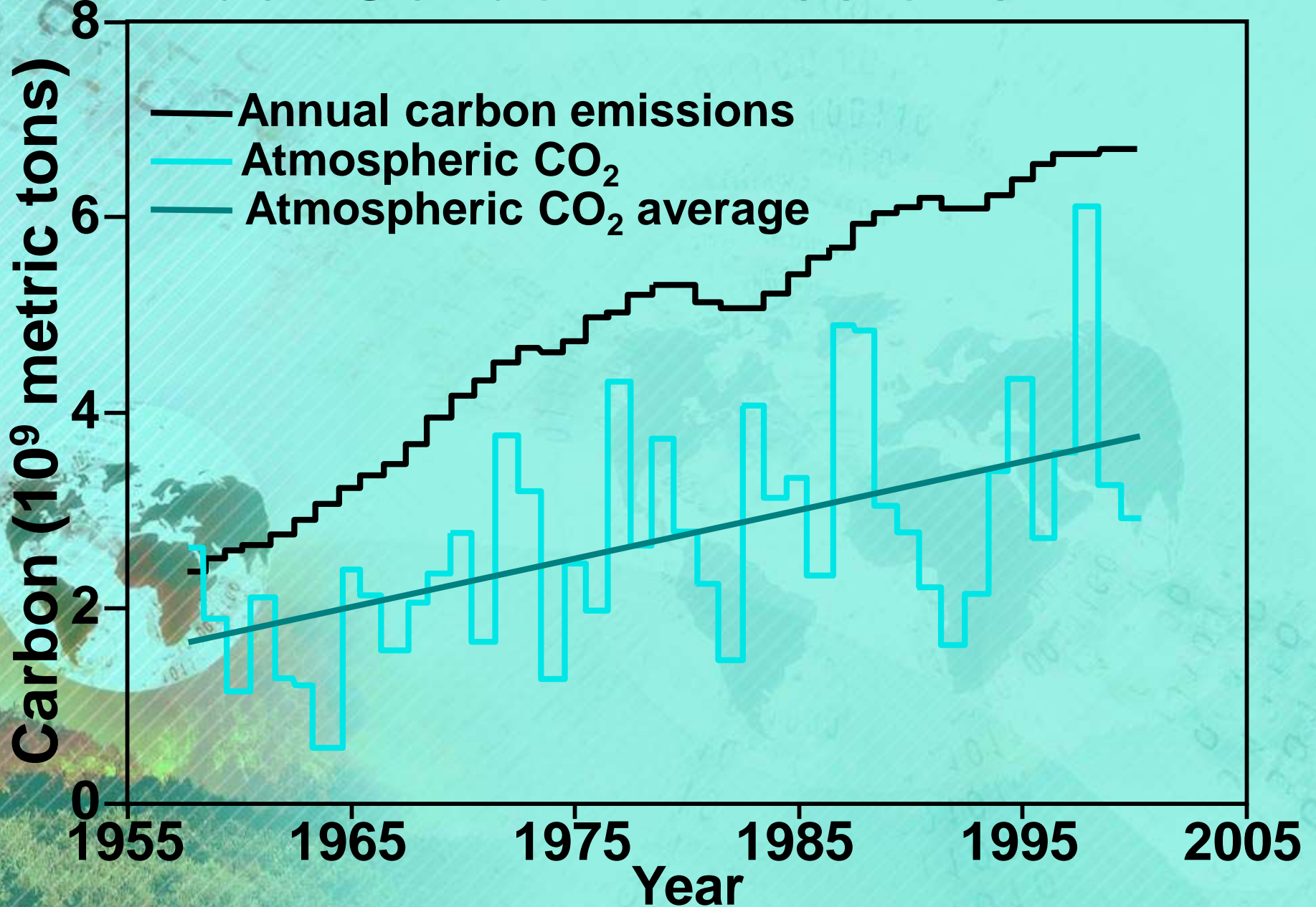




# Worldwide Carbon Emissions



# Annual Carbon Emissions





# Future Carbon Dioxide Levels

- Increasing CO<sub>2</sub> emissions, especially in China and developing countries
- Likely to double within 150 years:
  - Increased coal usage
  - Increased natural gas usage
  - Decreased petroleum usage (increased cost and decreasing supply)



# Households are Big Contributors to Climate Change

40%

Of all U.S. greenhouse gas emissions come from households:

- Vehicles
- Home Heating
- Electricity



So how can each of us slow  
global warming now?



# Reduce our consumption of fossil fuels

Because greenhouse gas emissions are tied very closely to our energy consumption, using less fossil fuel based energy puts fewer greenhouse gases into the atmosphere.

This will help slow global warming.

**Mountaintop removal for coal mining near Rawl, West Virginia.**

**50% of electricity in the United States is produced from coal.**





# Average Electricity Emission Factors

Region/State	CO2 lb/kWh	CO2 tons/MWh	CO2 Metric tons/MWh	CH4 lbs/MWh	NO2 lbs/MWh
South Atlantic	1.35	0.674	0.612	0.0127	0.0207
North Carolina	1.24	0.621	0.563	0.0105	0.0203
Virginia	1.16	0.582	0.528	0.0137	0.0192
<u>West Virginia</u>	1.98	0.998	0.897	0.0137	0.0316

# Kitchen Light Fixture



**Three 60 Watt Bulbs**





# How much energy are those bulbs using?

1	2	3	4	5	6	7
Wattage of the bulbs	# of bulbs	Watts Used (Wattage x number of bulbs)	Hours used per day	Watts Used (#3) x Total Hours/day (#4)	Watts hours / year (#5 x 365 days)	Kilowatt hours / year (1000Wh = 1kWh) (divide #6 by 1000)
(Incandescent bulbs) 60 W	3 bulbs	(60 x 3)  180 W	10 hours a day	(180 x 10)  1800 Wh/day	(1800 x 365)  640,800 Wh/ year	(640,800/1000)  640.8 kWh per year
(CFL bulbs) 18 W	3 bulbs	18 x 3  54 W	10 hours a day	54 x 10  540 Wh/day	540x365  197,100 Wh/day	197,100 <hr/> 1000 197.1 kWh/yr

### 3 BULB REPLACEMENT EMISSION and COST COMPARISON INCANDESCENT vs. COMPACT FLUORESCENT

	Incandescents	Compact Fluorescents (CFLs)
Total kWh for 3 bulb (#7 from above)	<b>640.8 kWh</b>	<b>197 kWh</b>
Cost (kWh #7 x \$.18)	<b>\$115.34</b>	<b>\$35.46</b>
CO <sub>2</sub> produced @ 1.16 lbs/kWh	<b>743.3</b> lbs	<b>228.52</b> lbs
<b>CO<sub>2</sub> <u>not</u> emitted by switching 3 bulbs</b> (C O <sub>2</sub> of incandescents - C O <sub>2</sub> of CFLs)		<b>514.8</b> lbs
<b>Money saved in energy</b> (Cost incandescents - cost of CFLs)		<b>\$79.88</b>



We can make some simple substitutions

Replacing just **1** incandescent light bulb with **1** compact florescent bulb saves about **150 pounds of carbon dioxide per year!**



**If every American household replaced just 5 high-use incandescent bulbs with compact florescent lights we'd collectively save more than \$8 billion each year in energy costs and we would prevent the greenhouse gases equivalent to the emissions from nearly 10 million cars.**

# Small changes really add up

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Replace your old refrigerator with a new Energy Star:  
Annual savings:  
\$90; 700 pounds CO<sub>2</sub>



Set your thermostat down a few degrees in the winter  
Annual savings:  
\$135; 1400 pounds CO<sub>2</sub>



Drive JUST 10 fewer miles per week  
Annual savings:  
\$80; 520 pounds CO<sub>2</sub>



Wash clothes in cold water only  
Annual savings:  
\$70; 500 pounds CO<sub>2</sub>



Reduce your garbage by 10% through greater recycling or reduced packaging  
Annual savings:  
1200 pounds CO<sub>2</sub>



Caulk and weather-strip around doors and windows  
Annual savings:  
\$80; 650 pounds CO<sub>2</sub>

\* These are mid-range estimates from published sources; your savings may vary.



# Blowing Up Your World

- 1. How many of you leave your bedroom light on when you are not in the room?
- *Turning off lights saves energy and money. The more energy used, the more rivers are dammed or more fossil fuel is burned, causing air pollution and increased levels of carbon dioxide in the atmosphere.* 2 pts d



# Blowing Up Your World

- How many of you walked, bicycled or took public transportation to get to school today, instead of coming by private automobile?

***Our reliance on cars that burn fossil fuels is one of the major causes of increased levels of carbon dioxide in the atmosphere and it is the primary cause of urban smog.***

***3 pts u***



# Blowing Up Your World

- How many of you, when you drink a soft drink, throw the container into the garbage?
- *Throwing away containers of any kind wastes energy and resources and adds to our waste problem. Many towns are running out of landfill space. 3 pts d*



# Blowing Up Your World

A vibrant assortment of fresh vegetables including corn, tomatoes, bell peppers, and broccoli.

**How many of you eat fresh vegetables instead of canned or frozen?**

***Fresh vegetables cook more quickly and are usually more nutritious than frozen or canned foods. Canned and frozen vegetables are often over-processed, contain additives, contribute to air pollution (transport and packaging) and add to our waste problem. 4 pts u***



# Blowing Up Your World

- How many of you use a hairdryer or other energy-consuming convenience appliance, especially in the morning?
- *Hairdryers use a lot of energy. In the morning so much energy demand is put on our grids that power companies have to find other sources of energy just to meet the morning rush hour* 2 pts d

# Blowing Up Your World

- . How many of you, when you go to a store, get a bag for your purchases, even if you have only one or two small items to carry?
- *Making paper and plastic bags uses energy and resources. The bags add to our litter and waste problems, and plastic is not biodegradable. Recycling is not the best answer because collecting and recycling materials requires energy. Instead, carry a reusable cloth bag or a knapsack with you.*  
3 pts d



# Blowing Up Your World

**How many of you carry your lunch to school in a lunch box or reusable container?**

***Making paper and plastic bags uses energy and resources. 3 pts u***

# Blowing Up Your World

- How many of you eat take-out or cafeteria food that is served in foam or plastic containers?
- ***Polystyrene and other plastic containers are made from precious petrochemicals, do not decompose in landfills, and release toxic gases when they are burned in incinerators.***  
***10 pts d***



# Blowing Up Your World

- How many of you use handkerchiefs instead of tissues and use cloth towels instead of paper towels?
- *Paper comes from trees. The more of it we use, the more trees that are cut down 2 pts d*



# Blowing Up Your World

- How many are changing incandescent bulbs for new compact fluorescent bulbs?

**Changing one bulb could save 150 pounds of carbon dioxide per year!**

**10 pts u**





# Blowing Up Your World

- 31 - 40 Very good. You're an environmentalist!
- 21 - 30 Good, you're starting to save the world.
- 11 - 20 Lots of room for improvement.
- 0 - 10 You're exiled to the town dump!



## **Our take-home message...**



**Each of us must take steps to protect our Earth's climate.**