

Using Energy in the Real World

Objectives

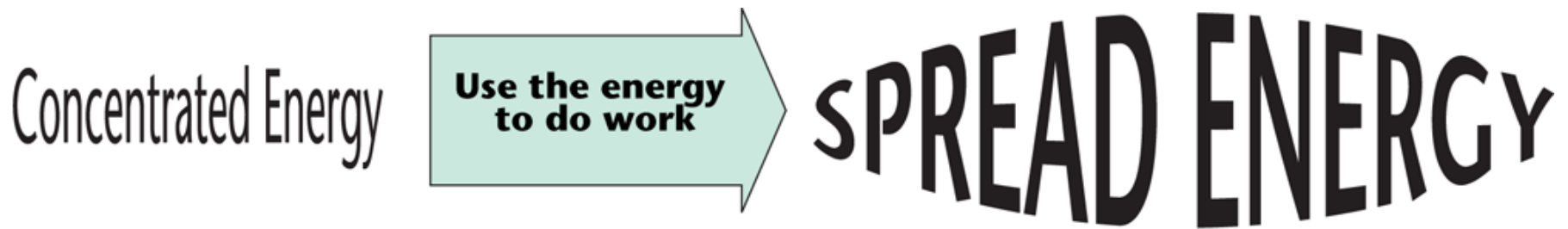
1. To understand how the quality of energy changes as it is used
2. To consider the energy resources of our world
3. To understand energy as a driving force for natural processes

Section 10.4

Using Energy in the Real World

A. Quality Versus Quantity of Energy

- When we use energy to do work we degrade its usefulness.

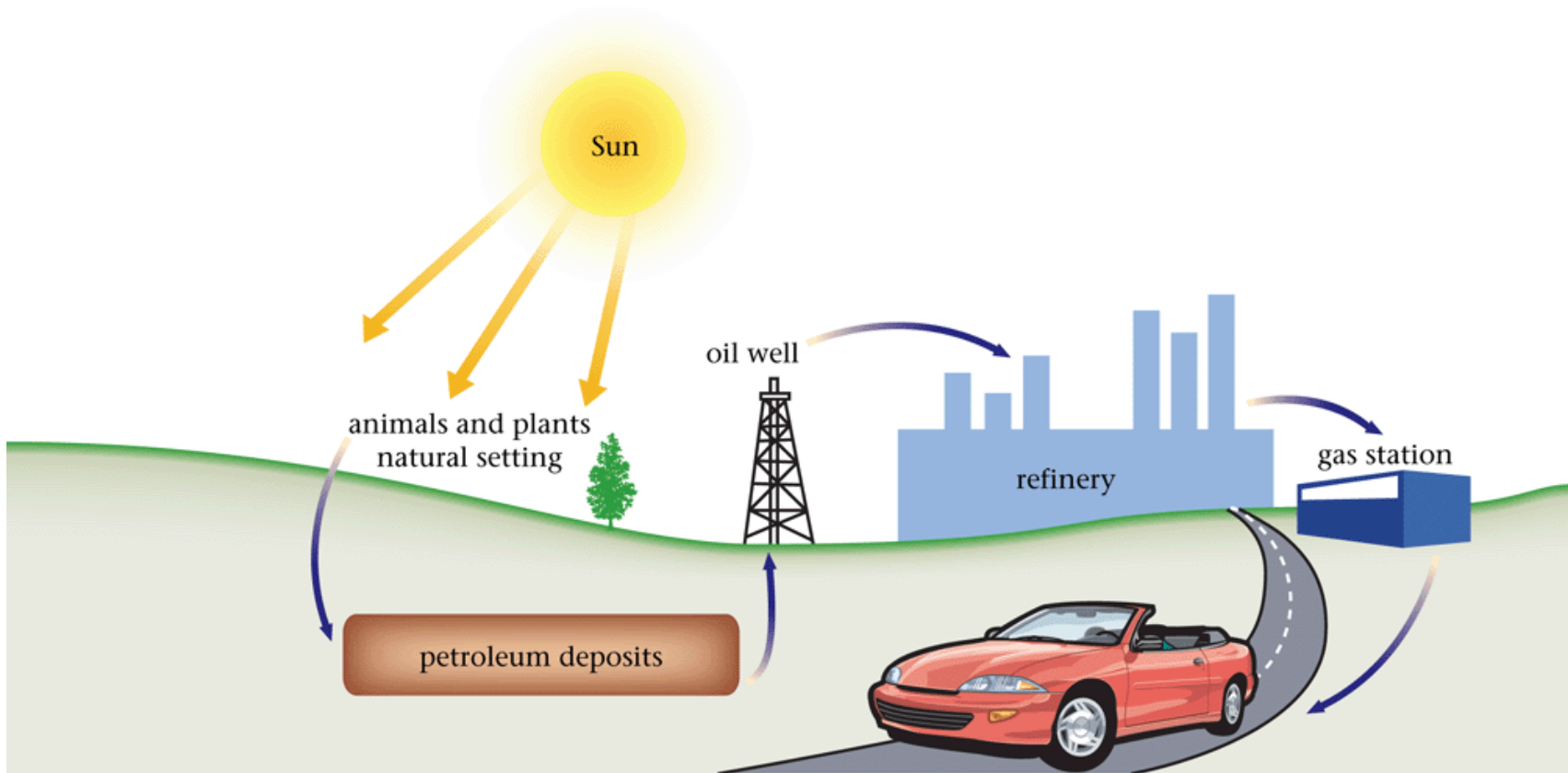


Section 10.4

Using Energy in the Real World

A. Quality Versus Quantity of Energy

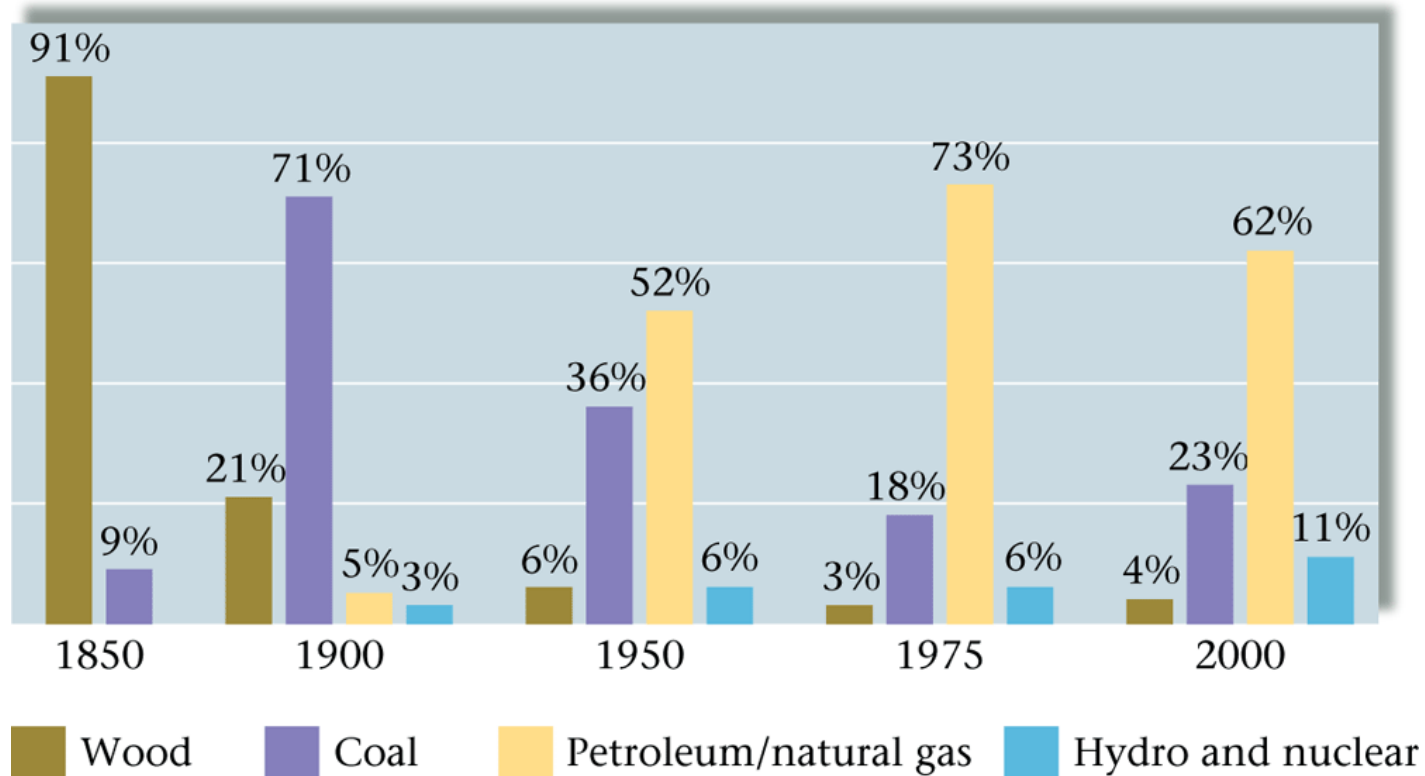
- Petroleum as energy



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B. Energy and Our World

- **Fossil fuel** – carbon based molecules from decomposing plants and animals
 - Energy source for United States



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B. Energy and Our World

- **Petroleum** – thick liquids composed of mainly hydrocarbons
 - Hydrocarbon – compound composed of C and H

Uses of the Various Petroleum Fractions

Petroleum Fraction in Terms of Numbers of Carbon Atoms	Major Uses
C_5-C_{10}	Gasoline
$C_{10}-C_{18}$	Kerosene Jet fuel
$C_{15}-C_{25}$	Diesel fuel Heating oil Lubricating oil
$>C_{25}$	Asphalt

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B. Energy and Our World

- **Natural gas** – gas composed of hydrocarbons

Names and Formulas for Some Common Hydrocarbons

Formula	Name
CH_4	Methane
C_2H_6	Ethane
C_3H_8	Propane
C_4H_{10}	Butane
C_5H_{12}	Pentane
C_6H_{14}	Hexane
C_7H_{16}	Heptane
C_8H_{18}	Octane

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B. Energy and Our World

- **Coal** – formed from the remains of plants under high pressure and heat over time

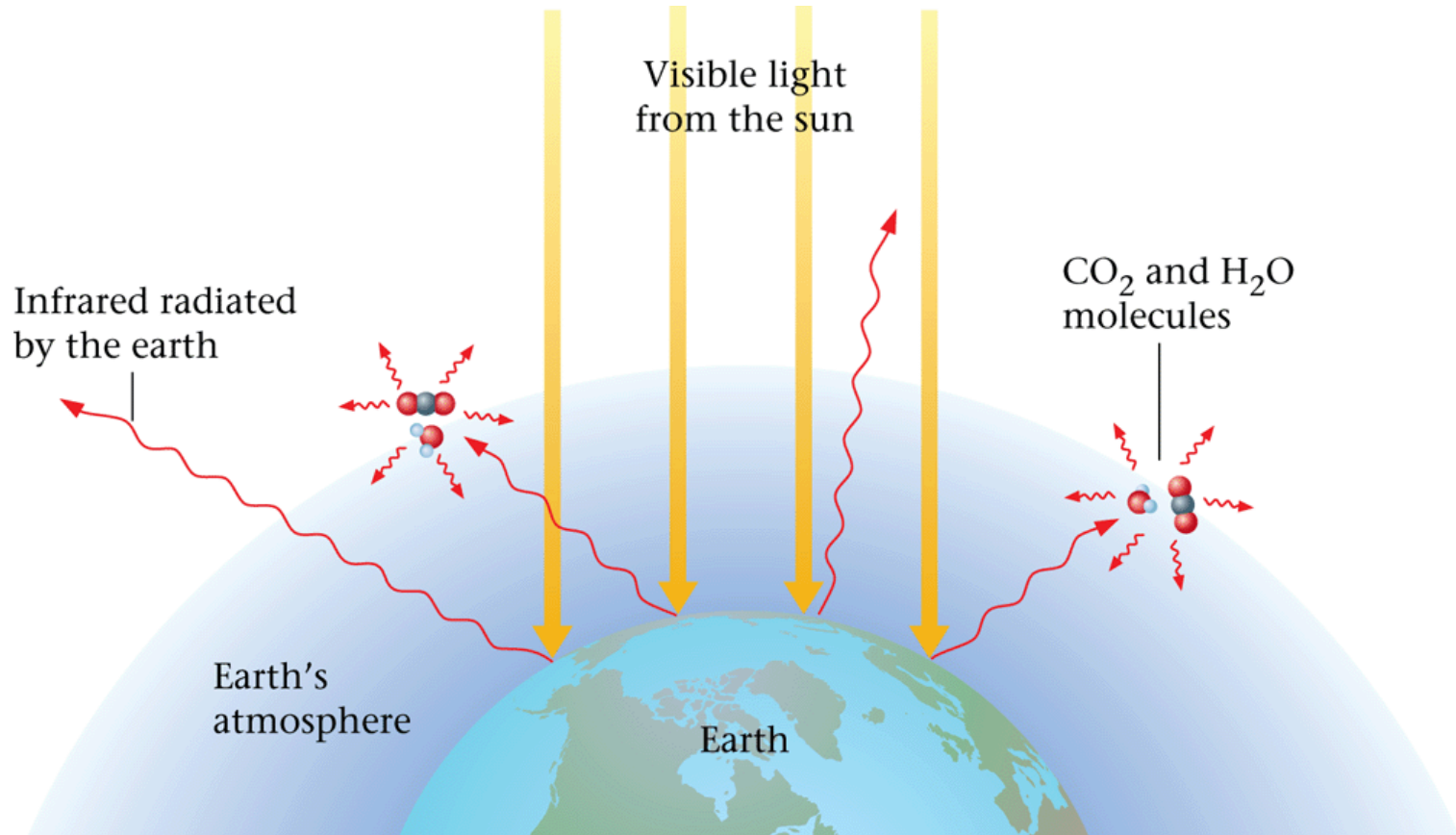
Element Composition of Various Types of Coal

Type of Coal	Mass Percent of Each Element				
	C	H	O	N	S
Lignite	71	4	23	1	1
Subbituminous	77	5	16	1	1
Bituminous	80	6	8	1	5
Anthracite	92	3	3	1	1

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B. Energy and Our World

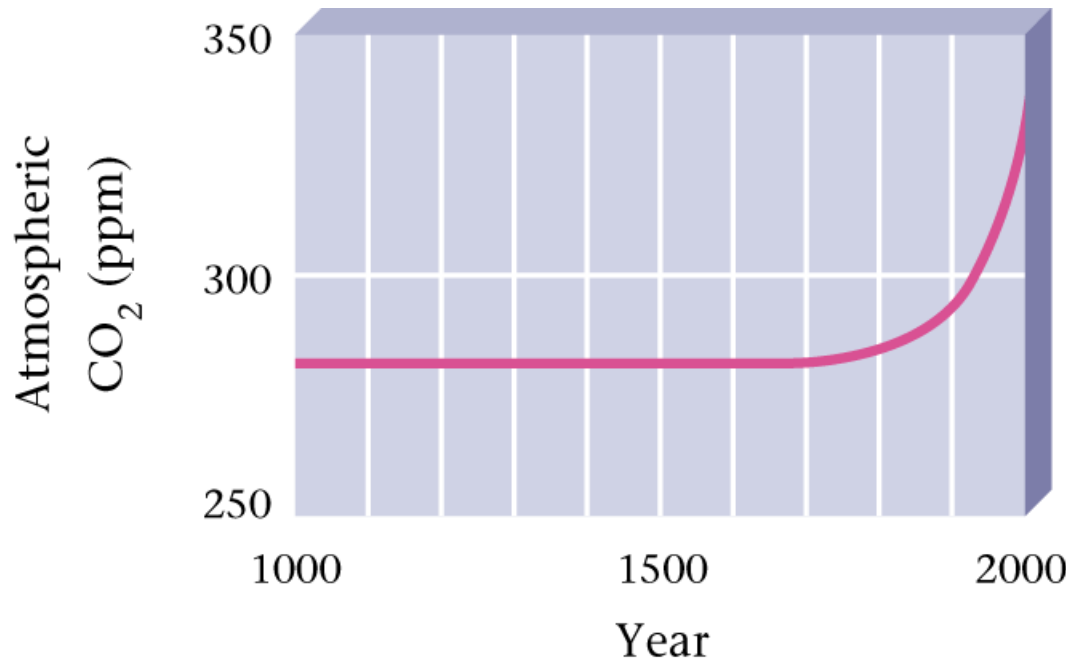
- Effects of carbon dioxide on climate
- Greenhouse effect



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B. Energy and Our World

- Effects of carbon dioxide on climate
- Atmospheric CO₂
 - Controlled by water cycle
 - Could increase temperature by 10°C



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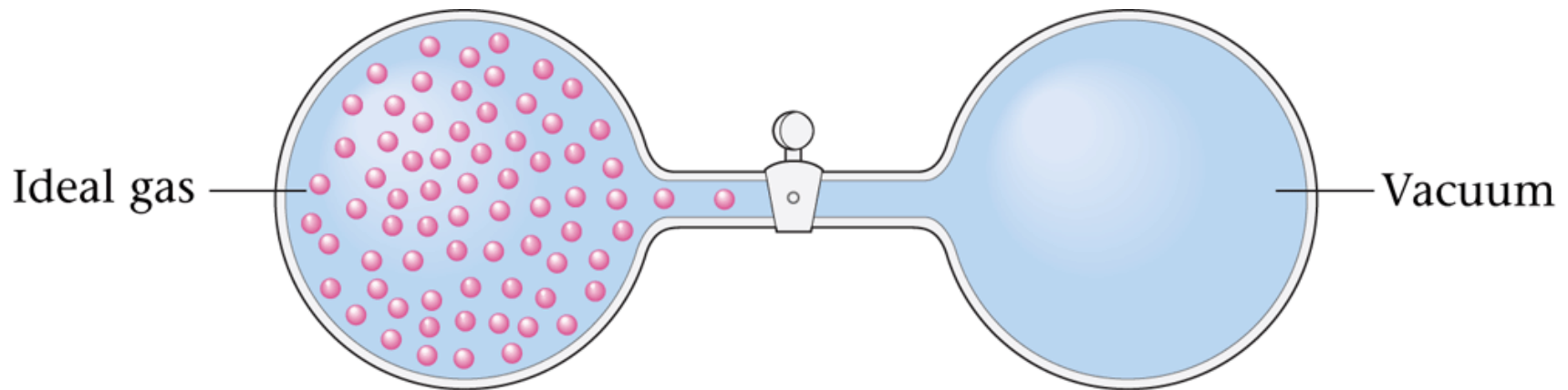
B. Energy and Our World

- New energy sources
 - Solar
 - Nuclear
 - Biomass
 - Wind
 - Synthetic fuels

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C. Energy as a Driving Force

- Natural processes occur in the direction that leads to an increase in the disorder of the universe.
- Example:
 - Consider a gas trapped as shown

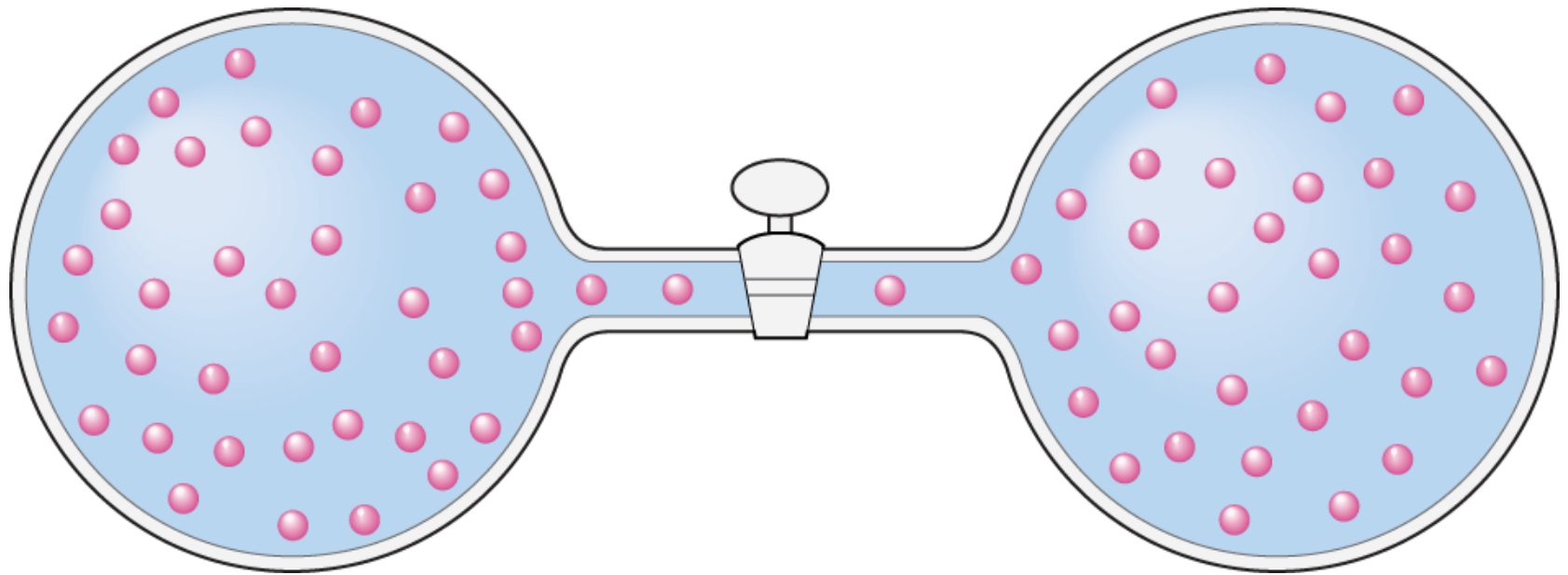


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C. Energy as a Driving Force

- What happens when the valve is opened?



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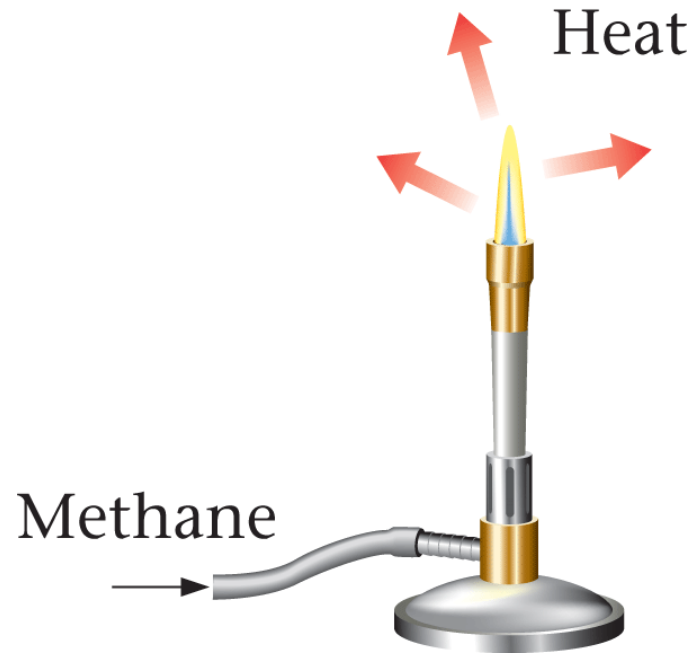
C. Energy as a Driving Force

- Two driving forces
 - Energy spread
 - Matter spread

Using Energy in the Real World

C. Energy as a Driving Force

- Energy spread
 - In a given process concentrated energy is dispersed widely.

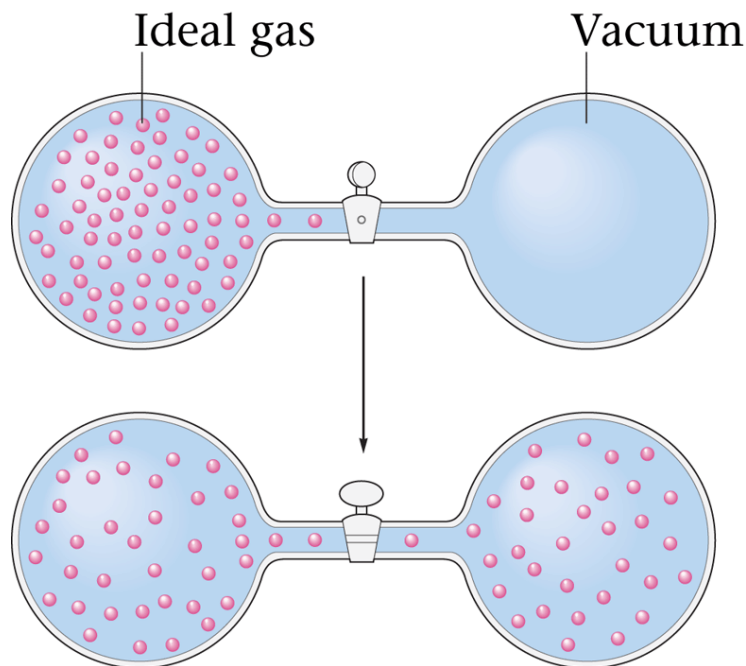


- This happens in every exothermic process.

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C. Energy as a Driving Force

- Matter spread
 - Molecules of a substance spread out to occupy a larger volume.

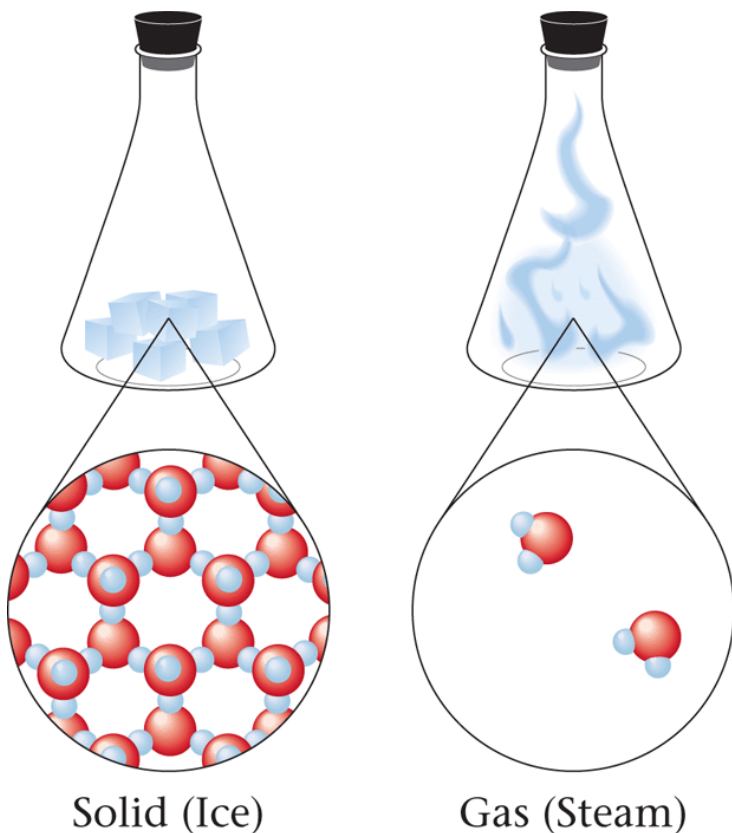


- Processes are favored if they involve energy and matter spread.

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C. Energy as a Driving Force

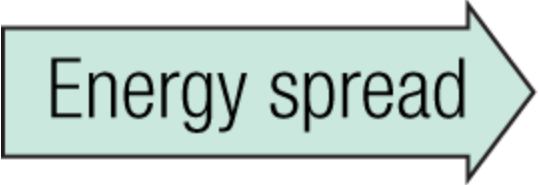
- **Entropy, S** – function which keeps track of the tendency for the components of the universe to become disordered



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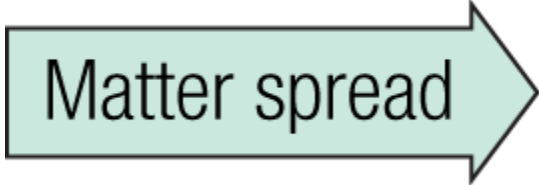
C. Energy as a Driving Force

- What happens to the disorder in the universe as energy and matter spread?



Energy spread

Faster random motions of the molecules in surroundings



Matter spread

Components of matter are dispersed—they occupy a larger volume

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C. Energy as a Driving Force

- Second law of thermodynamics
 - The entropy of the universe is always increasing.