

## Preview of Period 6a: Entropy

### 6.1 Conservation of Energy and the 1<sup>st</sup> Law of Thermodynamics

How does conservation of energy relate to molecular motion?

What is the 1<sup>st</sup> Law of Thermodynamics?

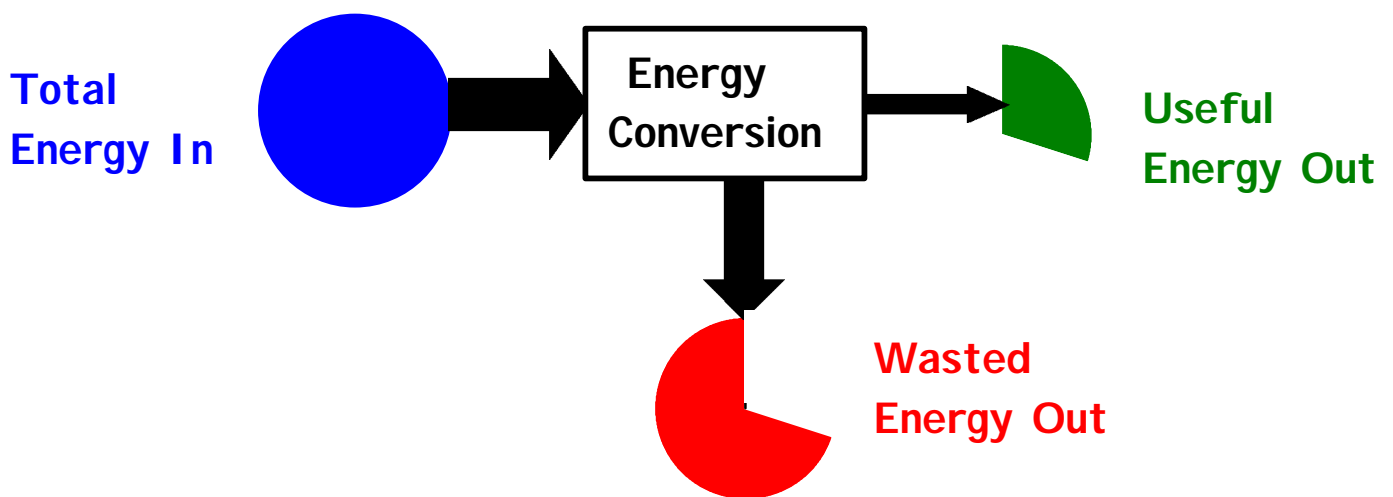
### 6.2 Order, Disorder and Entropy

What defines an “orderly” pattern?

What is entropy? Why does it increase?

## The law of conservation of energy:

- ◆ Energy can be neither created nor destroyed.
- ◆ The total amount of energy we have now in the Universe is the same amount that existed at its beginning.
- ◆ All the energy that goes into a conversion process must come out.
- ◆ In every energy conversion, some energy is wasted, often in the form of thermal energy.
- ◆ When applied to thermodynamic systems, the law of conservation of energy is called the **first law of thermodynamics**.



How is energy conserved by the rolling carts?

## First Law of Thermodynamics

The change in internal energy of a system  $DU$  equals the heat  $Q$  added to or subtracted from the system minus the work  $W$  done by the system

$$DU = Q - W$$

$U$  = total internal energy (joules)

$DU$  = the change in internal energy (joules)

$Q$  = heat added to or subtracted from the system (joules)

$W$  = work done by the system (joules)

- **Total internal energy** is the kinetic energy of the molecules plus the potential energy stored in molecular attractions.
- It is not possible to get more energy out of a system that is put into the system!

## Act 6.2: Ordered and Disordered Checkers

R	R
R	R

R	B
R	R

R	R
B	R

R	R
R	B

R	R
B	B



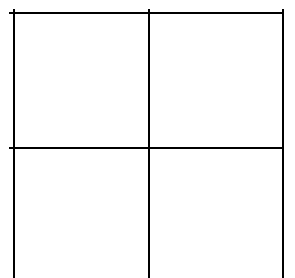
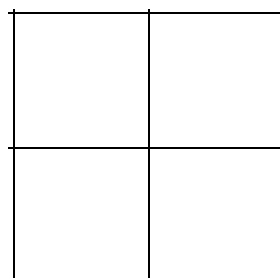
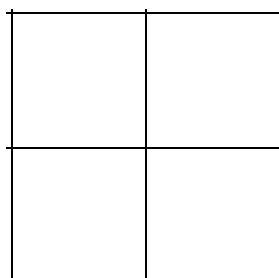
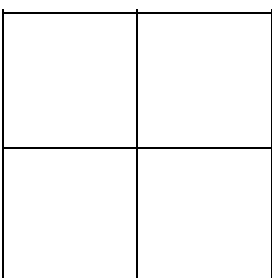
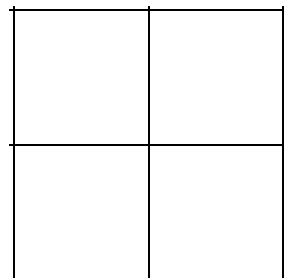
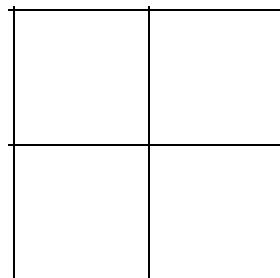
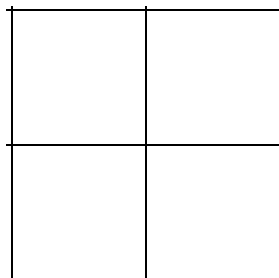
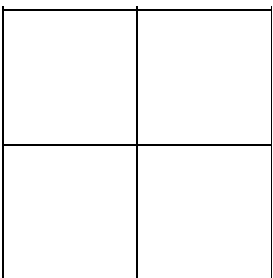
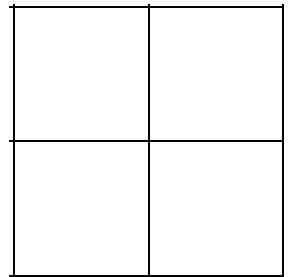
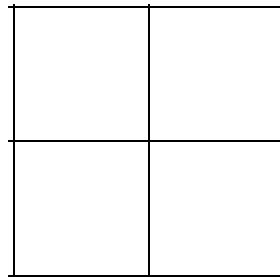
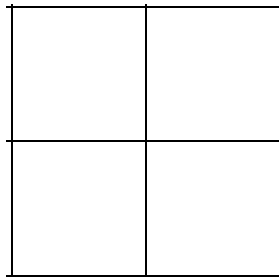
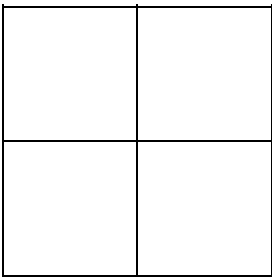
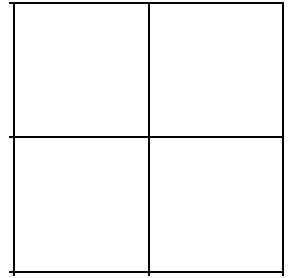
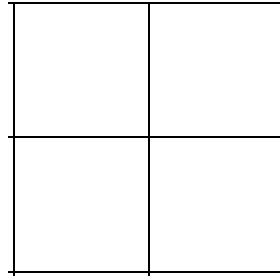
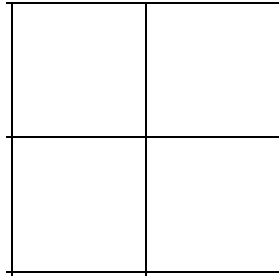
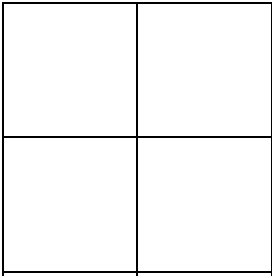









## Act 6.2: Ordered and Disordered Checkers



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R	R
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R	B
R	R

R	R
B	R

R	R
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R	R
B	B

B	R
R	R

B	R
R	B

R	B
B	R

B	B
R	R

R	B
R	B

B	R
B	R

R	B
B	B

B	B
R	B

B	B
B	R

B	R
B	B

B	B
B	B

## Entropy (Disorder) and the 2<sup>nd</sup> Law of Thermodynamics

- ◆ Entropy is the measure of degree of order or disorder of a system.
- ◆ The greater the disorder, the greater the entropy
- ◆ Order and disorder are always described in relation to a set of rules or property.
- ◆ In most physical situations there are more disordered than ordered states.
- ◆ The entropy (disorder) of the Universe always increases.
- ◆ To reduce the entropy of a system, work must be done on that system.

We will discuss entropy and the 2<sup>nd</sup> law of thermodynamics in more detail next time.

## Period 6a Summary

**6.1:** An ordered system conforms to a predetermined set of rules.

In nature, disordered systems are more common than ordered systems because there are many more disorderly arrangements than orderly arrangements.

Entropy is a measure of the degree of disorder of a system.

The greater the disorder, the greater the amount of entropy.

If the temperature is constant, the change in entropy is given by

$$DS = DQ/T$$

Entropy tends to increase with time. For example, ice melts at room temperature or metal rusts when exposed to moisture.

**6.2:** The **first law of thermodynamics** states the change in internal energy of a system equals the heat added to the system minus the work done by the system.

$$DU = Q - W$$