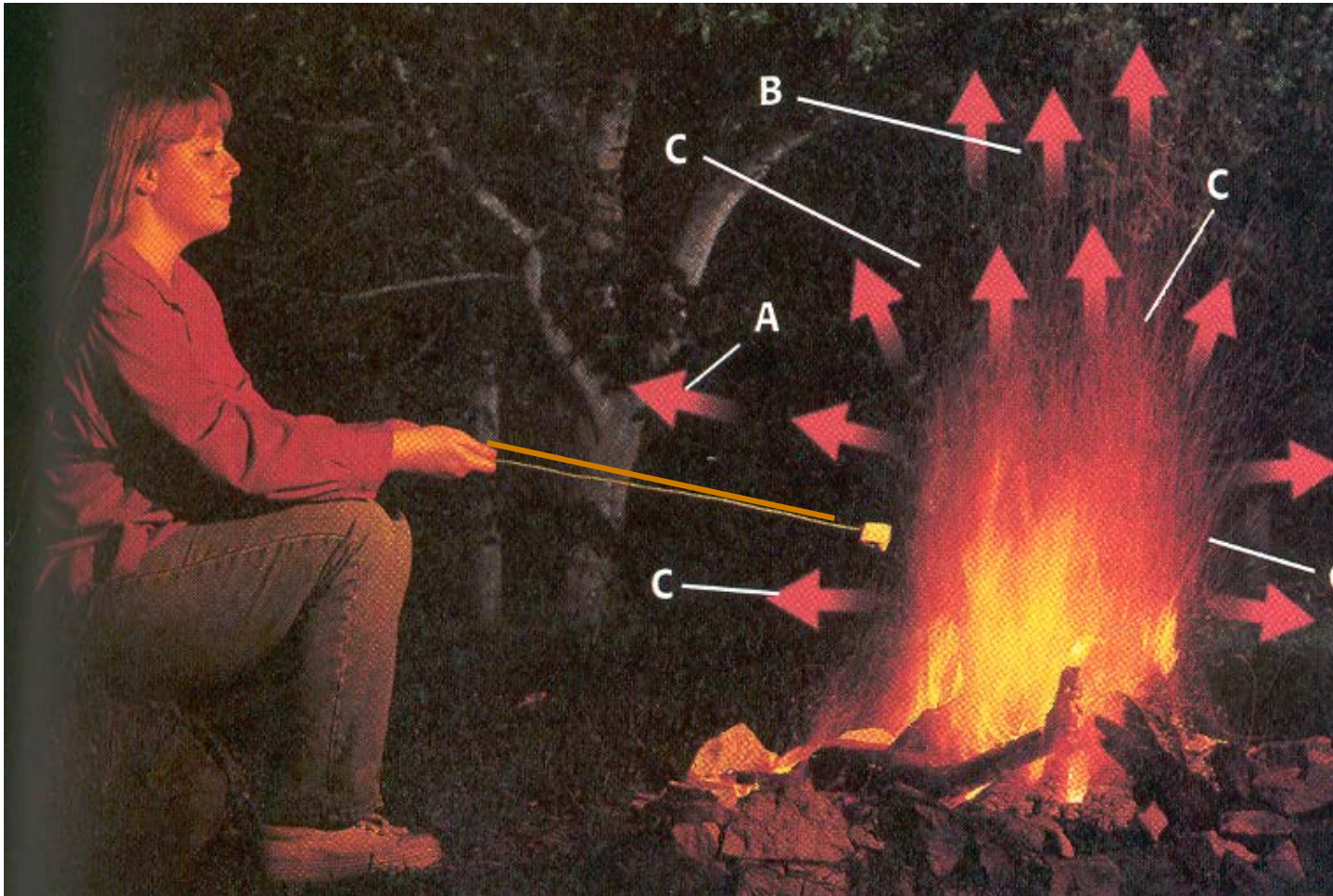
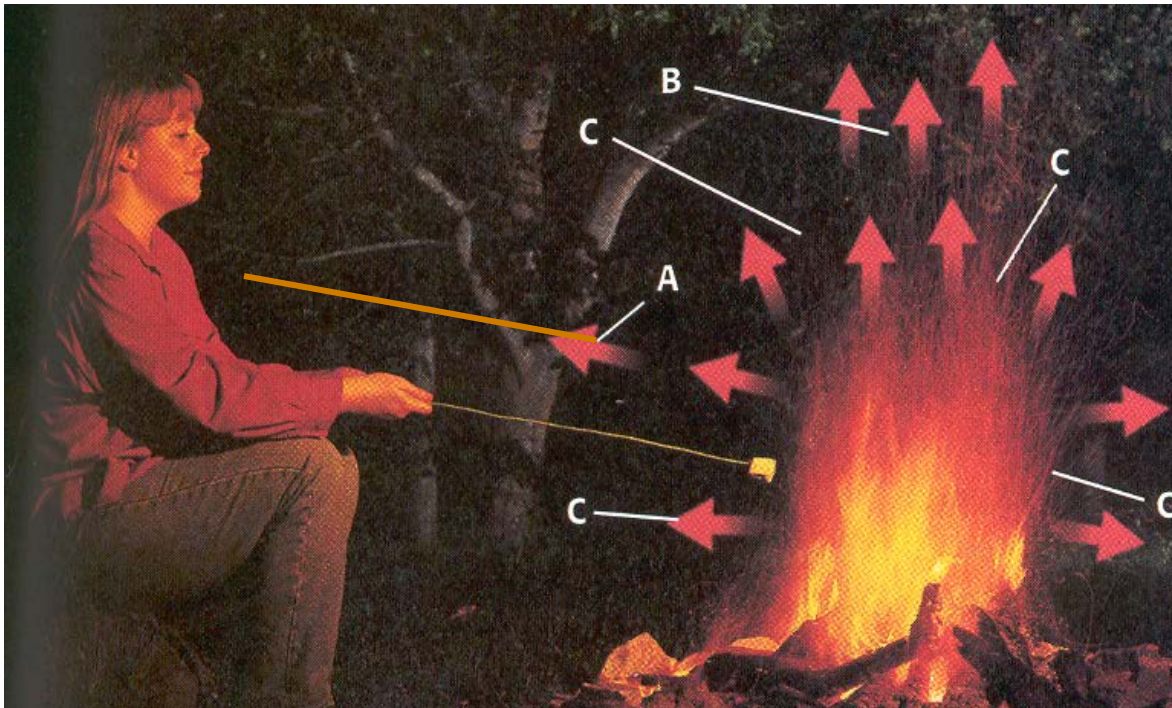
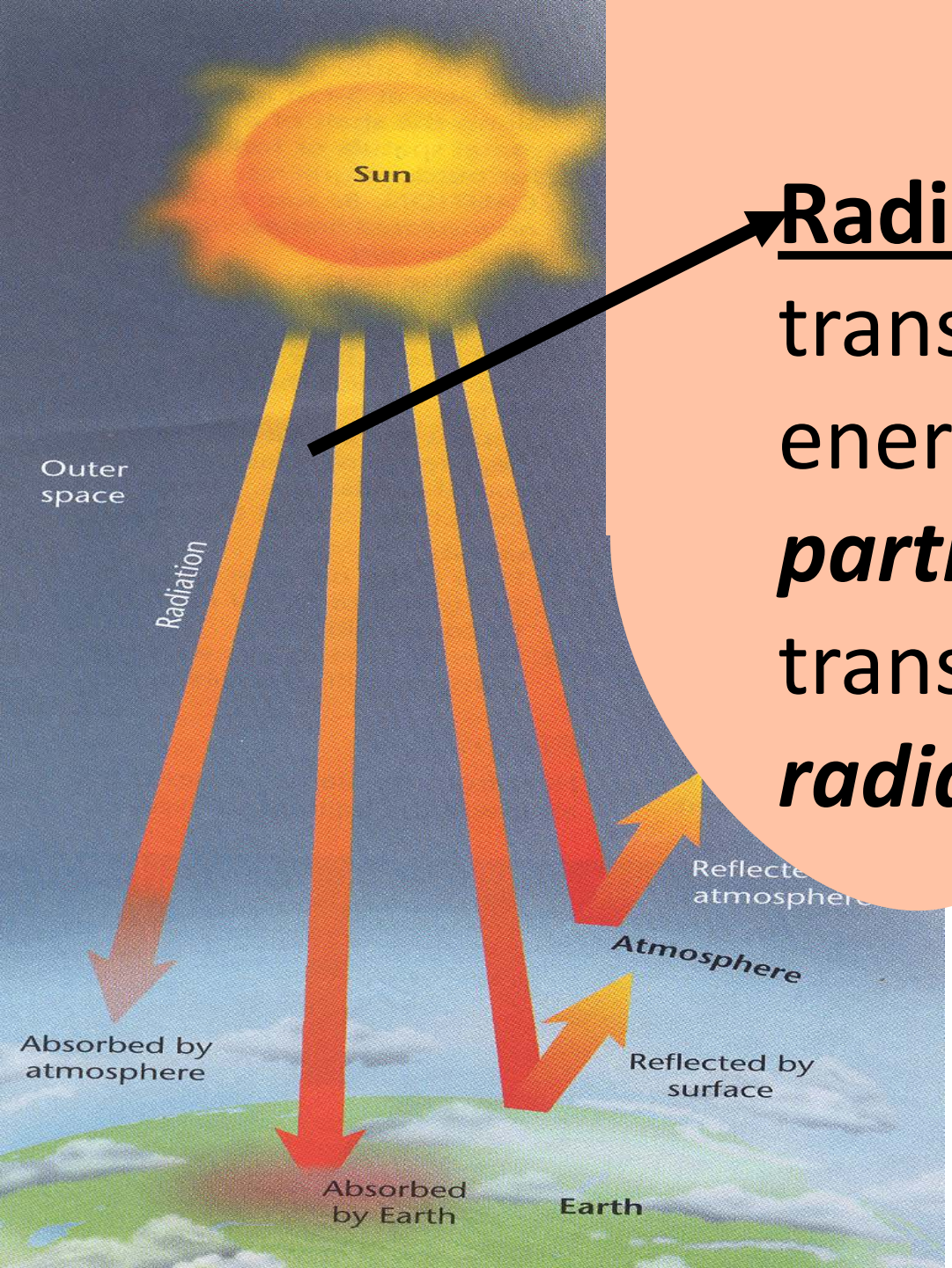
Thermal Energy Transfer (Heat)

<u>Conduction</u> is the transfer of thermal energy by direct contact between particles.



<u>Convection</u> is heat transfer that occurs in moving fluids. **<u>Hot liquids and gases rise</u>.** ***<u>Cold liquids and gases fall</u>*.** This creates currents that carry thermal energy .





<u>Radiation</u> is the transfer of thermal energy by waves. ***No particles are needed*** to transfer energy ***by radiation***.

Temperature Scales

- **Fahrenheit (English)**
- **Celsius (Metric)**
- **Kelvin (Standard)**

- **The Fahrenheit degree is *smaller than* the *Celsius degree* or *Kelvin.***

- 1 Kelvin unit = 1 ^{o}C scale

Fahrenheit

Freezing point of water 32 °F

BOILING POINT of water 2l2 °F.

On the Celsius temperature scale, (the METRIC SCALE *based on the freezing and boiling point of water*)

water's freezing point is 0 ^{o}C &

water's boiling point is l00 ^{o}C.

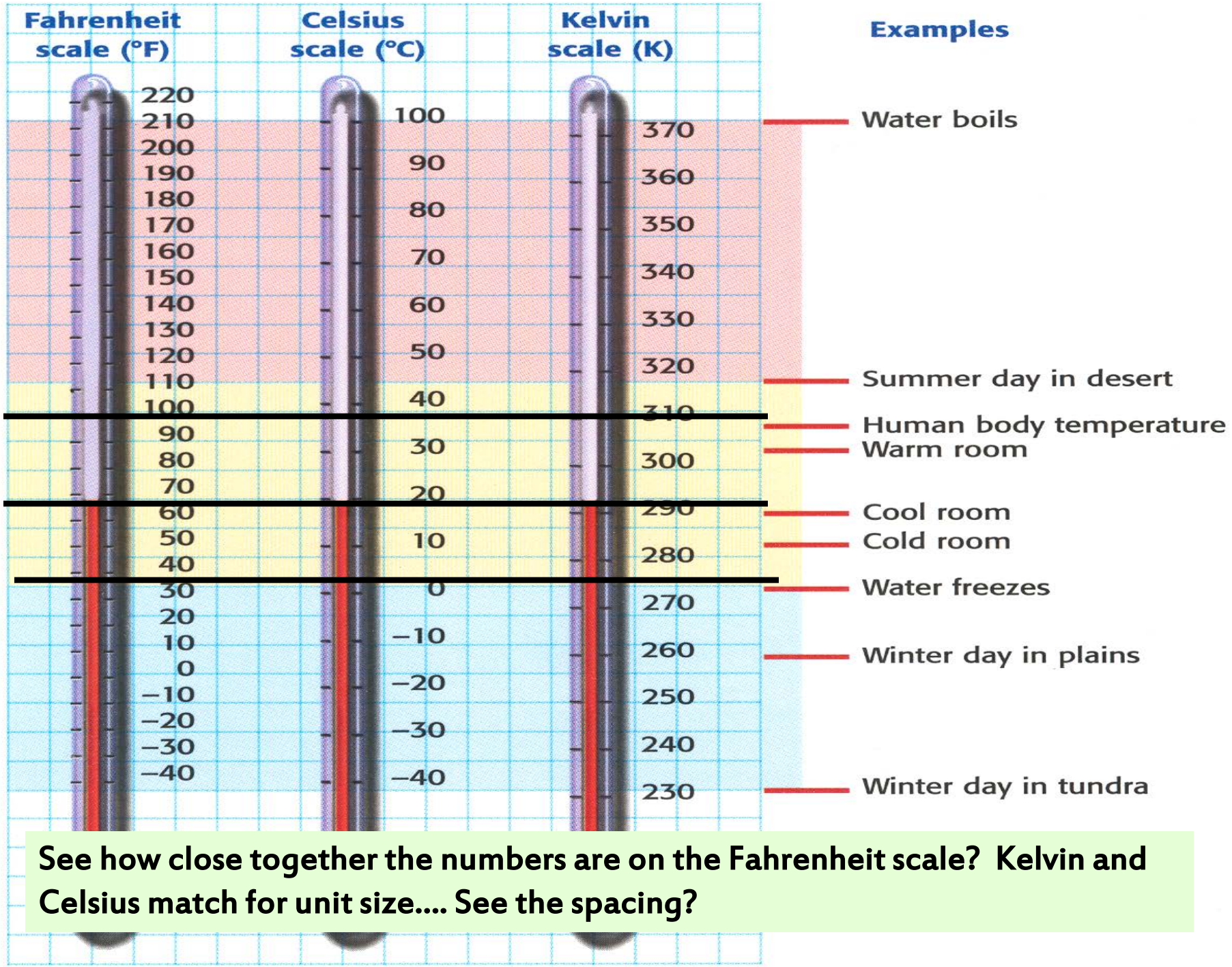
The Kelvin (K) scale is *based on the boiling and freezing point of water and absolute zero.*

The Kelvin scale does not use the degree symbol. The units are Kelvins (K), not degrees Kelvin.

On this scale the lowest possible temperature is absolute zero, written ”0 K."

At absolute zero, the average kinetic energy of particles is zero.

Absolute zero on the Kelvin scale is equal to -273 degrees Celsius.



See how close together the numbers are on the Fahrenheit scale? Kelvin and Celsius match for unit size.... See the spacing?

In a liquid thermometer, as the temperature rises the liquid expands (gets bigger) and rises in the tube.

As the temperature falls, the liquid contracts (gets smaller) and sinks in the tube.

Temperature Conversion Formulas:

$^{o}C = K - 273$

$K = {}^{o}C + 273$

$$^{o}C = \frac{(^{o}F - 32)}{1.8}$$

$^{o}F = (1.8\,^{o}C) + 32$

Steps for using temperature conversion formulas:

see next page →

Thermal Energy is the *total** *kinetic energy* of all the particles in a sample of matter.

Temperature is a measure of the *average** *kinetic energy* of a substance.

END ON LONG DAY!! TEMP CONVERSION WS

The three factors that determine the amount of thermal energy are: mass, temperature of the object , and

Mass: 1 hot dog **(less mass) holds less energy** than the entire package of hot dogs.

A package of **8** hot dogs **(more mass)** at the same temp. **would have more thermal energy inside (total).**

Temperature: A **warm** hot dog **has more energy in it than a frozen one.**

Specific Heat Capacity :

The amount of energy necessary to raise the temperature of 1 gram of the material 1 degree Celsius

Some materials are easier (require less energy) to heat than others.

Metal is easier to heat up than wood. Metal has a lower specific heat capacity and therefore is likely to gain thermal energy easily.... Metals heat up and cool down FAST!

The higher the specific heat, the more energy the material contains when **it is at the same temperature as a material with a lower specific heat.**

2 kg of Copper (385 J/kg*^{o}C)

2 kg of Glass [664 J/kg*^{o}C]

If both are 20 ^{o}C, Glass has more energy!

Calculating Thermal Energy

$Q = mc\Delta T$

Q = change in thermal energy

Joules (J)

m = mass (kg)

c = specific heat (J/kg*°C)

ΔT = change in temperature °C

Heat is measured as a change in the amount of energy that is *added to* or *removed* from an object.

There is NO such thing as "*cold* energy"!

The unit of *thermal energy* is the joule (J). The joule is the correct unit for measuring any form of energy.

The *c*alorie – the quantity of heat needed to raise the temperature of one gram of water 1^0C.

1 calorie = 4.18 joules

The calorie –

The *C*alorie (also called a *kilocalorie*) – often measures the energy content in food

1 Calorie = *1000 calories*

There is a difference!