Cosmos Episode 12 Worksheet **Name:**_____

http://evolution.about.com/od/teaching/fl/Cosmos-Episode-2-Viewing-Worksheet.htm

Directions: Answer the questions as you watch episode 12 of Cosmos: A Spacetime Odyssey

1. What planet is Neil deGrasse Tyson talking about when he says it used to be paradise? Venus

2. How hot is the surface of Venus? really hot
   864°F hot enough to melt lead

3. What are the clouds that block the Sun on Venus made of?
   H_2SO_4 sulfuric acid

4. Which country landed a probe on Venus in 1982?
   Russians ; USSR

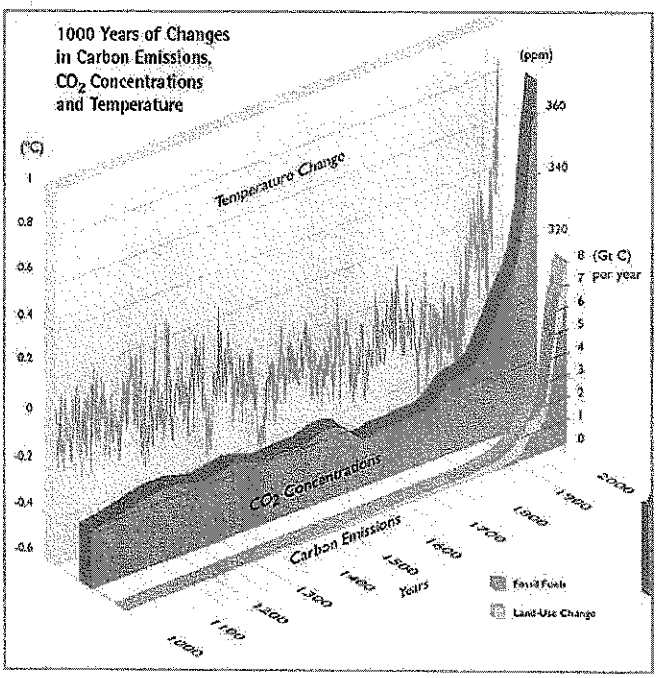
5. What is the difference in the way carbon is stored on Venus and on Earth?
   geysers in rocks

6. What living thing created the White Cliffs of Dover?
   single celled algae

7. What would Venus have needed in order to store carbon in the form of a mineral?
   an ocean

8. What on Earth primarily controls the amount of carbon dioxide in the air?
   our rain forests / forests; although the ocean is also very important!

9. The butterfly analogy used in this episode helps us visualize concentration.
   This is a healthy concentration of CO_2 in the atmosphere 3 /10,000
   This is a concentration that is becoming too warm for humans 10 /10,000



10. What did Charles David Keeling manage to do in 1958?
    measured $[CO_2]$ to see that during winter in Northern Hemisphere $[CO_2]$ ↗ and in summer $[CO_2]$ ↘

11. Look at the graph on the left. What measurements are strongly correlated?
    carbon emissions, CO_2 conc, & temperature change are all strongly correlated. The 3 peak (large change!) at the same time.

12. How can scientists read the "diary" of the Earth written in the snow? ice caps
ancient air is trapped in glacial ice

13. What major event in history is the starting point of the exponential rise of carbon dioxide in the atmosphere?
Industrial Revolution

14. How much carbon dioxide do volcanoes add to the atmosphere on Earth every year?

15. How did scientists conclude the extra carbon dioxide in the air contributing to climate change was not made from volcanoes, but instead comes from burning fossil fuels?
30 billion tons (equal to the White Cliffs of Dover)

16. How much extra carbon dioxide are humans putting into the atmosphere every year by burning fossil fuels?
volcanic-expelled CO_2 is heavier

15. In what year did scientists begin to warn the human populations about the dangers of emitting too much carbon dioxide?
1896

17. What are 4 major types of events that will occur because of global warming:
a) killer heat wave b) increased droughts c) rising sea levels
d) mass extinctions

18. How much additional carbon dioxide has been spewed into the atmosphere since Carl Sagan first warned about doing so in the original "Cosmos" television series in 1980?
~400 billion tons

19. What do Neil deGrasse Tyson and his dog walking on the beach symbolize?
weather vs. climate

20. At what rate are the Arctic Ocean ice caps receding now?

21. How is the permafrost near the North Pole melting increasing carbon dioxide levels?
Permafrost trapped CO_2 + CH_4 a long, long time ago.

22. What are two ways we know that the Sun is not the cause of the current global warming trend?
observable nighttime heating + winter heating

23. What amazing invention did Augustin Mouchot first display in France in 1878?
solar concentrator

24. Why was there no interest in Augustin Mouchot's invention after he won the gold medal at the fair?
the price of coal dropped

25. Why did Frank Shuman's dream of irrigating the desert in Egypt never come to be?
petroleum market exploded; then WWI broke out

26. How much of the wind's power would have to be tapped in order to run all of civilization?
one percent 1%

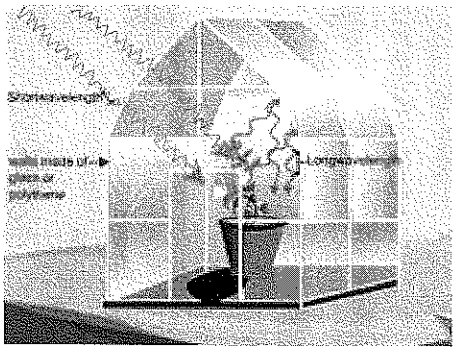
27. One hour of sunlight striking the Earth's surfaces is enough energy to power our entire civilization for how long?
one entire year

28. The manned missions to the moon were a direct result of what period in the United States' history?
the Cold War

29. 10,000 years ago, what change gave birth to "civilization"?
ancient people developed agriculture

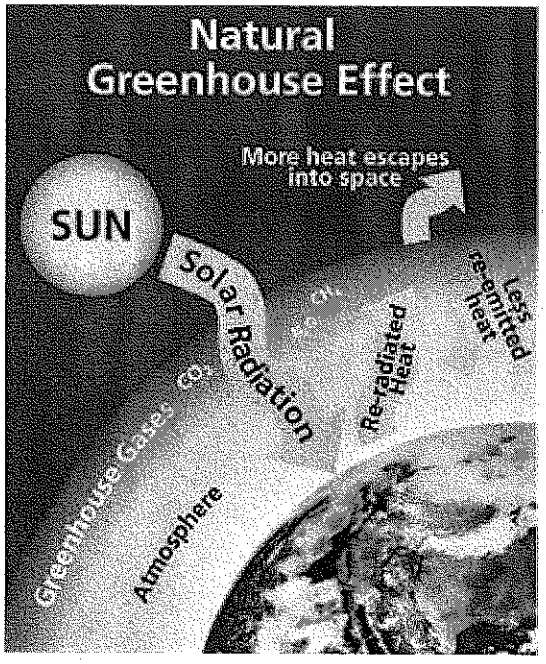
POST-VIEWING QUESTIONS/ RESEARCH _____

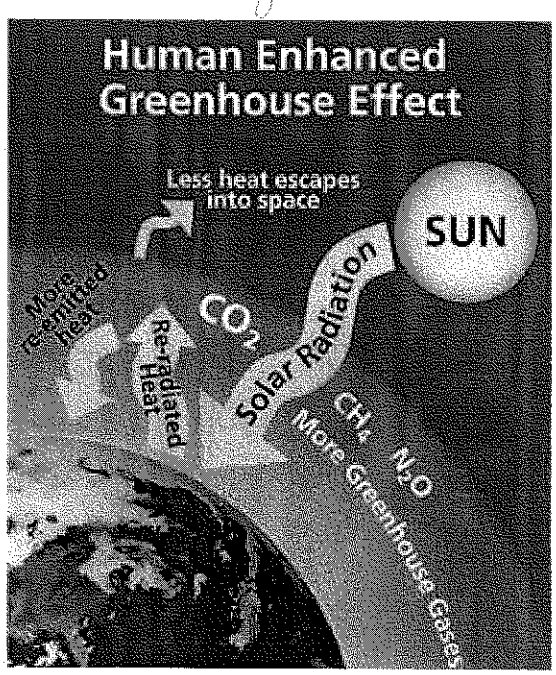
Greenhouse Effect



Describe what is happening in this picture. (How are the plants protected from freezing in the winter months?)

high energy shortwave radiation can pass into the space thru the glass. The plants/air warm up and re-emit the heat energy in the longwave range. The longwave energy cannot pass thru the glass & is trapped. The trapped heat keeps the greenhouse warm, even on freezing nights.





A **greenhouse gas** (sometimes abbreviated **GHG**) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range.(source: Wikipedia.org)

Go to http://www.popsci.com/environment/article/2009-03/top-ten-greenhouse-gases and list the top ten GHG:

10 sulfuryl flouride
9 trichlorofluoromethane
8 sulfur hexaflouride
7 hexafluoroethane
6 trifluoromethane
5 ozone
4 nitrous oxide
3 methane
2 carbon dioxide
1 water vapor

Which of the greenhouse gases is most potent? In other words, which GHG has the highest heat holding capacity? sulfur hexaflouride

Which GHG lingers in the atmosphere the longest? In other words, which one takes the longest to breakdown? hexafluoroethane at 10,000 yrs

What is their #1 listed GHG? water vapor Does this surprise you?

Positive Feedback Loops ---------
There were 2 major positive feedback loops associated with global climate change discussed in the video: Arctic Sea Ice and Methane Release.
First, what is a positive feedback loop? (search for a definition online)

enhance or amplify changes causing a system to become more unstable

CCR and Energy Transformations Practice **Name:** _____

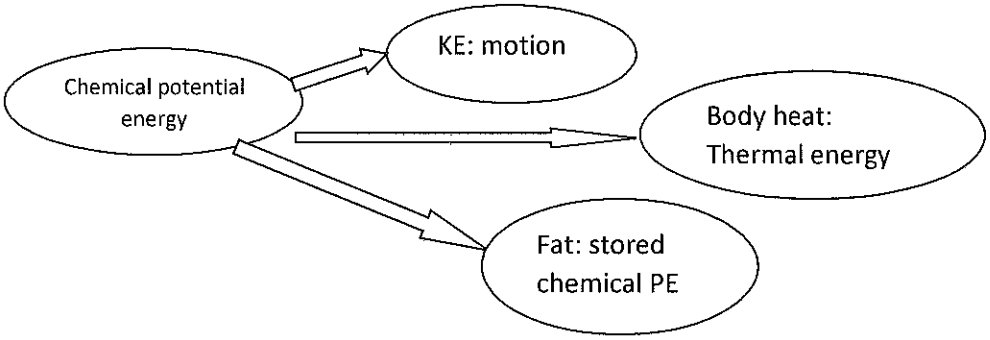
- In the following scenarios, identify and label any example of conduction, convection and/or radiation.
- Also, identify the energy transformations in the scenarios. In the space below the scenario, create a flow chart of the energy transformations.

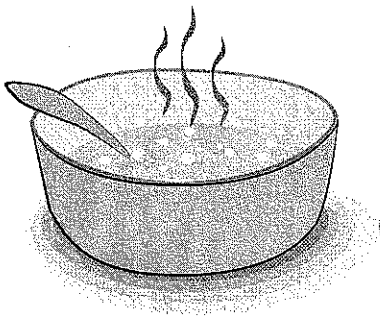
10 pts per scenario

EXAMPLE:

A boy feels steam from a cup of hot cocoa and sees his marshmallows beginning to melt. Then the boy drinks the hot cocoa.

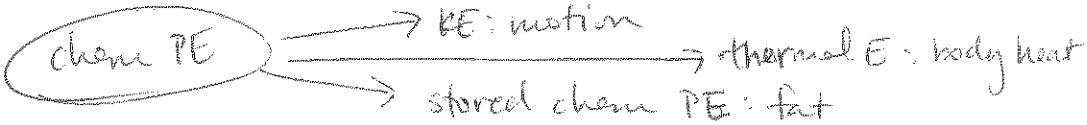
The steam is an example of convection. Within the cup of hot liquid, there are convection currents as the top layer of cocoa cools, and sinks. The marshmallows melting are due to conduction. The warmth that the boy's hand feels through the mug is via conduction.

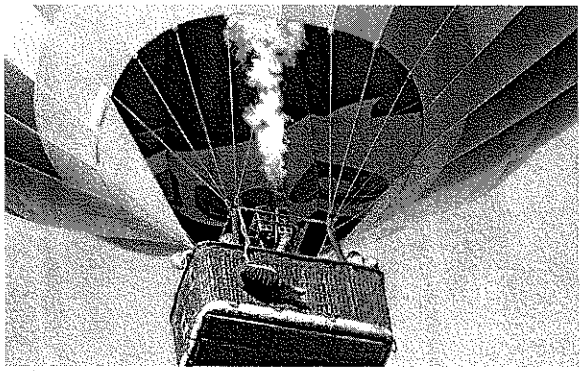




1) A person picks up a metal spoon sitting in a steaming bowl of soup. The soup is consumed and is delicious.

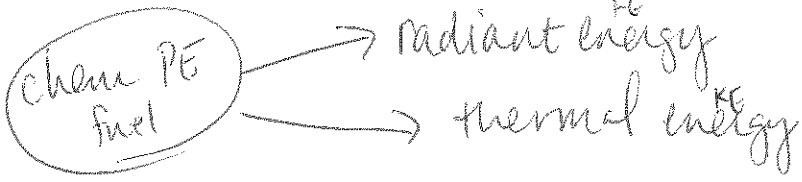
Hot soup conducts heat to the spoon. The spoon conducts heat to the person's hand. The rising steam is convection.

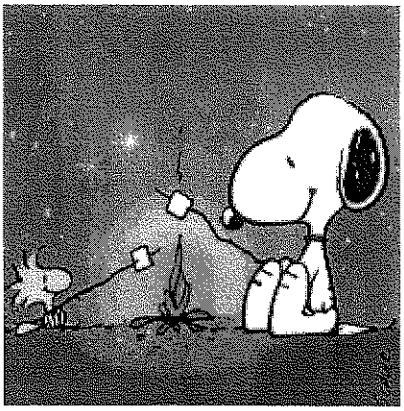




2) A hot air balloon rises when the engine is fired.

- The fire radiates light & thermal energy.
- The air conducts heat from the flame by colliding w/ the hot exhaust gases.
- the flames & heated air convect up into the balloon

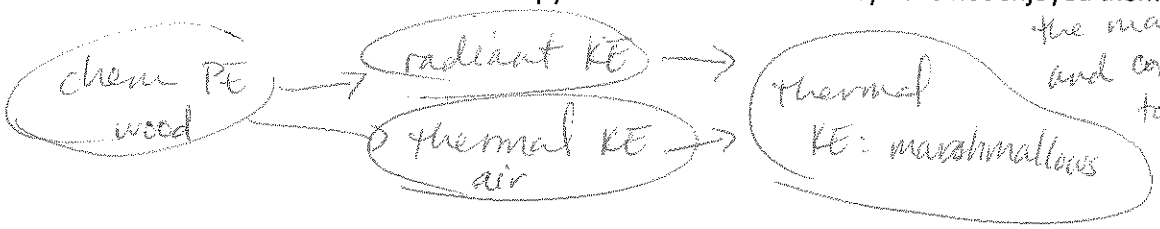


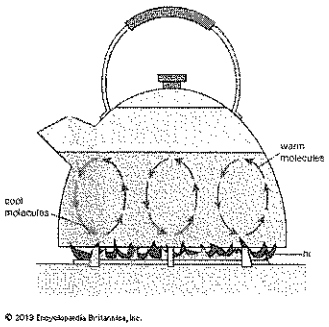


3) Woodstock and Snoopy roast marshmallows. They have not enjoyed them yet.

The fire radiate light & heat in all directions. The flames conduct thermal energy to the air via collisions.

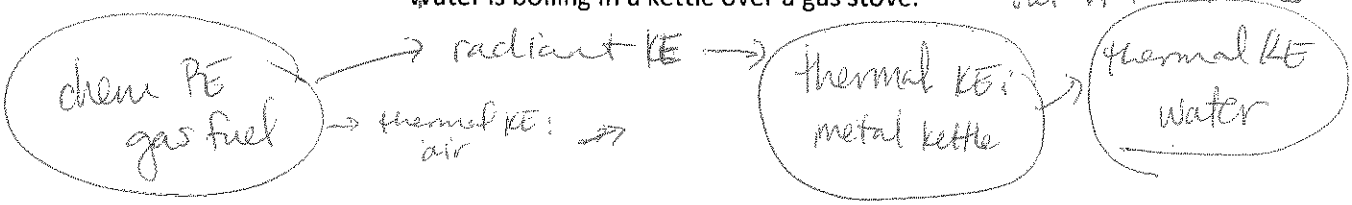
The flames (hot exhaust gases) and heated air convect up. The radiant heat ~~heats the air~~ is absorbed by the marshmallows. The heated air collides w/ the marshmallows and conducts heat to them.





4) Water is boiling in a kettle over a gas stove.

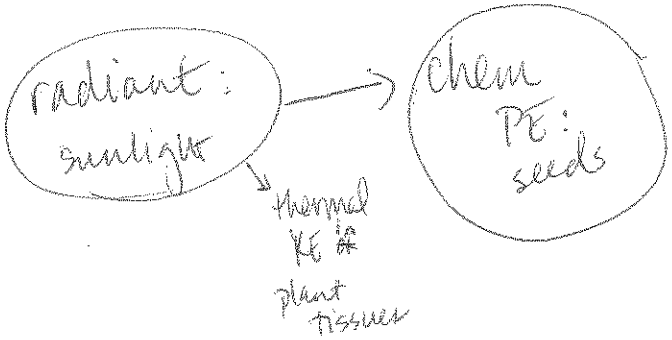
Flames radiate heat to the metal kettle. The metal conducts heat to the water. The water convects until water vapor begins to form. [water vapor ~~convects~~ forms at the water surface & convects out of the spout]

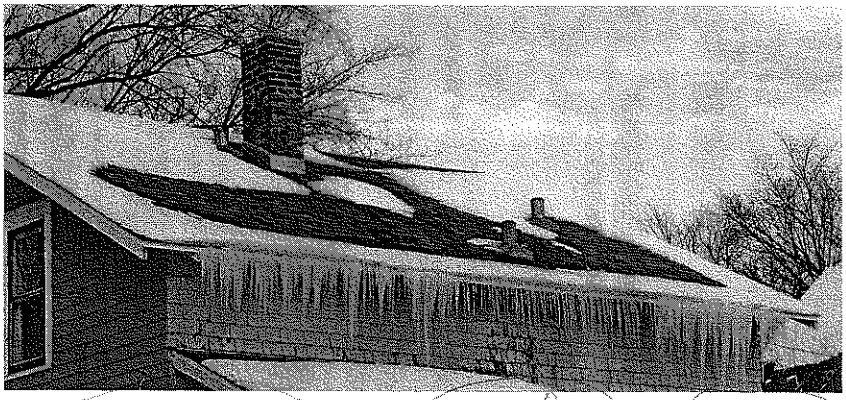


5) The sun is shining on sunflowers which produce sunflower seeds.

Sunshine radiates heat energy to the leaves of the plant.

[Plants convect water vapor out of tissues to cool down]

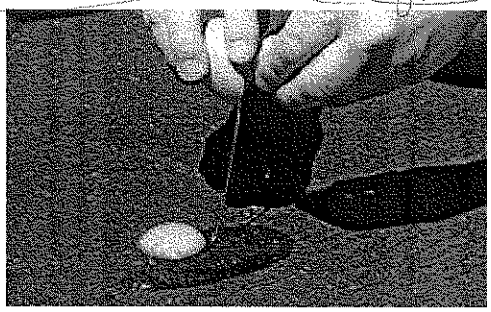


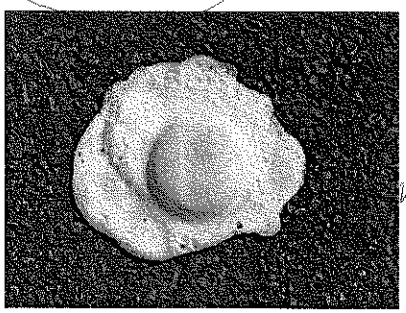


6) Snow melts from the roof, over certain rooms, but not the insulated attic space.

Heated air in certain rooms of the house convect air. The heated air collides w/ the ceiling, conducting heat to the roof. The roof conducts heat to the snow in direct contact causing it to melt.

thermal KE: inside air → thermal KE ceiling/roof → thermal KE snow → water

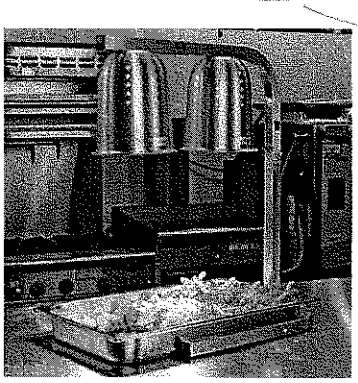




7) Before: After: An egg is cooked on black pavement on a sunny day.

The sun radiates energy to the black pavement. The pavement conducts heat energy to the egg.

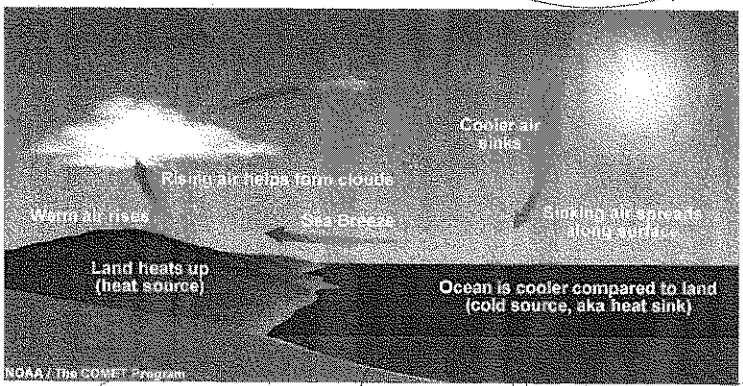
radiant energy: sunlight → thermal E pavement → thermal energy: cooked egg



8) A "heat lamp" shines on a french fries.

The lamp radiates heat to the fries. Air molecules also collide w/ the lamp & conduct heat. The heated air molecules convect in the kitchen. [The some fries themselves poorly conduct heat to other fries]

radi: electrical KE → radiant heat lamp → thermal KE: hot fries



9) This is a diagram of a sea breeze.

Sunlight radiates energy to the land, & ocean. Land conducts heat to the air. Air convects heat up high into the atmosphere. The ocean absorbs a lot of energy before heating up so it accepts radiated sunlight for most of the day before sharing its heat, b/c heat flows from high to low.

radiant: sunlight → thermal E land → thermal energy: air → thermal E ocean

Energy Unit Conversion Practice 5 pt/question Name: Ans Key

unit definitions: http://www.physics.uci.edu/~silverma/units.html

SHOW YOUR WORK!!

1) My stove on "high" can produce 341 BTU's in 5 minutes. What is the power rating (in watts) of my stove? ← 300 s

$341\ BTU \times \frac{1055\ J}{1\ BTU} = 359{,}755\ J \qquad P = \frac{E}{t} \qquad \frac{359{,}755}{300\ s} = \boxed{1199.2\ W}$

2) Water is heated to boil pasta for dinner. The amount of water present requires 17,925 joules of thermal energy to come up to boiling. How many calories is this?

$17{,}925\ J \times \frac{1\ cal}{4.184\ J} = \boxed{4{,}284.2\ cal}$

3) A banana has about 105 food calories. How many joules of energy is this if we could extract _all_ of the energy present?

$105\ \text{food calories} = 105{,}000\ \text{calories} \times \frac{4.184\ J}{1\ cal} = \boxed{439{,}320\ J \text{ in a banana}}$

4) A small house needs 1×10^6 J to keep it warm for a day.
   a) How many cords of wood does a person need to buy for one week?

$\frac{1 \times 10^6\ J}{day} \times \frac{1\ BTU}{1055\ J} \times \frac{1\ cord\ wood}{2 \times 10^7\ BTU} \times \frac{7\ days}{1\ wk} = \boxed{.00033\ cord/wk}$

   b) How many barrels of oil (NOT crude oil) should he/she purchase for one month? (Assume one month has 30 days.)

$\frac{1 \times 10^6\ J}{day} \times \frac{30\ d}{1\ month} \times \frac{1\ BTU}{1055\ J} \times \frac{1\ barrel}{5.78 \times 10^6\ BTU} = \boxed{.00492\ barrel \text{ for one month}}$

5) A Corvette is stated as having 650 hp. If the car performs at peak horsepower for 10 seconds,
   a) how many joules of energy has it used?

$P \cdot t = E \qquad 650\ hp \times \frac{746\ W}{1\ hp} = 484{,}900\ W \cdot 10\ s = \boxed{4.84 \times 10^6\ J}$

   b) Assume that 30% of the energy from part a) became thermal energy, as opposed to motion forward. How many BTU's did the car release to the surrounding environment?

$(4.84 \times 10^6\ J)(.3) = 1{,}454{,}700\ J \times \frac{1\ BTU}{1055\ J} = \boxed{1378.9\ BTUs}$