A few wrap-up items on Thermodynamics . . .

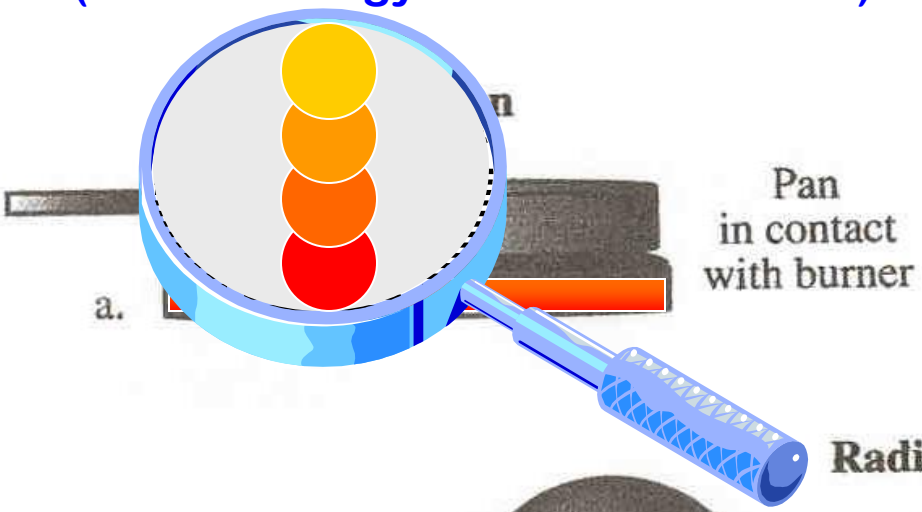
HEAT TRANSFER

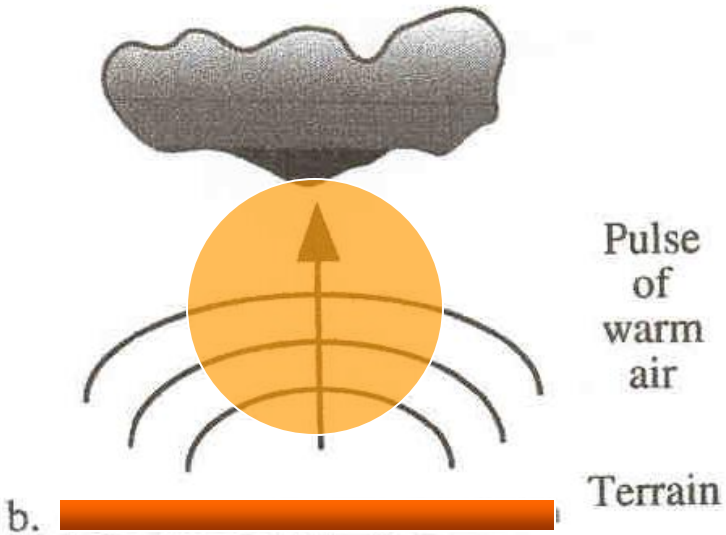
CONVECTION

Mass of warm air or liquid heats, expands, rises

CONDUCTION

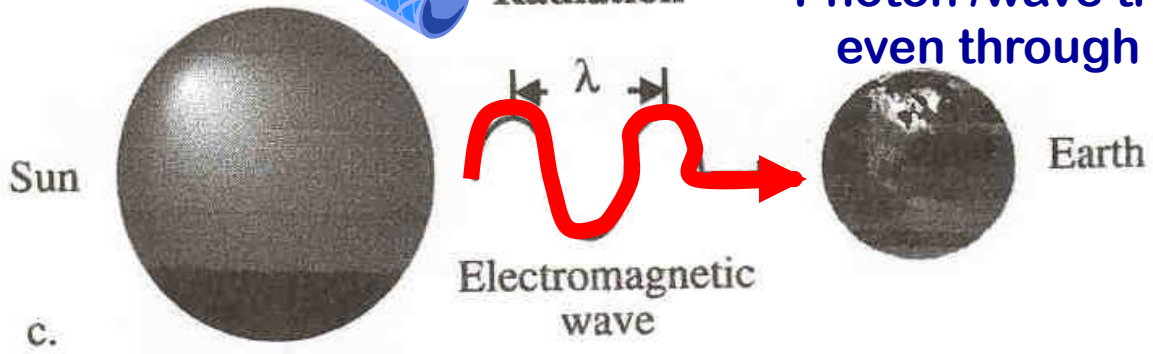
Jiggling molecule ➔ jiggling molecule
transfer of heat
(kinetic energy at molecular scale)





RADIATION

Photon /wave transport: even through a void!



Electromagnetic Radiation

(some of you had trouble with this concept on Test #2!)

Electromagnetic energy (radiation) is not heat energy.

It does not become heat (jiggling molecules) until it strikes an object, is absorbed by the object and sets the molecules in the object in motion, thereby heating up the object.

KEY CONCEPT:

The sun's energy comes in as radiant (electromagnetic) energy, and is converted to measurable heat only after it is absorbed (e.g., by the surface of the earth, a gas in the atmosphere, etc.).

An application of the 2nd Law :

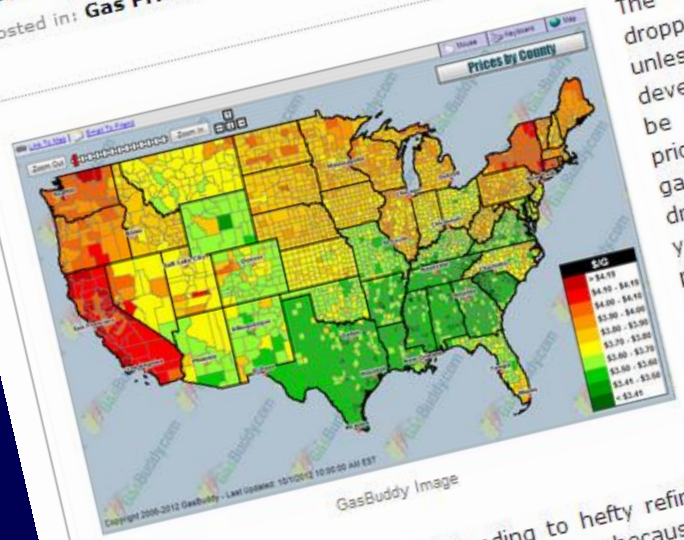
FUEL ECONOMY!!

BlogGasBuddy.com

Gas price decline may be short-lived

Posted in: Gas Prices, by Patrick DeHaan on Oct 1, 2012 11:06

1053 Comments



GasBuddy Image

The U.S. nati
dropped for se
unless there'
develops qui
be short li
prices dec
gasoline d
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year, it
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Oil
las
re

rose while oil prices declined, leading to hefty refinery
traders sent wholesale gasoline prices higher because of

Energy Resources

Calif. seeks relief from high gas prices

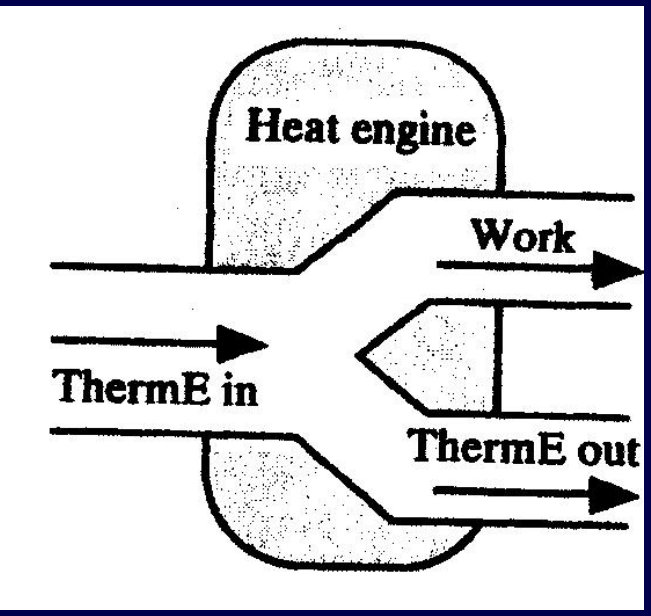
Recommend 4 Share +1 0 Tweet 1

Fuel prices approaching six dollars per gallon are posted at a gas station in Calabasas, Cal
2012. Industry spokespersons have sighted a variety of reasons as contributing to the appa
including power outages and scheduled maintenance. UPI/ Phil McCarten

Published: Oct. 8, 2012 at 8:32 AM

An application of the 2nd Law :

FUEL ECONOMY!!



Energy flow diagram for a heat engine.

"2nd Law" = Any process that uses thermal energy as input to do the work must also have thermal energy output -- or **exhaust!**

WHAT TO REMEMBER: heat engines are always less than 100 % efficient!

IMPROVED ENERGY EFFICIENCY IS A KEY ASPECT OF GREEN TECHNOLOGIES!

Fuel Economy: Where the Energy Goes . . .

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

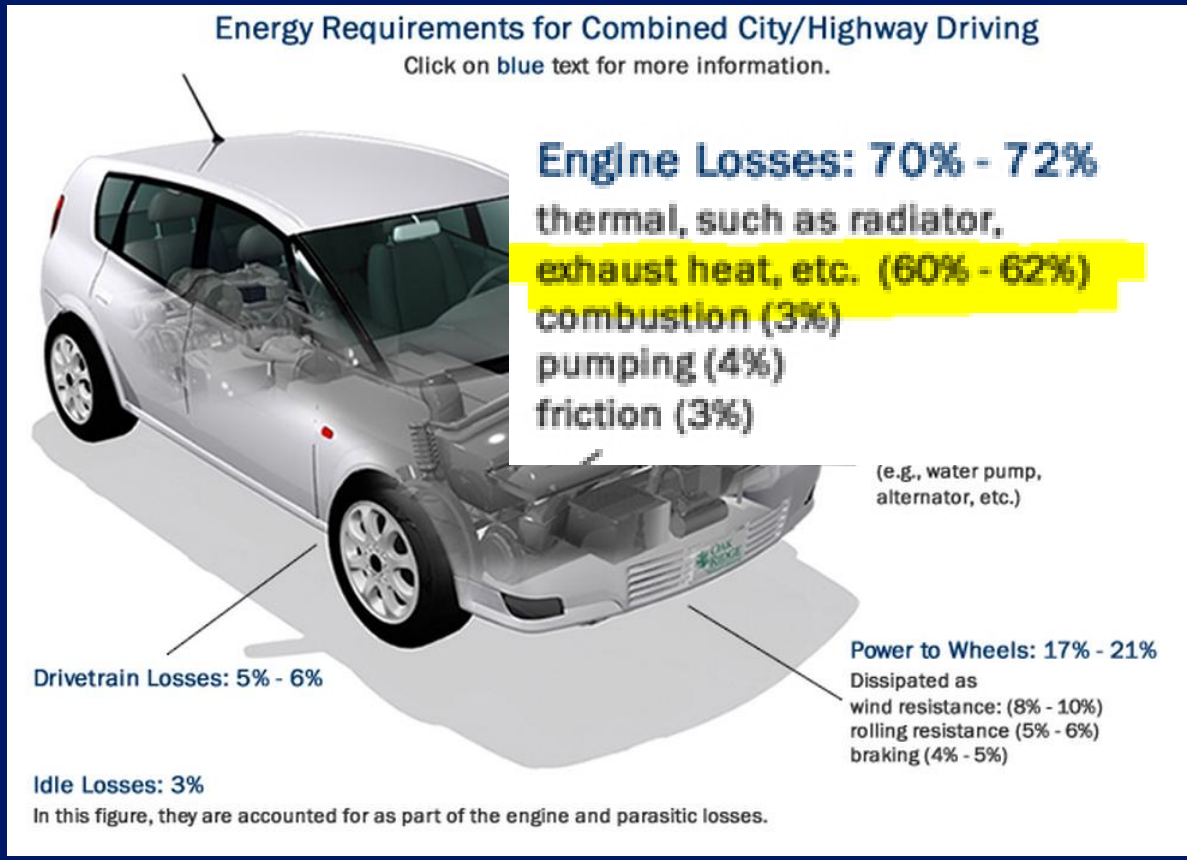
www.fueleconomy.gov

the official U.S. government source for fuel economy information

Only about 14%–26% of the energy from the fuel you put in your tank gets used to move your car . . . depending on the drive cycle!!

The rest of the energy is lost as exhaust heat or dissipated in various ways!

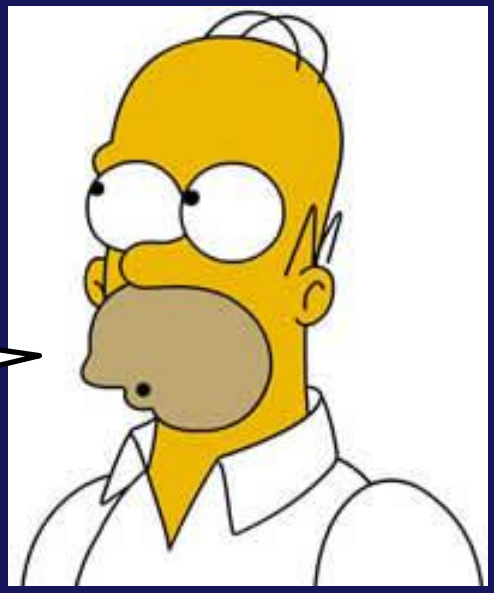
Therefore, the potential to improve fuel efficiency with advanced technologies is ENORMOUS!



http://www.fueleconomy.gov/feg/atv.shtml

Doh!

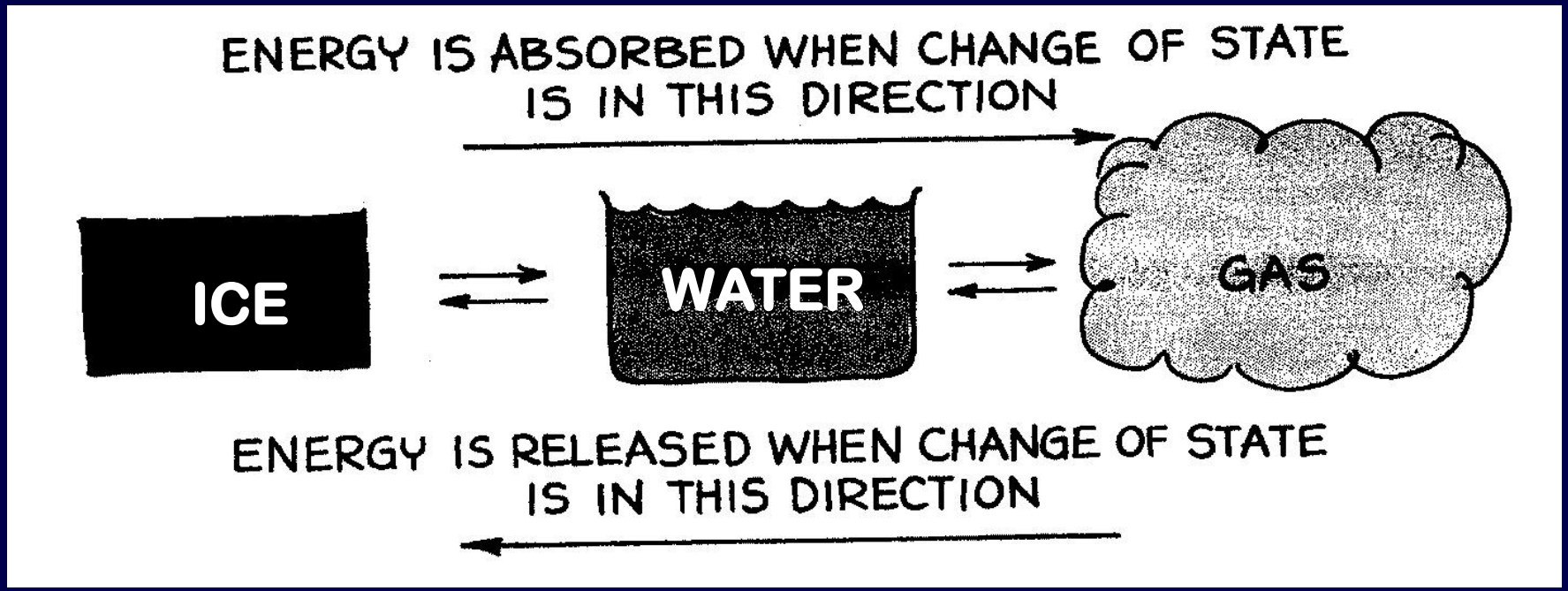
What's all this about PHASE CHANGES????



THERMAL ENERGY & PHASE CHANGES IN H_2O

Energy **stored** in H_2O as LATENT ENERGY

(energy is "hidden" & not sensed) ⟶



Energy **released** by H_2O as SENSIBLE HEAT

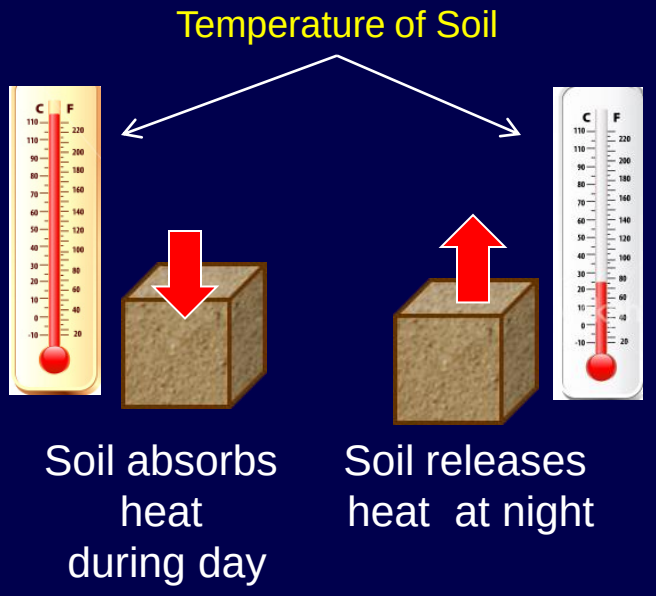
⟵ (i.e. the warmth can be "sensed")

DEFINITIONS:

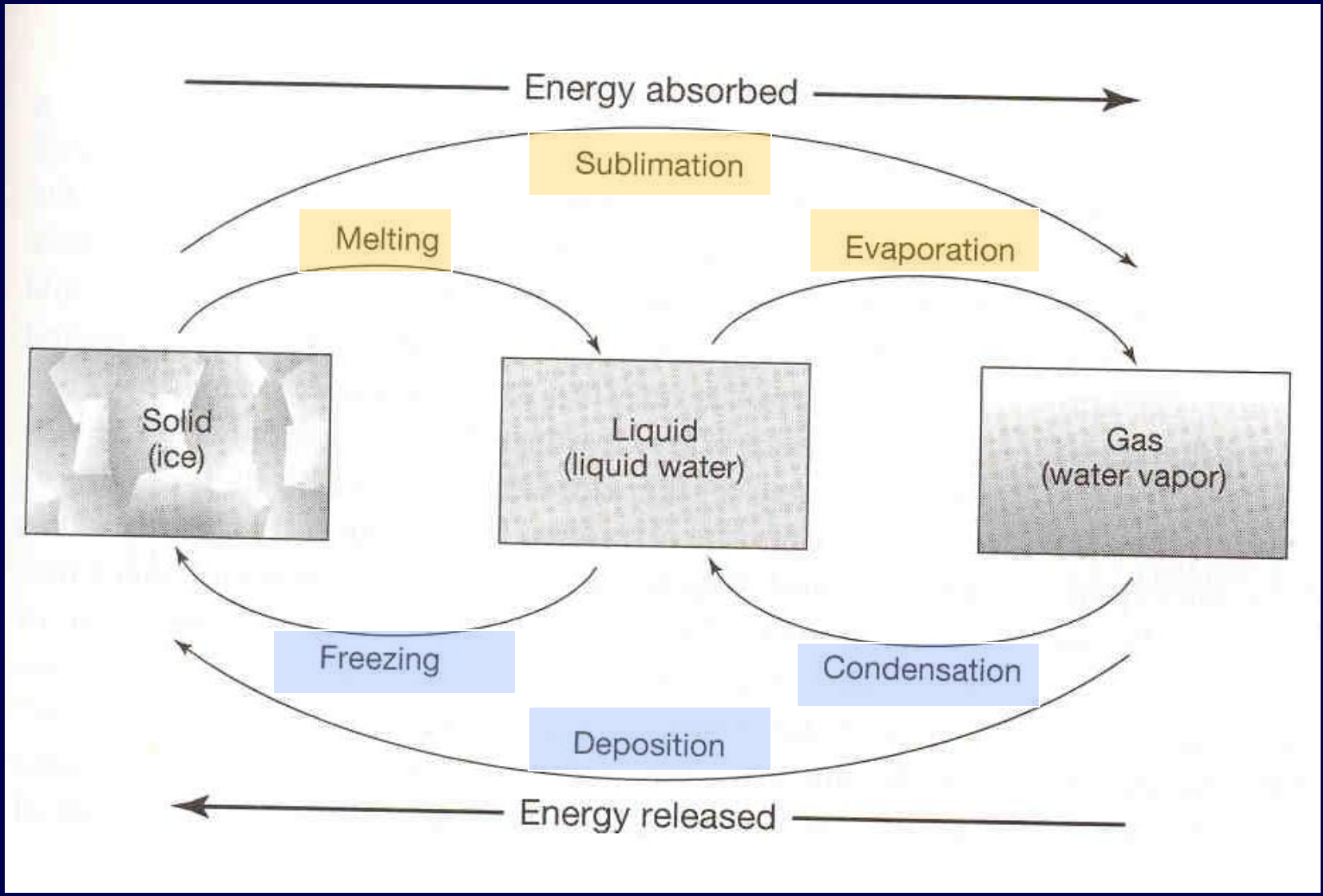
LATENT ENERGY (LE) & SENSIBLE HEAT (H)

LATENT ENERGY (LE) = the amount of energy released or absorbed by a substance during a **change of phase**, such as when water evaporates.

SENSIBLE HEAT (H) = the amount of energy released or absorbed by a substance during a change of temperature (which is not accompanied by a change of state)



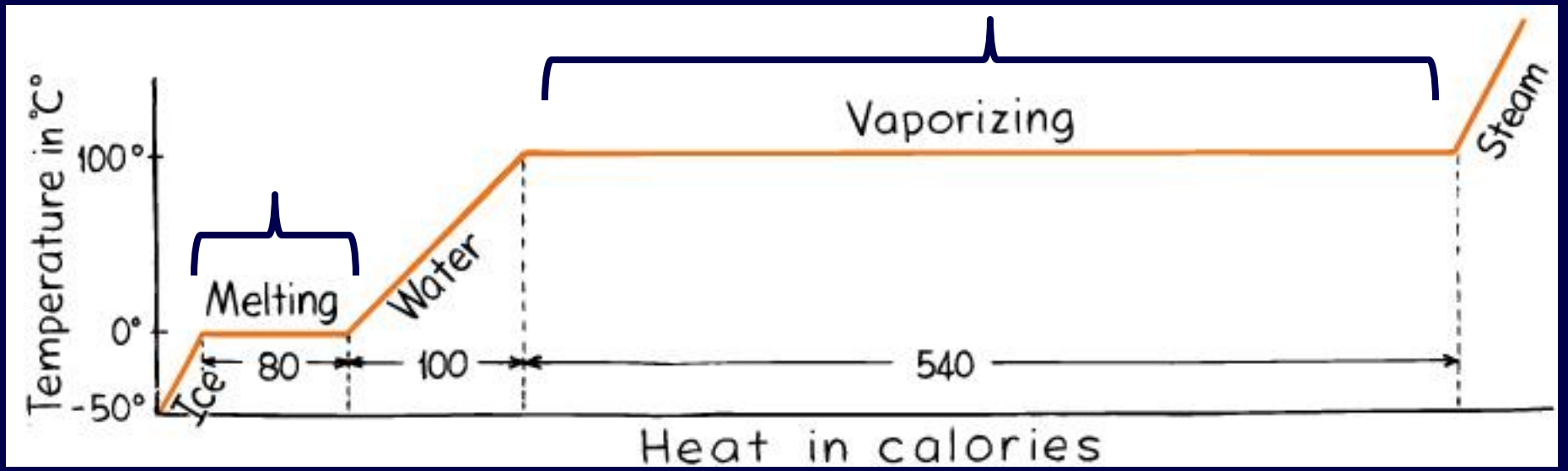
PHASE CHANGES (another view)



This is in your textbook: Fig 4-23 p 77 in SGC E-text

THOUGHT QUESTION:

In this graph, what's happening to the energy in the portions where the graph is <u>horizontal</u>?



HINT: look at the temperature change . . . The answer is related to: SENSIBLE HEAT (H)

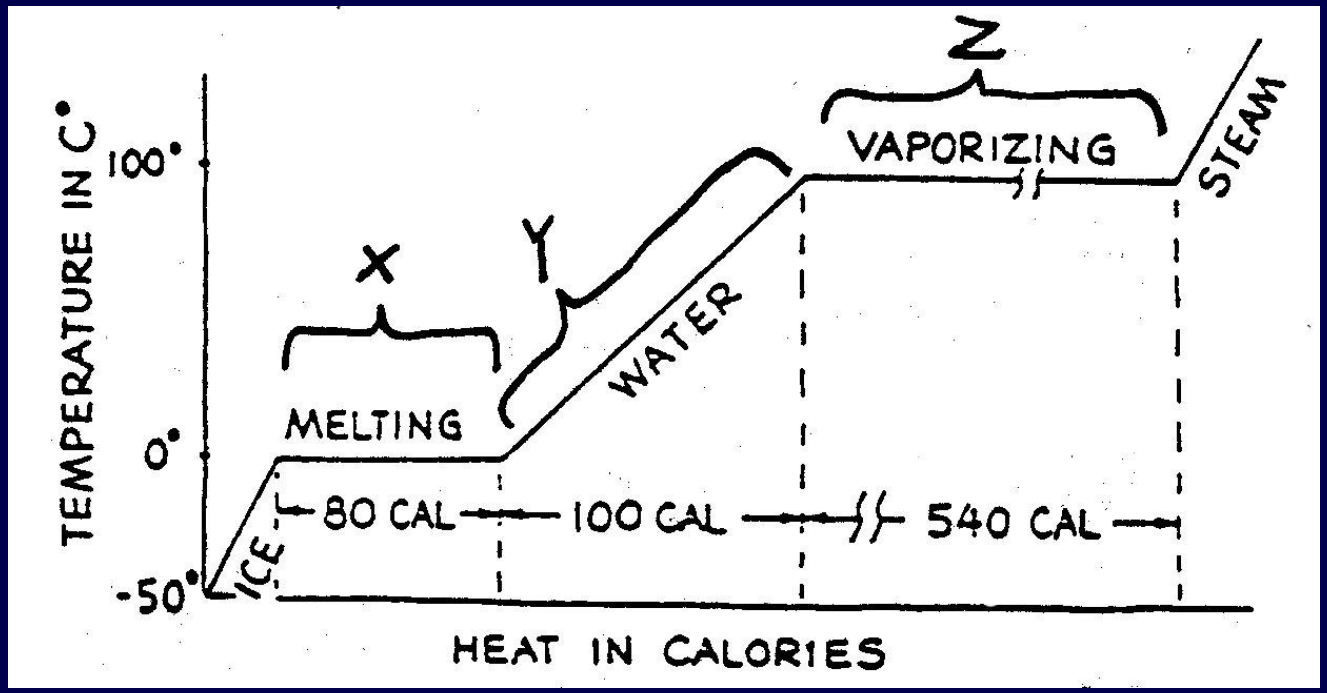
VS

LATENT HEAT (LATENT ENERGY) LE

REVIEW / BACKGROUND:

SENSIBLE = the energy can be SENSED (e.g., with a thermometer, by the environment, etc.)

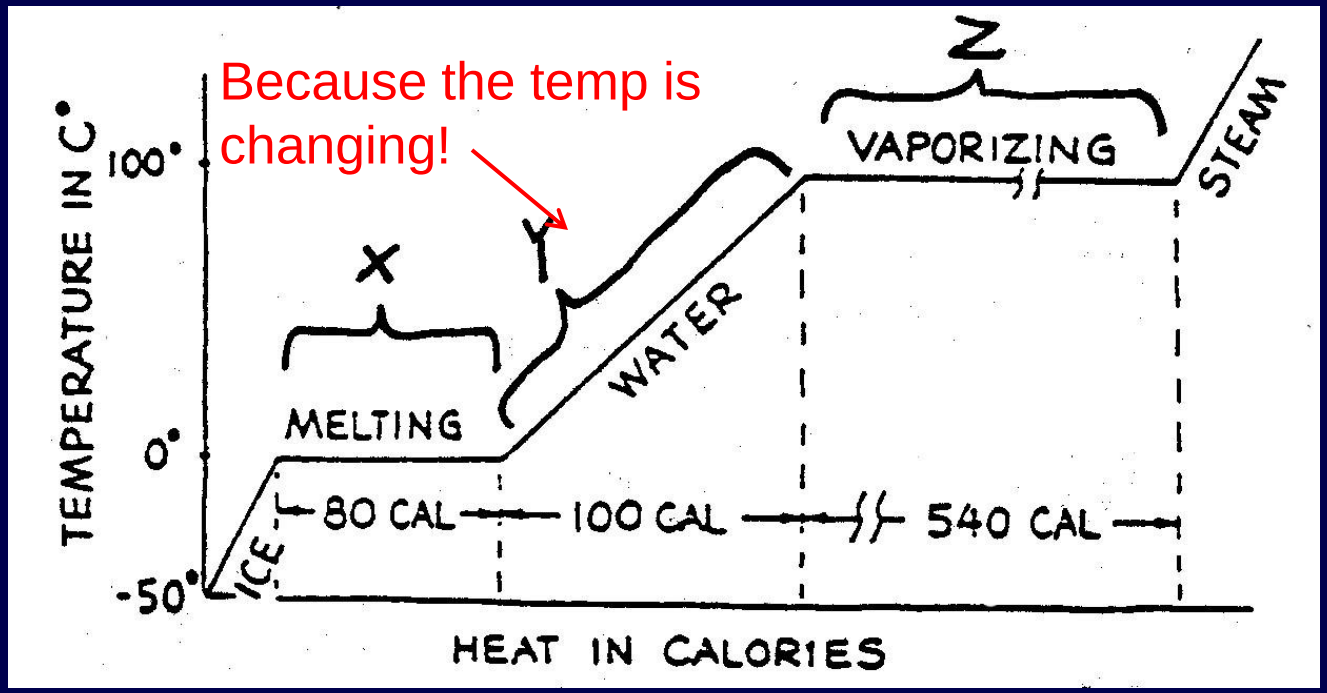
LATENT (means “HIDDEN”) = the energy is there, but it is NOT SENSED by the environment, a thermometer . . . or YOU!



Q -- Which LABELED segment or segments of the graph represent(s) **SENSIBLE HEAT (H)** ?

1 = X & Z **3 = Y only**

2 = X only **4 = Z only**



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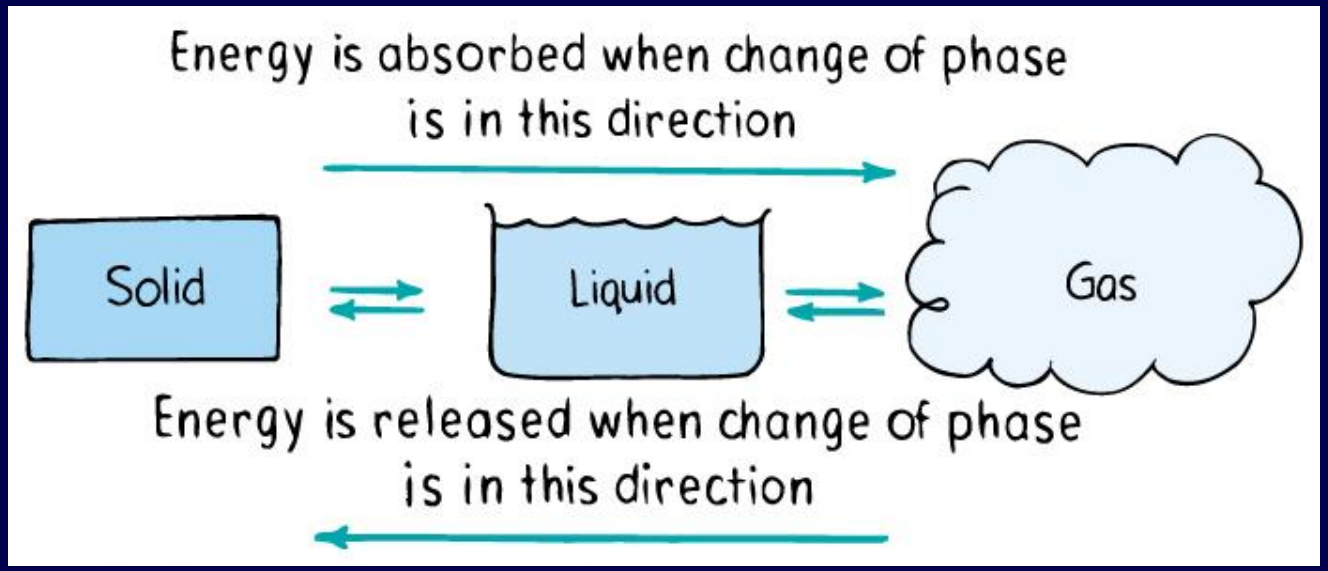
Q - In a phase change from ice to water or water to water vapor, <u>WHAT</u> is absorbing the energy?

1 = the surrounding environment

2 = the H_2O molecules

3 = both the environment & the H_2O



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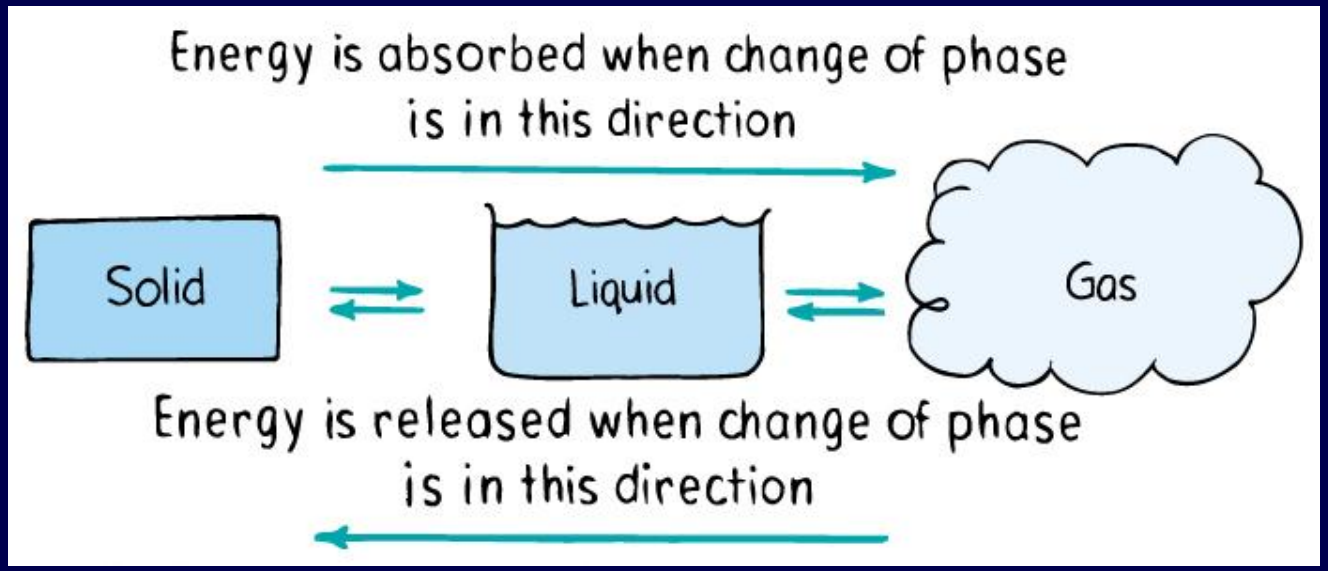
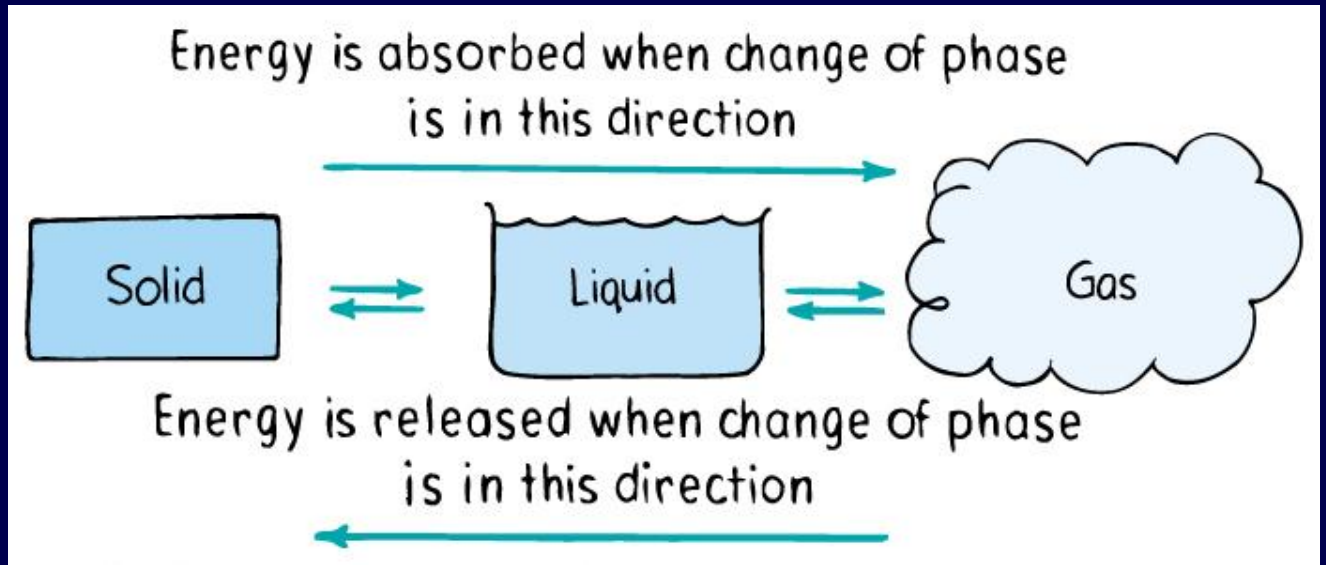


Q - In a phase change from water vapor to liquid water or liquid water to ice, TO WHERE is the energy being released?

1 = into the surrounding environment

2 = into the H_2O molecules

3 = into both the environment & the H_2O



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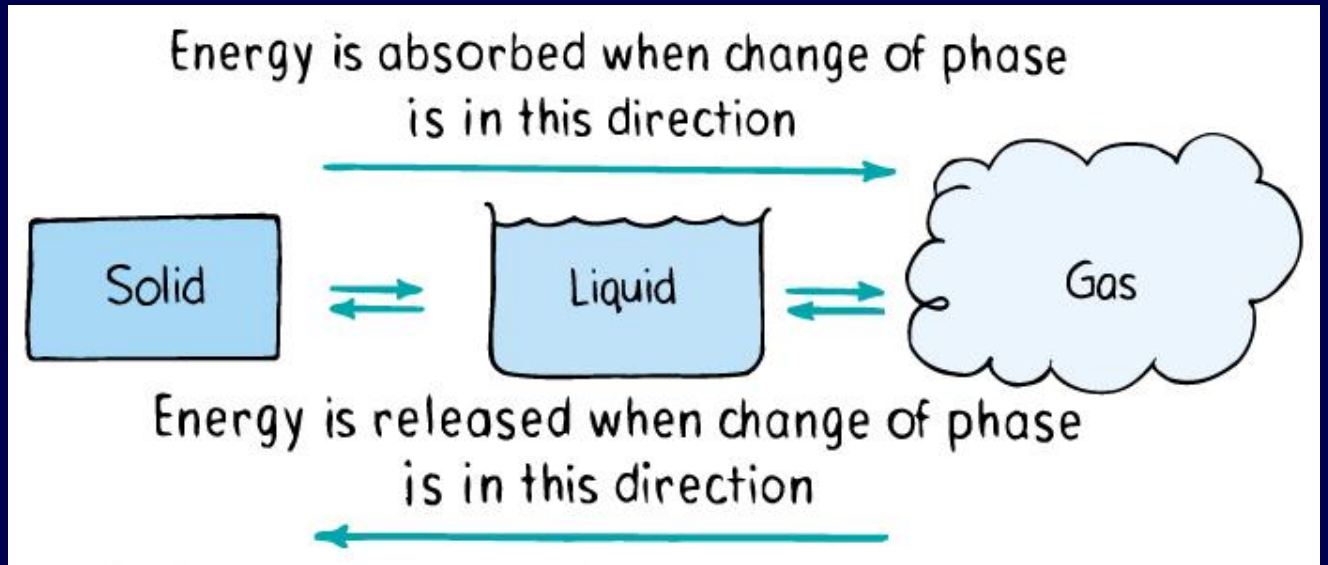
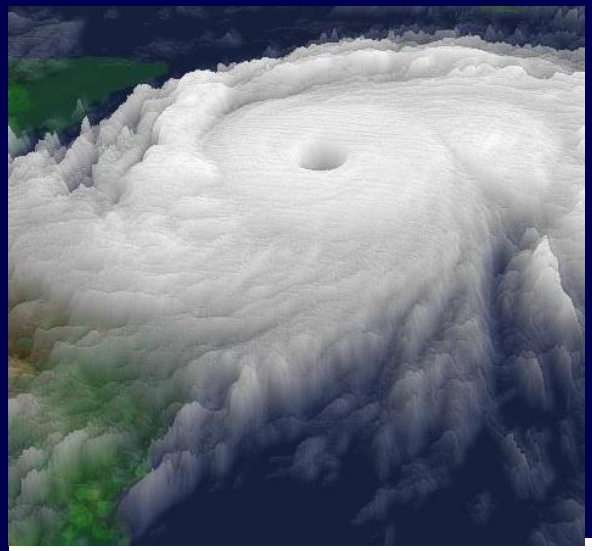
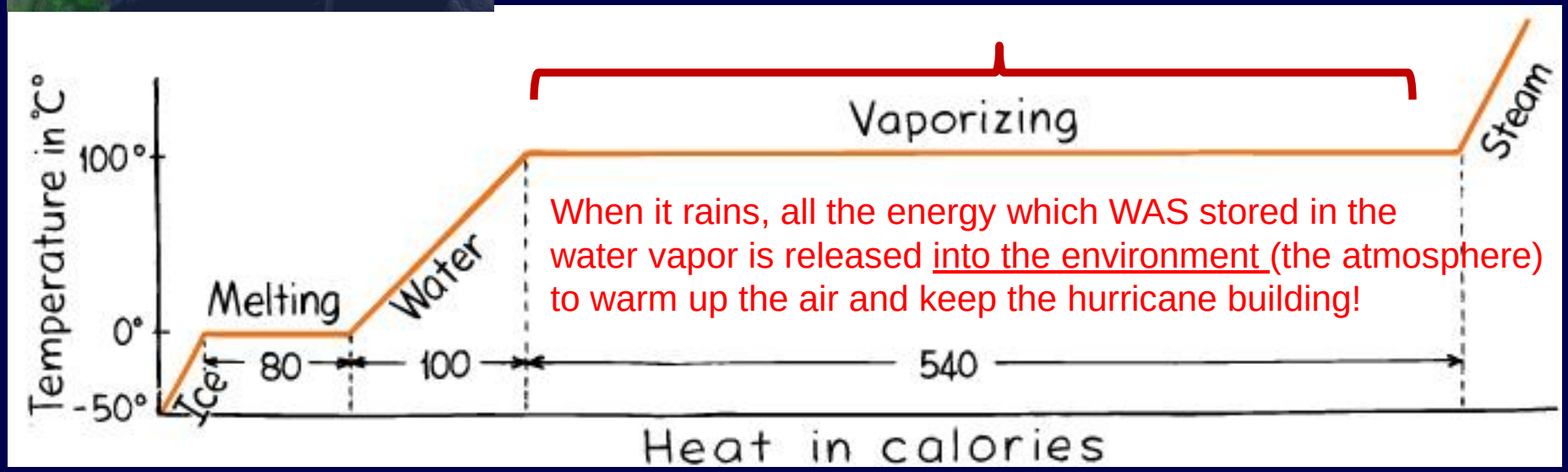


This is what drives tropical storms & HURRICANES!!



Latent energy released during condensation becomes sensible heat which heats of the hurricane and keeps the storm going

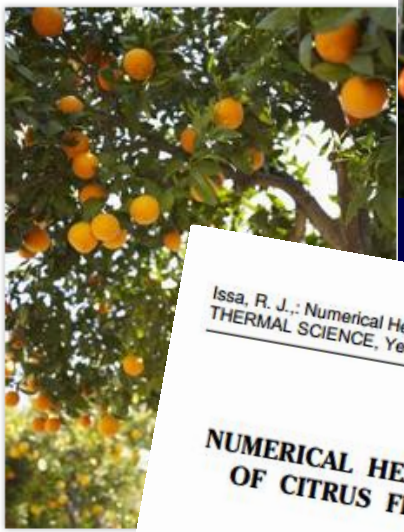


Another illustration:

Why Spray Water on Trees to Prevent Fruit From Freezing?

Written by Darcy Logan | Translated by Ehow Contributor

Spraying citrus trees with water before a freeze seems counterproductive, especially when seeing images of oranges encased with ice. The conventional wisdom is that ice makes things colder, not warmer. That might be true for drinks, but not when dealing with thermodynamics. The process of changing water to ice actually releases heat and protects fruit from being damaged by frost.



Citrus trees are
by an early fro

About Frost Damage

Cold temperatures damage fruit by causing ice crystals to from on the surface of the fruit. The ice crystals draw moisture from the fruit. Ice crystals can also cause the juice vesicles inside a fruit to burst. Both situations cause the fruit to dehydrate. Fruit will deteriorate within a few days or weeks.

Thermodynamics

Whenever water changes from one state to another, energy is involved. In order for water to change to gas, you add energy from the sun or heat. Ice, however, is considered a low energy state. To change water to ice, energy is taken away and not added. The excess energy is then released into the air. Since this energy takes the form of heat, it means that in order for water to change into ice, i must release heat.

http://www.ehow.co.uk/info_8698014_spray-trees-prevent-fruit-freezing.html

http://www.doiserbia.nb.rs/Article.aspx?id=0354-98361100084I

NUMERICAL HEAT TRANSFER MODEL FOR FROST PROTECTION OF CITRUS FRUITS BY WATER FROM A SPRAYING SYSTEM

by

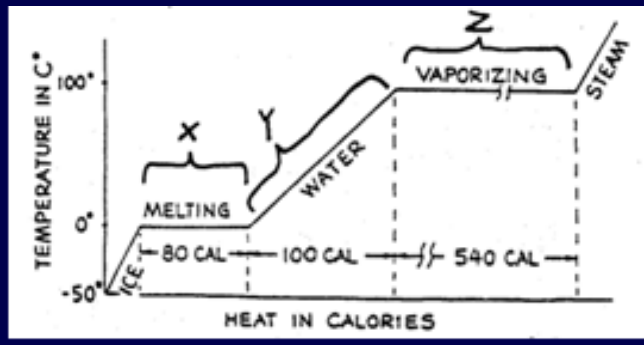
Roy J. ISSA

Department of Engineering and Computer Science, Mechanical Engineering Division,
West Texas A&M University, Canyon, Tex., USA

Original scientific paper
DOI: 10.2298/TSCI110331084I

A simplified model is developed to simulate the conditions associated with the protection of fruits from frost damage using water from a spraying system. The model simulates the movement of the solidifying water front on a single fruit, and based on that determines the spray frequency needed for a water film to continuously surround the ice-coated fruit to prevent the fruit temperature from dropping below 0 °C. Simulations are presented for the frost protection of sweet oranges (citrus sinensis). The effect of environmental conditions such as air temperature, air velocity, surface radiation, and water film evaporation on the development of the ice layer encasing is considered. Simulations show the effect the encasing ice sheet thickness has on the fruit temperature if water from a spraying system is turned off permanently. Experimental tests are also conducted to determine the change in the thermal properties of citrus sinensis for operating temperatures that range from above freezing to sub-freezing. The experimental tests and the numerical simulations of fruit protection from frost
system.

Q – Which choice best explains what the graph is illustrating about the energy involved in phase changes (changes of state) in H_2O.



1. **Portion X** of the graph indicates that it takes **much more energy** to create a **phase change from ice to liquid** than it does from liquid to vapor.

2. **Portion Y** of the graph indicates that 100 calories of energy are being added to one gram of H_2O **without changing the temperature** of the H_2O at all. This process produces a **phase change** from ice to vapor.

3. **Portions X and Z** of the graph indicate that **during phase changes**, the calories of energy being added to a gram of H_2O, **do not change the temperature of the H_2O .**

4. **Portion Z** of the graph indicates that as soon as the temperature of H_2O reaches 100 º C, it immediately starts cooling off and condenses into a liquid.

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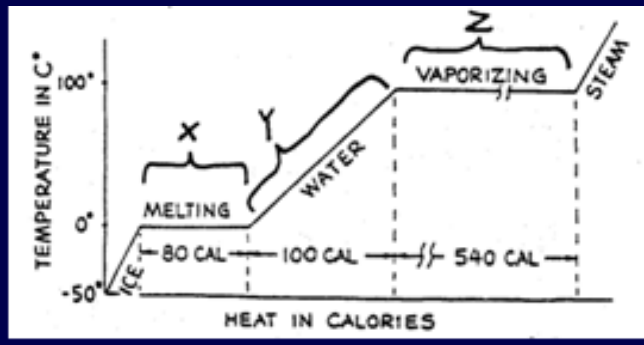

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MIDTERM LOGISTICS

MIDTERM EXAM LOGISTICS OVERVIEW

FORMAT OF THE EXAM:

- worth 100 points
- multiple choice questions (~25 , 3-4 pt questions)
- also: fill-in-the-blank, figure or graph interpretation, make-a-sketch, short answer/ essay.
- IF / AT form for partial credit|
  – KEEP SCRATCHING UNTIL YOU FIND THE STAR!

HOW WILL IT DIFFER FROM TESTS 1 and 2 ?:

- write in, sketches, figure/ graph interpretation, etc.
- short answer / essay component

• An important part of your studying should be to **TIE TOGETHER** different topics that we've covered and to make connections to start tying the concepts together into "a big picture." Questions will be asked that require you to link up different parts of the course.

For PRACTICE QUESTIONS
Go back to Class Follow up and click on
“The Answer Is:"
Practice Midterm Review Questions