

From Last Time:

Left arm Right arm

Water molecule Solute molecule

Selectively permeable membrane

Osmosis

Movement due to hydrostatic pressure

Applied pressure = osmotic pressure

Volumes equal

(a) Starting conditions (b) Equilibrium (c) Restoring starting conditions

Figure 23.28 Tortora, PRINCIPLES OF ANATOMY & PHYSIOLOGY, 11th Edition, © 2012 Elsevier Inc. All rights reserved.

<http://www.studyblue.com/notes/note/n/cell-physiology/chapter-3/section/2309000>

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Advising

Make an appointment early
Show that you've planned
Look at DAR and degree requirements
Have alternatives
Look at the long term

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Transferring Heat

Conduction
Direct contact with a hot or cold object

Convection
Transfer via a medium

Radiation
Energy travelling through space

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Heat Management

Specific Heat Capacity –
the amount of heat energy required to raise the temperature of 1 gram of a substance 1°C.

For water, 1 calorie per gram °C
“Dietary Calorie” vs. calorie

http://www.engineeringtoolbox.com/specific-heat-capacity-food-d_295.html

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Phase Changes

Stage 1 Stage 2 Stage 3 Stage 4 Stage 5

100 0 -100

40.7 kJ mol
80 cal g

4.184 J g °C
1 cal g °C

6.01 kJ mol
540 cal g

LIQUID - GAS

LIQUID

SOLID LIQUID

SOLID

Heat Addition

What is the energy needed to take 1g H₂O at 0°C to 100°C ? **80 + 100 + 540 = 720cal**

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Phase Changes

Stage 1 Stage 2 Stage 3 Stage 4 Stage 5

100 0 -100

1.84 J g °C
0.43 cal g °C

4.184 J g °C
1 cal g °C

6.01 kJ mol
80 cal g

2.09 J g °C
0.50 cal g °C

40.67 kJ mol
540 cal g

GAS - LIQUID

LIQUID

SOLID LIQUID

SOLID

Heat Removal


What is the energy needed to take 1g H₂O at 100°C to 0°C ? **540 + 100 + 80 = 720cal**

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“Browning”

Different meaning in different foods

But what colors make brown?




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Browning Reactions

Many foods “brown”

Reactions differ by molecules




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Maillard Browning

Proteins (+ reducing sugars)
Produce color and flavors

250°F/120°C



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Encouraging Maillard

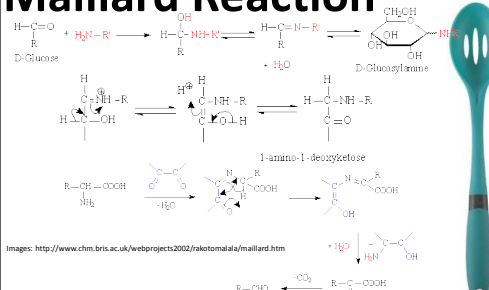
High heat, little water

Browning before stewing



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Maillard Reaction



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Sugar Browning

Sugar pyrolyzes (burns)

Flavor development

Caramelization

330°F/165°C



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Enzymatic Browning

Phenol oxidase
Polymerizes phenols
Usually undesirable



Image: <http://www.sciencemag.com/articlenutrition/what-are-antioxidants-and-how-do-they-help>

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Enz Brown

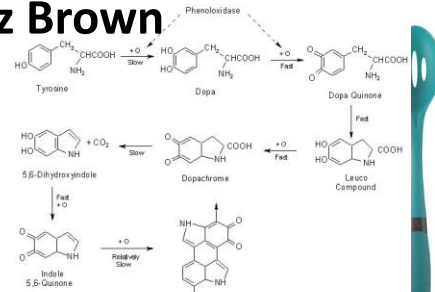


Image: <http://www.food-info.net/uk/labour/enzymatic/browning.htm>

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Balanced Browning

Control heat
Sugar browning @ higher Temp
Control water
Keeps Temp low

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Cooking Methods

Boiling
Steaming
Pressure cooking
Baking
Frying
Grilling

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Water-based Cooking

Effective heat transfer
High heat capacity

Boiling
Steaming
Pressure cooking



Image: <http://preparationsteps.wordpress.com/2009/08/11/myths-and-facts-of-water-storage/water-storage-myths-boiling-water/>

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Boiling

Even heating
Extracts flavors
Good for intense flavors (bitter, alkaloids)
Bad for subtle flavors
Easier to control cooking

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Steaming

- Even heating
- Less flavor extraction
- Easy to control
- Retain color
- Retain nutrients




Image: <http://www.vegetariantimes.com/article/full-steam-ahead/>

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Salting the water

- Colligative properties
- Vapor pressure
- Boiling point elevation




Image: <http://rowbe.com/tips/techniques/22-salting-water-for-cooking/>

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Pressure cookers

- Change P_{atm}
- Change $T_{boiling}$


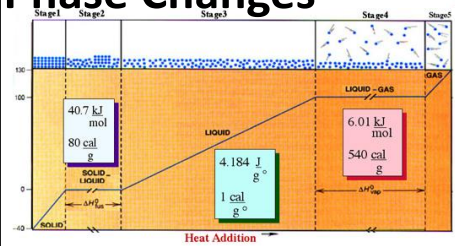


Image: <http://earthbeary.com/all-american-pressure-cooker-model-941-41-5-quat/>

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Phase Changes



What is the energy needed to take 1g H₂O at 0°C to 100°C ? **80+100+ 540 =720cal**

Image: http://science-administrator.edu/grades/Science/AL_Teach/300_Science/PhaseChanges/phasechanges.html

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Phase Diagram

P vs. T

Unique to each substance

For water →

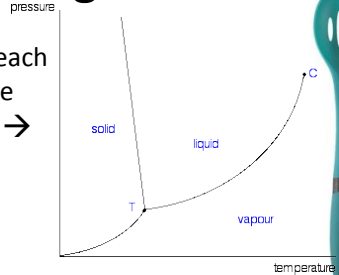


Image: <http://www.chemguide.co.uk/physical/phaseeqia/phasediag.html>

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Phase Diagram

“Normal” conditions

1atm = 15psi

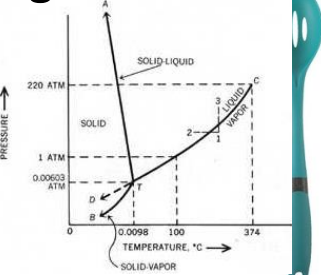


Image: http://www.sv.tu.edu/courses/MSJ2094_Notebook/96ClassProj/examples/triplet.html

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Baking

Heat transfer medium is air
 Poor conductor of heat
 Dehydrates
 Intensifies flavor
 To preheat or not to preheat...



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Preheating

Food safety – time at temperature
 Surface heating
 Food
 Radiant heat
 Walls



Image: <http://momsgoingreenblog.com/?p=942>
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Frying

Heat transfer medium is oil
 Good heat transfer
 Seals in water
 Creates steam



Image: <http://www.themediatrust.com/news/eating-fried-foods-wont-lead-to-a-heart-attack-unless/>
 Image: <http://2005.wordpress.com/category/japanese-cooking-methods/steak-frying/page/2/>
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“Good” Frying

Hot oil is essential!
 High “smoke point” oils
 Peanut, canola



Image: <http://www.blaitherskitchen.com/recipe/index.php?page=content&view=article&id=76&itemid=126>
 Image: http://culinarymasterclass.com/techniques.php?techniques_state=selected_technique&technique_id=9
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Grilling

Heat transfer medium is air
 Direct radiative infrared heating



Image: <http://www.stimuluscontrol.com/news/grilling-for-gods/>
 Image: <http://www.go.com/how-to/eat-and-drink/2010/7/summer-grilling-ideas/>
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Temperature Conversions

Fahrenheit (historically)
 0°F = Salt water freezing (colligative)
 32°F = Water freezing
 96°F = “blood heat”
 Celsius (historically)
 0°C = Water freezing
 100°C = Water boiling
 Adjustments over time...



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Absolute Scales

Kelvins

$$1\text{K} = 1^\circ\text{C}$$

"Zero" really means "zero"

$$0^\circ\text{C} = 273.15\text{K}$$

Rankine (rarely used)

$$1^\circ\text{R} = 1^\circ\text{F}$$

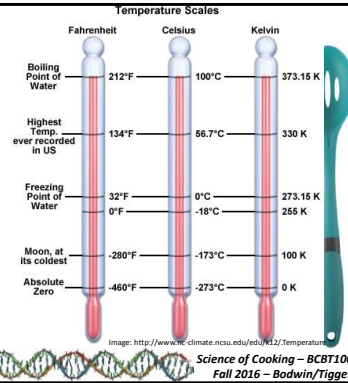
"Zero" is absolute zero

$$0^\circ\text{F} = ??^\circ\text{R}$$



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Temp! Scales



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Do the math

What is "body temperature"?



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