

# Center for Teaching and Learning

Presents the  
Fall Science Workshop Series  
Wednesday  
November 15, 2006  
1:00 p.m.

# Metabolism of the Holidays

Presented by the  
Center for Teaching and Learning  
and  
Marc McCloskey

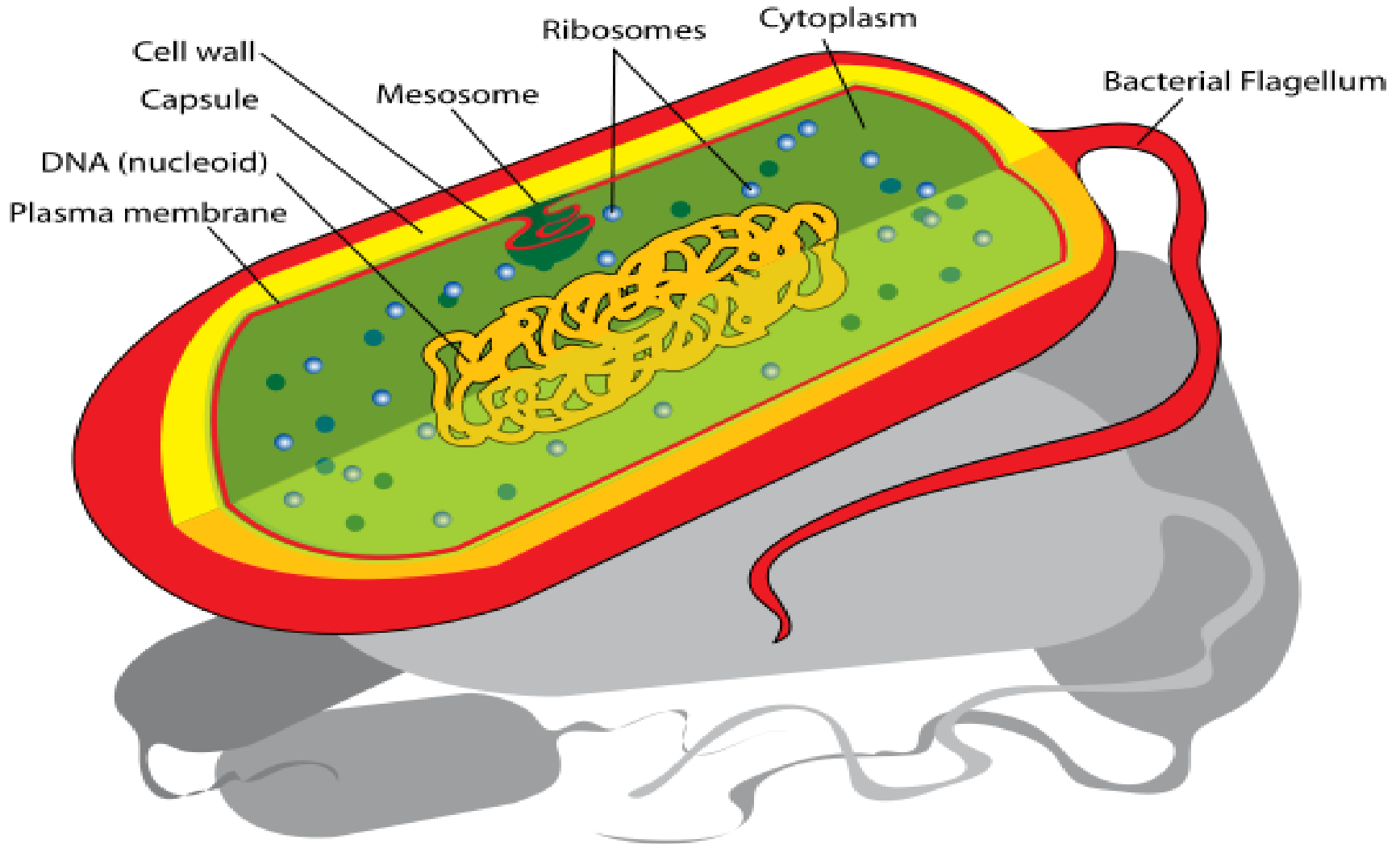
# Review

- Prokaryotic
  - Bacteria
  - Archaea
- Eukaryotic
  - Unicellular
    - Protists
  - Multi-cellular
    - Fungi
    - Plants
    - Animals

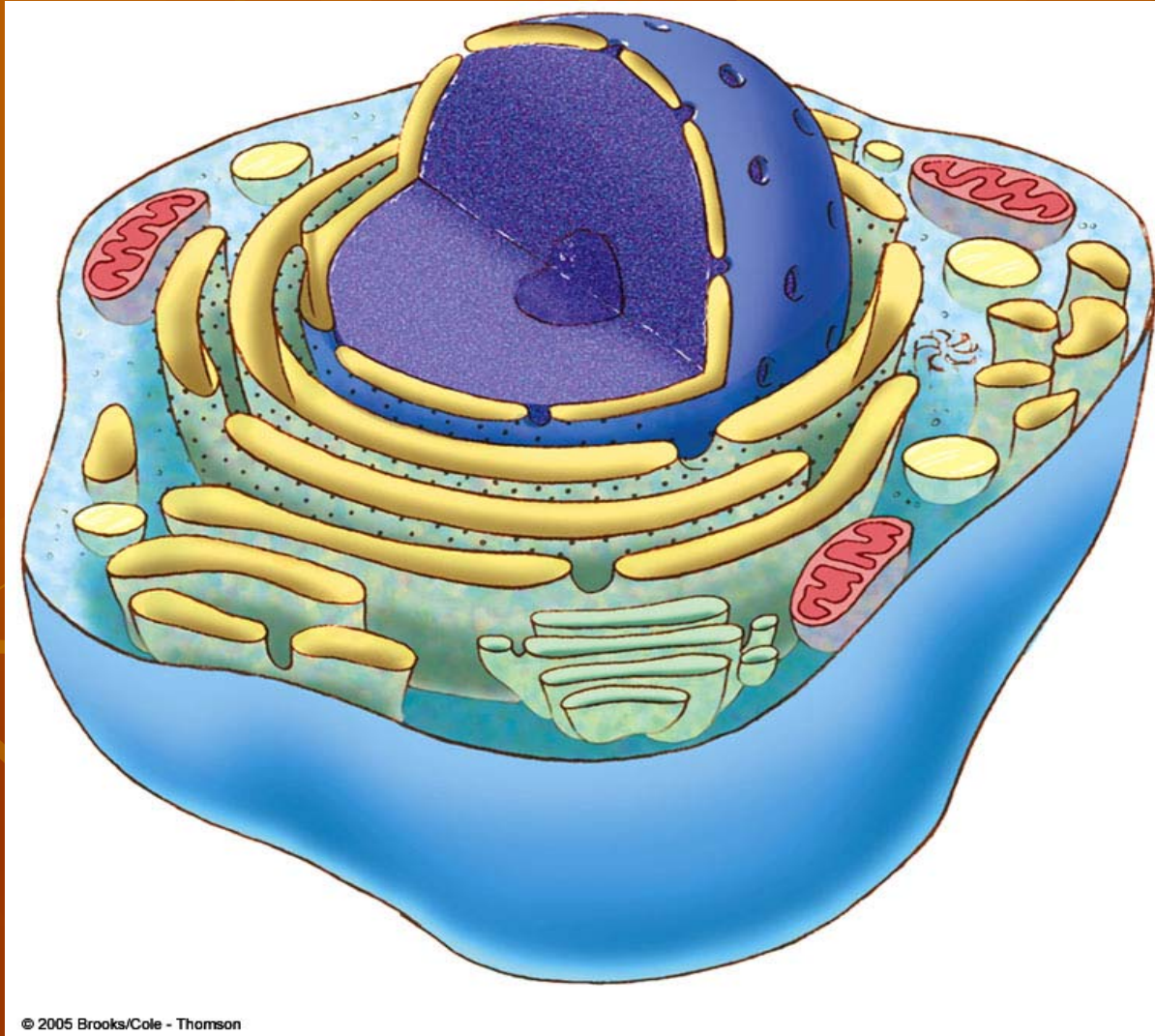
# Review-Requirements for Life

- carbon-and-water-based
- are cellular with complex organization
- undergo metabolism
- possess a capacity to grow
- respond to stimuli
- Reproduce
- through natural selection, adapt in succeeding generations

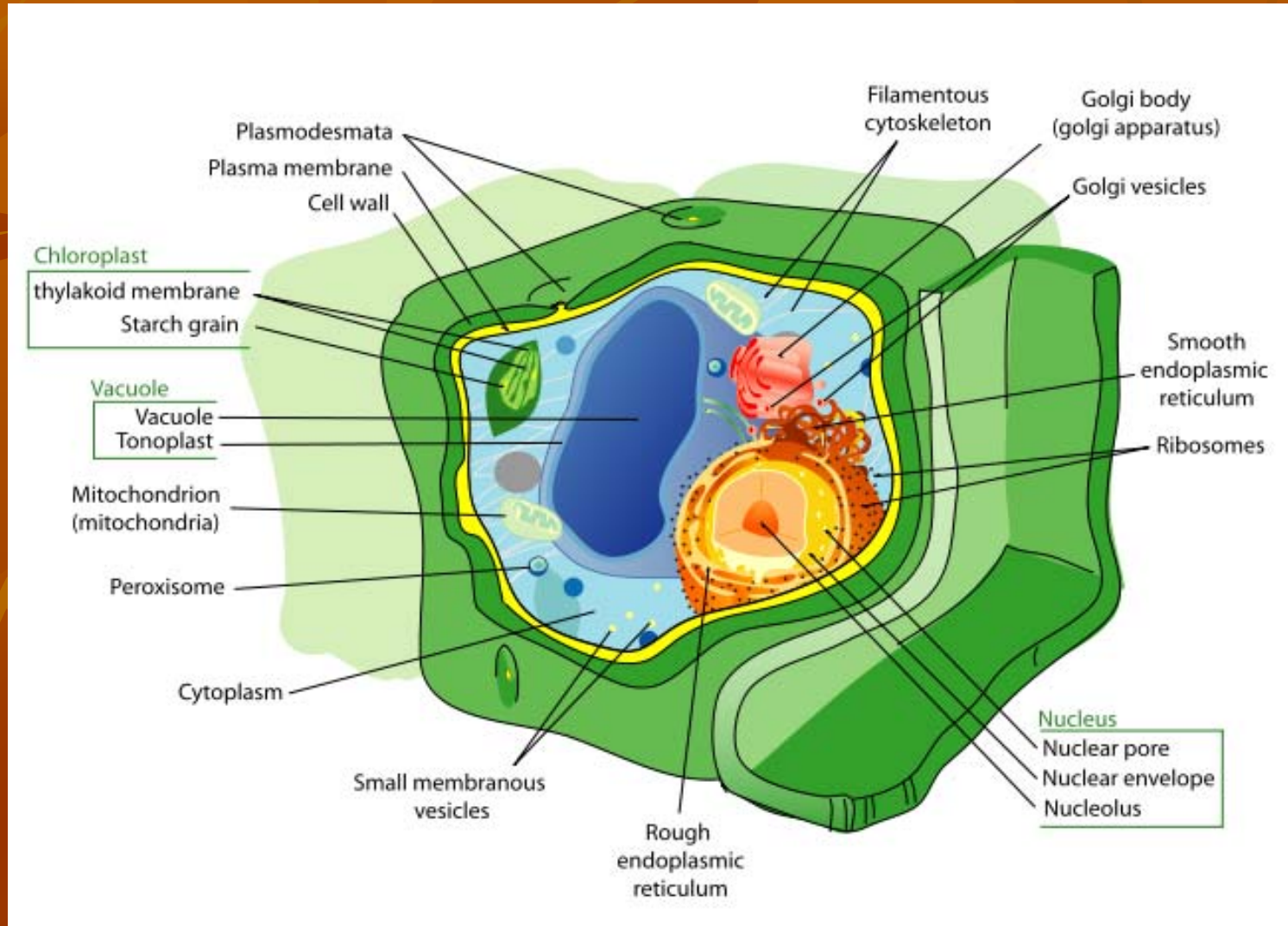
# Prokaryotic Cell



# Eukaryotic Cells--Animal



# Eukaryotic Cell--Plant



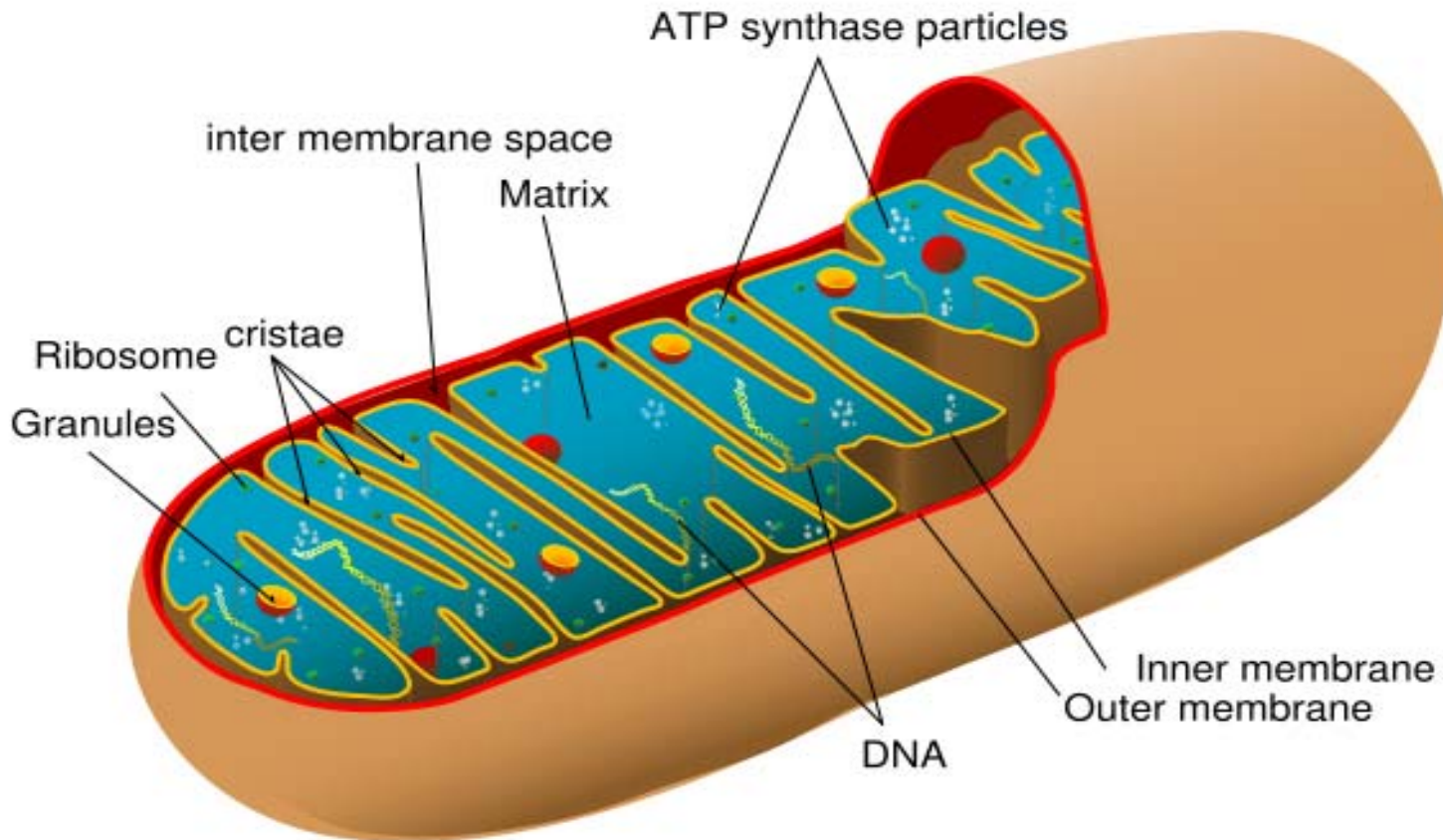
# Review--Organelles

- **Mitochondria**-metabolism and ATP production
- **Nucleus**-contains genetic material
- **Ribosome**-assembles proteins
- **Chloroplast\***-conduct photosynthesis
- **Vacuole**-storage, secretory, excretory
- **Endoplasmic Reticulum**-protein translation, folding, and transport
- **Golgi Apparatus**-delivery system for the cell
- **Lysosomes<sup>^</sup>**-digestion, apoptosis, “healing”
- **Glyoxysome\***-breakdown of fatty acids to sugars

# The Mitochondria

- Singular-- mitochondrion
- Contain their own DNA
- Origin: Endosymbiotic Hypothesis—thought to have descended from bacteria which was then incorporated into another species of bacteria by being engulfed and becoming part of the cytoplasm (chloroplasts)
- It is the organelle in eukaryotic cells that serves as the site of cellular respiration (aerobic)
- Cellular respiration is the catabolic pathway for the production of ATP, in which oxygen is consumed as a reactant along with the organic fuel.

# The Mitochondrion



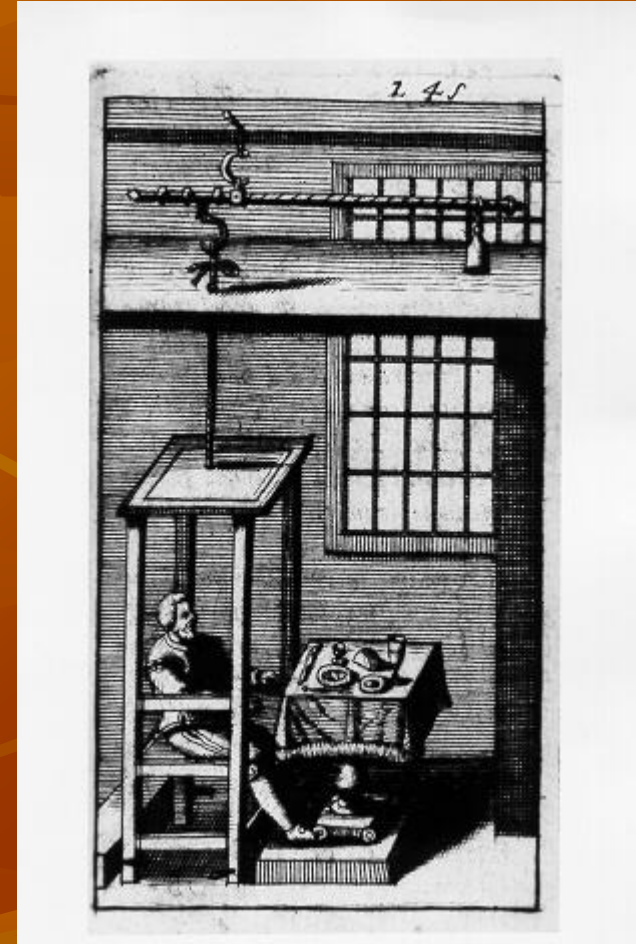
- Source: Wikipedia.com “mitochondria”

# The Mitochondria--Cont.

- Made of an inner and outer membrane
- Phospholipid bilayer and proteins
- Cristae: internal compartments/fold
  - Provides more surface area
  - Contains proteins, ATP synthase, and cytochromes
- Matrix: the internal space inside the inner layer
  - Contains 100's of enzymes, ribosomes, tRNA, and mitochondrial DNA

# What is Metabolism

- Greek for “change” or “overthrow”
- First studied by Santorio Santorio in 1614
- Dr. Johan Musk in 1984 (revised 1992)
- Metabolism is the totality of an organism’s chemical reactions, consisting of catabolic and anabolic pathways
- Basal Metabolic Rate: Energy used at rest
- Usually faster in smaller animals than in larger animals (mouse vs. elephant)
- Influenced by many factors such as age, size, genetic disposition, gender, general health, activity levels, medications



# Reactions of Metabolism

- **Metabolic Pathways:** the series of chemical reactions
- **Anabolism:** the metabolic pathway that builds larger molecules from smaller ones
  - Example: amino acids into enzymes or nucleic acids
- **Catabolism:** the metabolic pathway that breaks down larger molecules into smaller ones
  - Example: Fats, Carbohydrates, Protein

# Anabolism

- The synthesis of complex molecules from simple molecules
- Bone and Muscle
- Anabolic Steroids
  - Natural and Synthetic
  - Promotes cell growth
  - Many Side effects associated with
- Hormone Regulated
- Opposite of Catabolism

# Catabolism

- Carbohydrate Catabolism: the breakdown of monosaccharides, disaccharides, and polysaccharides
  - Glycolysis
  - Glycogenesis
  - Glycogenolysis
  - Gluconeogenesis

# Catabolism—cont.

## ■ Lipid (fat) Catabolism:

- ingested as triglycerides and broken down into free fatty acids and monoglycerides where they are then stored or used up as energy.
- 1 gram of fat has more than 2x the energy yield of protein and carbohydrates
- Fatty acids have 6x the energy storage as glycogen
  - So: 1 lb of fat = 6.75 lbs of glycogen

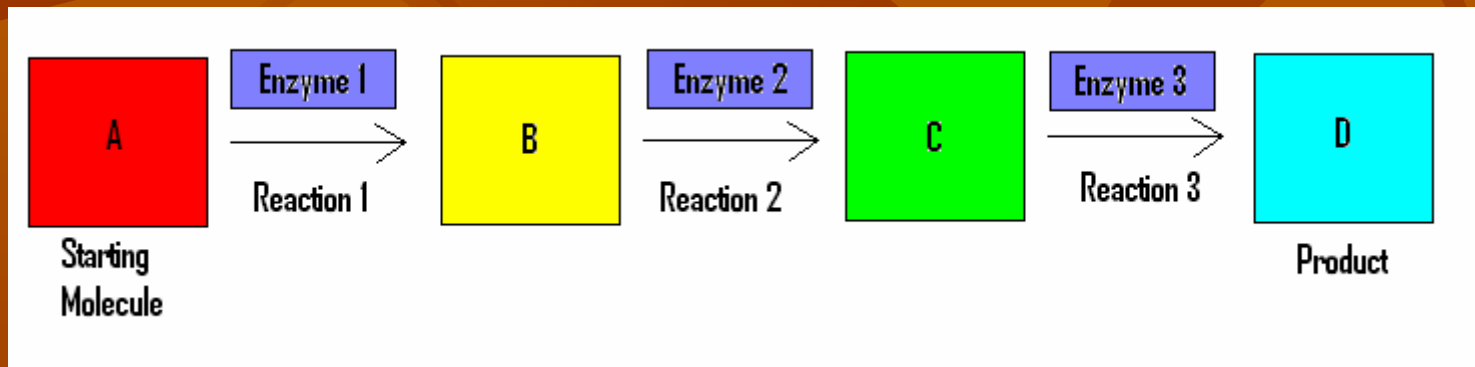
## ■ Protein Catabolism:

- The break down of proteins into amino acids
- Recycled or used to make new amino acids

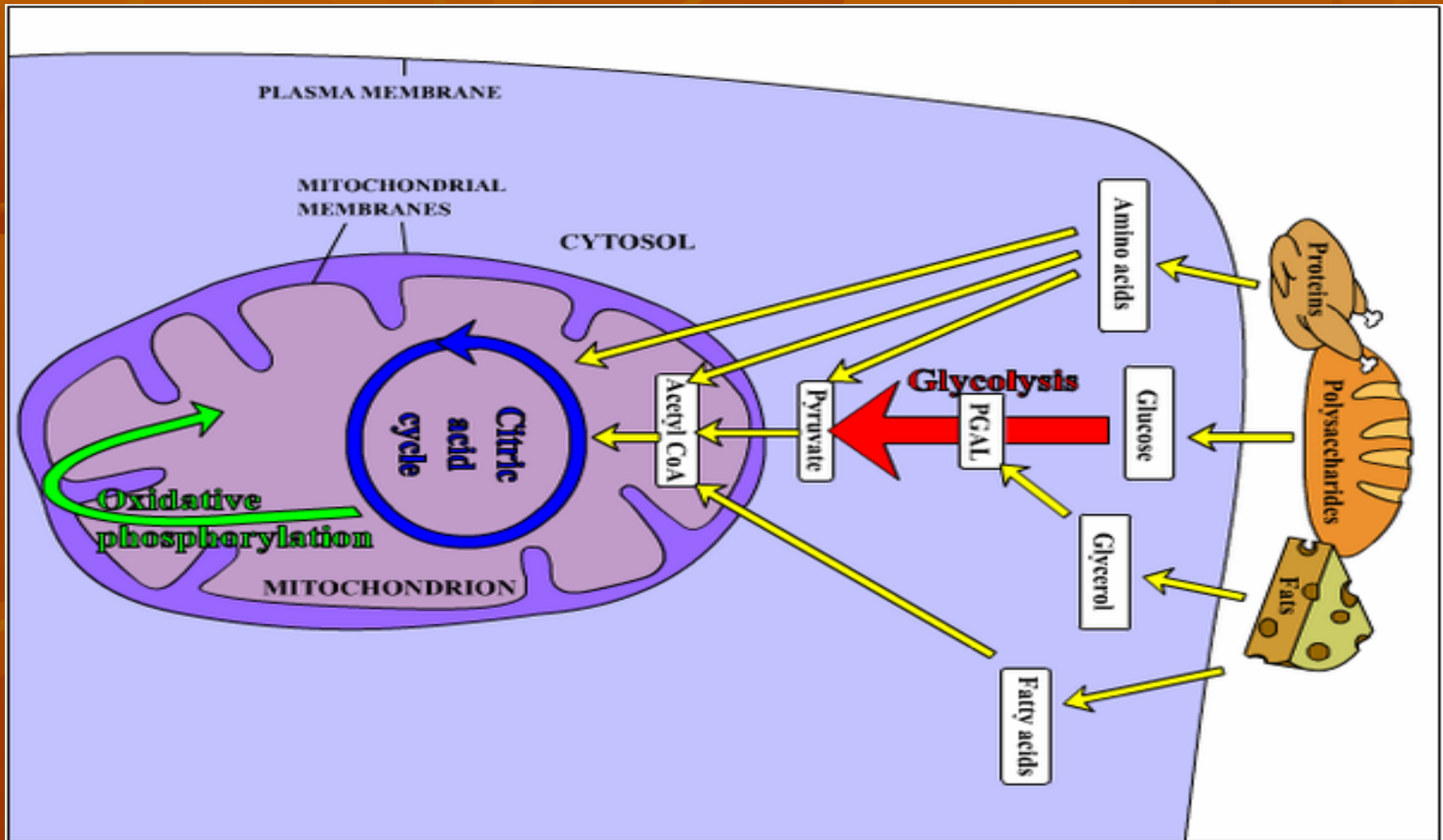
# So.....How Do We Obtain Energy

- The Liver
  - Responsible for various functions in the body
  - Food is digested in the mouth, stomach, and intestines where it is then absorbed through the gut wall where it then ends up in the liver via blood where it then becomes metabolized so it can be used or stored
- Food and Drink
  - Measured in Calories
    - Measurement of energy
    - Calorie (kg) vs. calorie (g)
    - 3200 Calories required to burn 1lb of fat
  - Daily Suggested Servings
    - The food pyramid
  - Basal Metabolic Rate

# Simple Metabolic Pathway



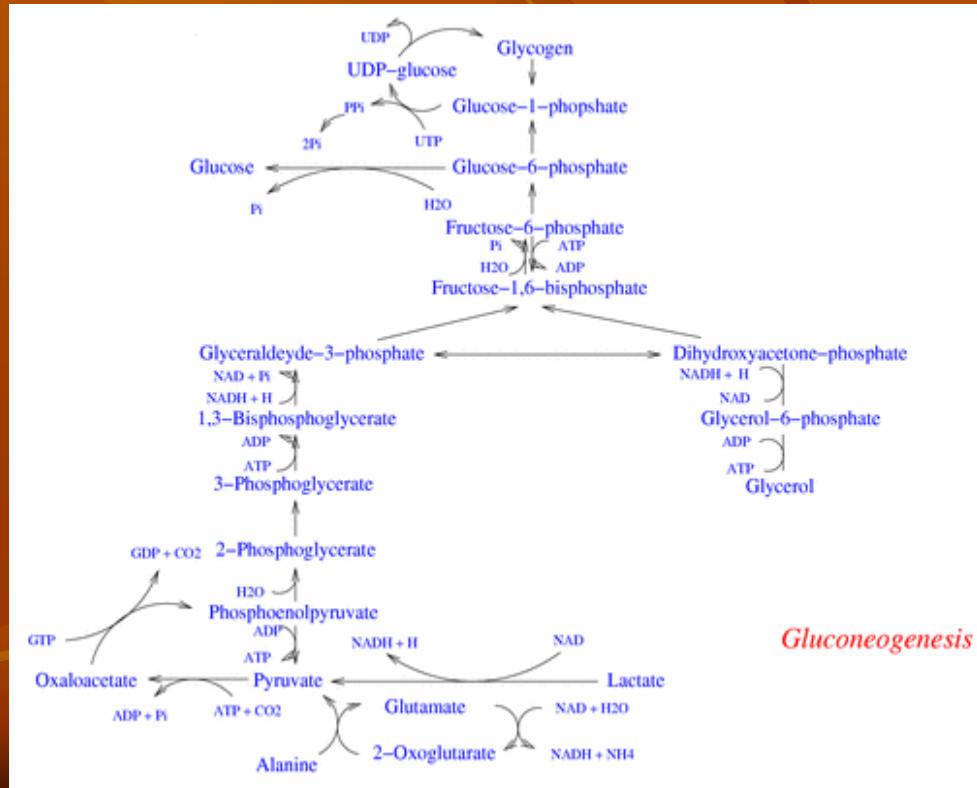
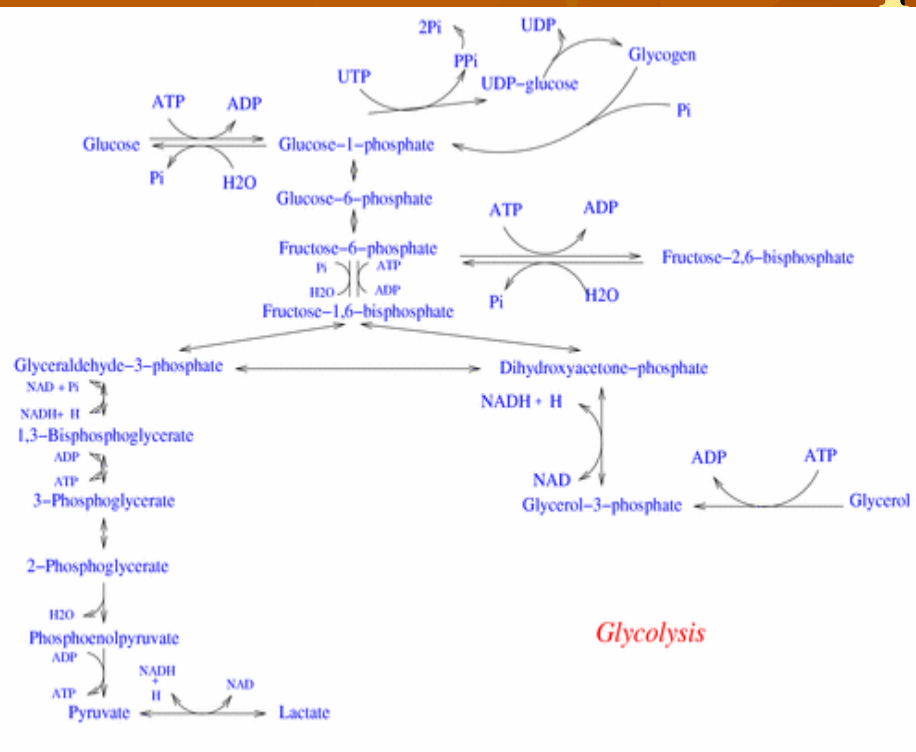
# Catabolic Pathways



- Source: Wikipedia.com “cell metabolism”

# Some Complex Pathways

## Carbohydrates



Source: Cellml.org "metabolic pathways"

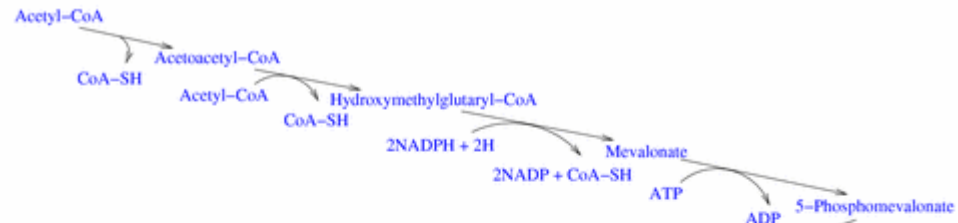
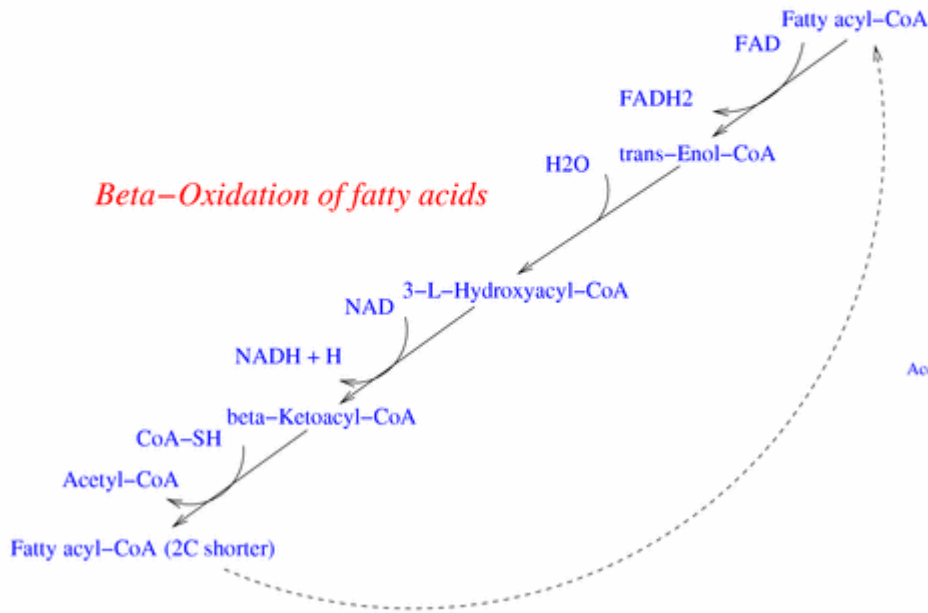
# Some More Complex Pathways

## Lipids

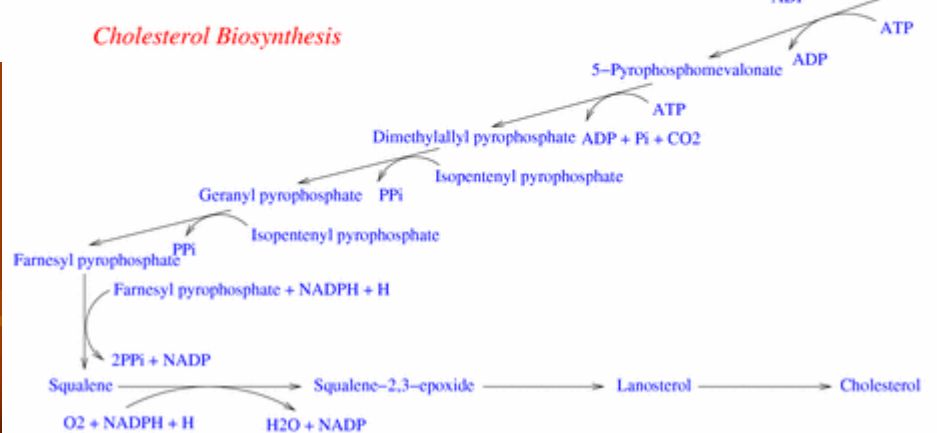
### Fatty acid activation



### Beta-Oxidation of fatty acids

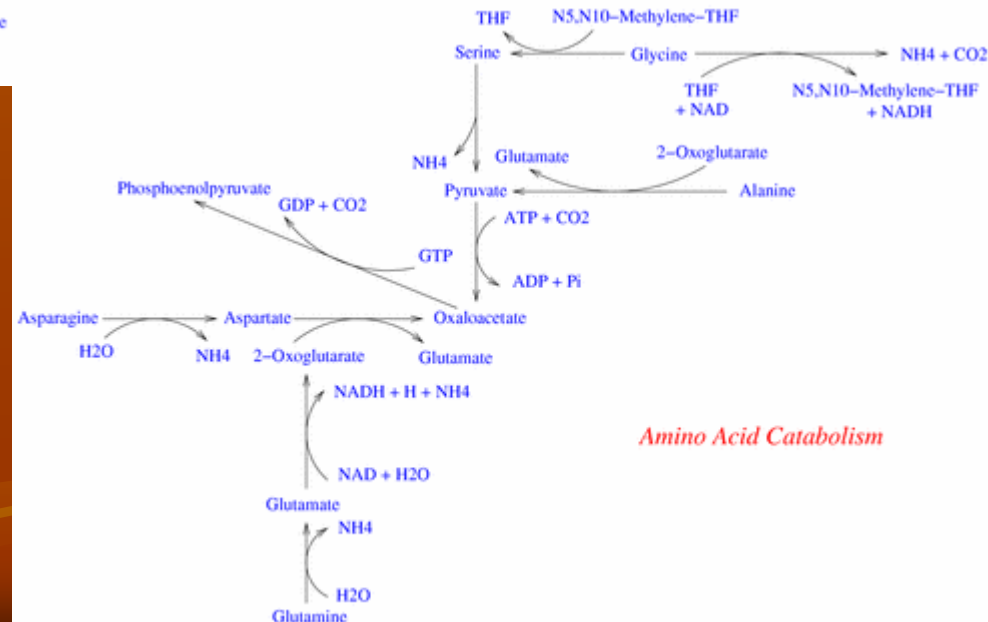
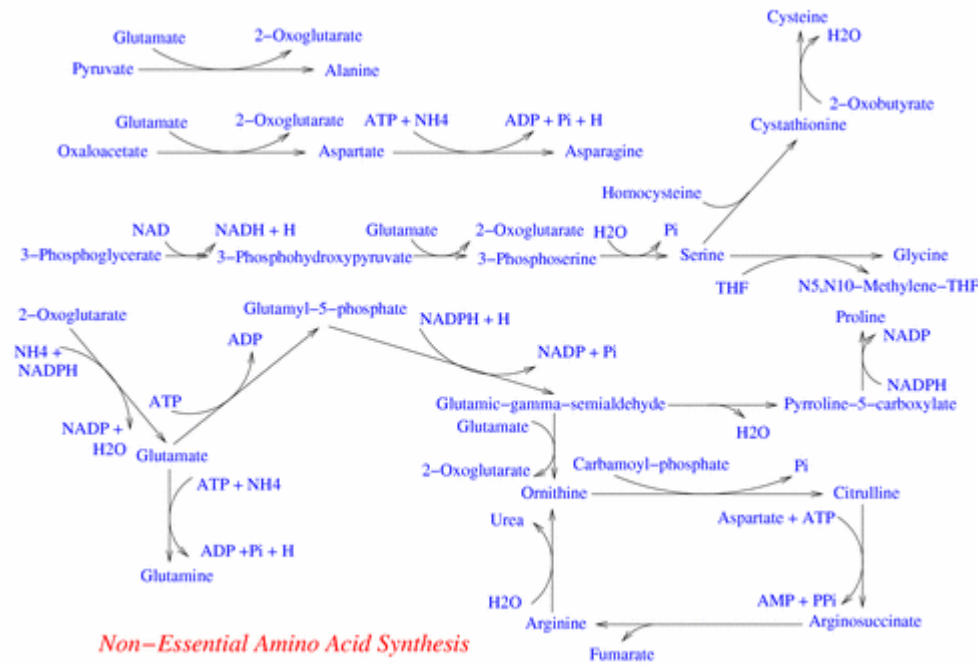


### Cholesterol Biosynthesis

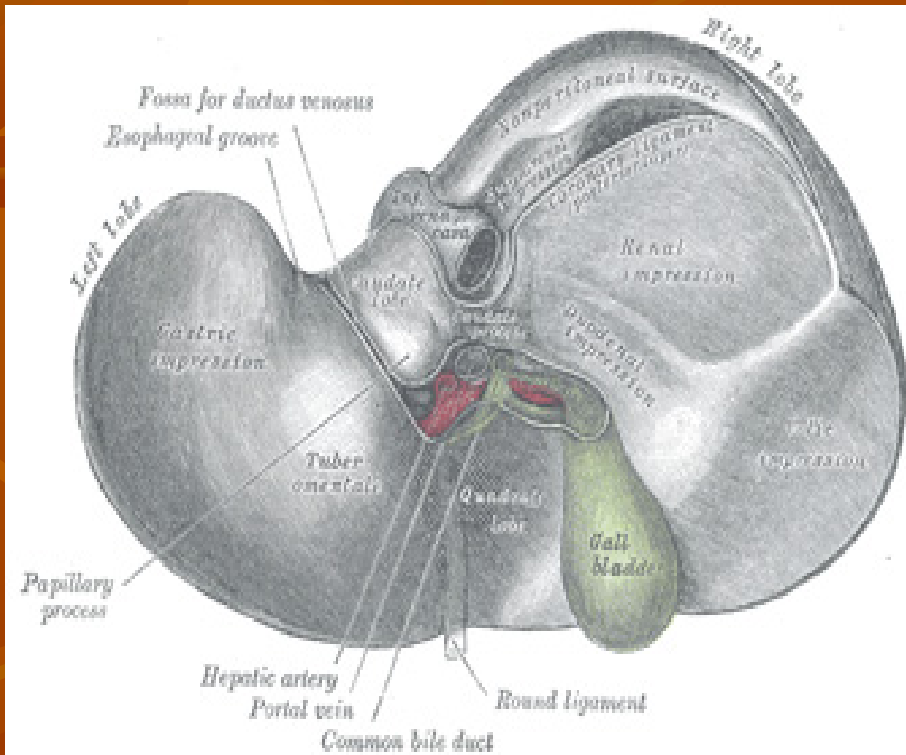


# Even More Complex Pathways

## ■ Amino Acids



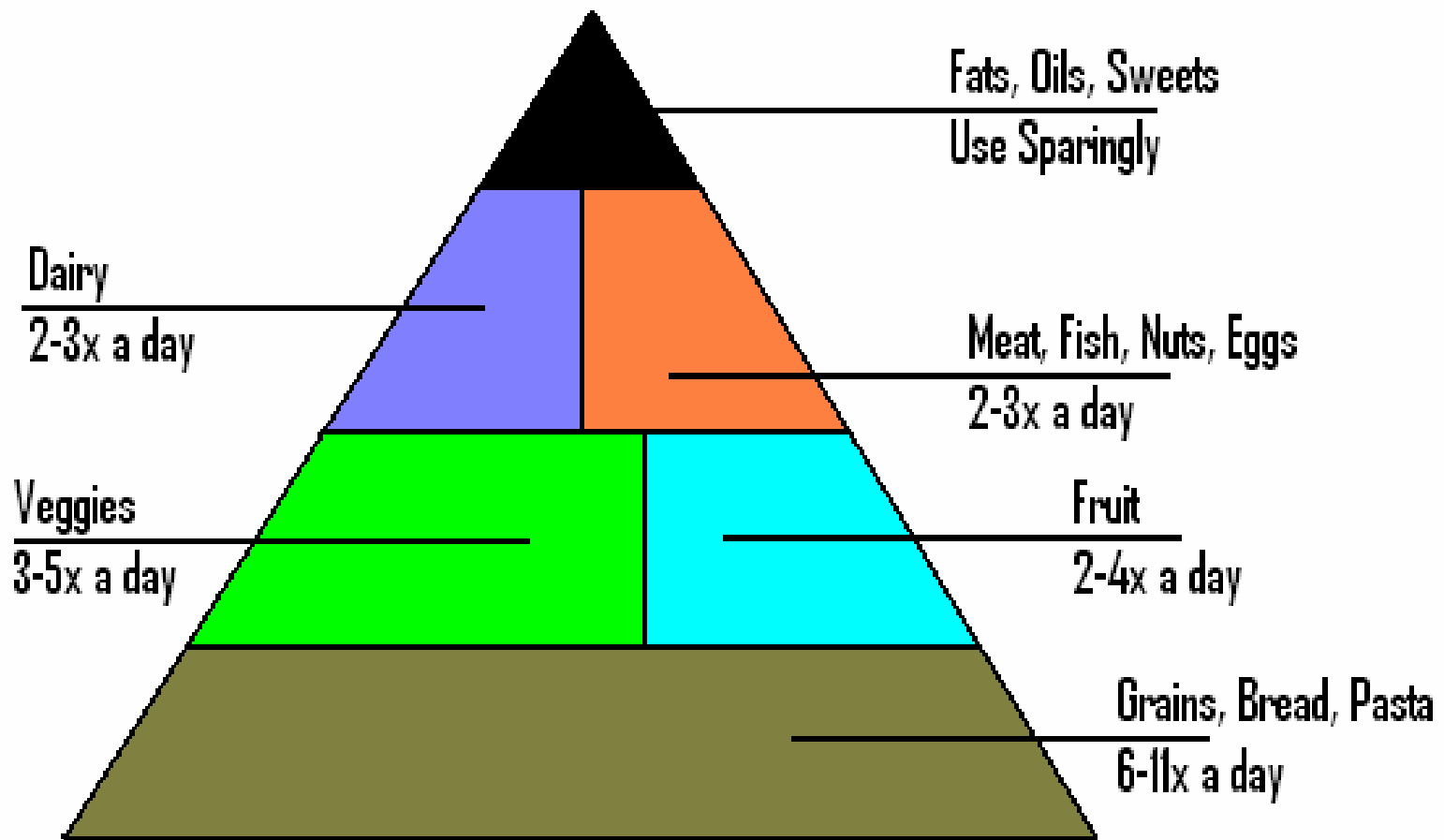
# The Liver



Source: Wikipedia "liver"

Source: <http://www.epidemic.org>

# The Food Pyramid



# BMR

## Weight-Loss-Lose-Weight.com

### Basal Metabolic Rate Calculator

Please enter the following information:

Gender:  (enter 1 for female, 2 for male)

Current Weight:  (in pounds)

Height:  (in inches)

Age:  (in years)

Your Basal Metabolic Rate is:

This means that if you sleep for 24 hours and do nothing else you will burn approximately 2000 calories in one day.

Source: <http://www.weight-loss-lose-weight.com/basal-metabolic-rate-calculator.htm>

## Activity required to burn 100 Calories

Exercise to burn	Time
Bicycling	10 minutes
Running	6 minutes
Walking up Stairs	4 minutes
Standing	50 minutes
Basketball	10 minutes

Source: <http://www.uen.org/Lessonplan/preview.cgi?LPid=1253>

# Turkey

Meat Type	Calories	Total Fat	Protein
Breast with skin	194	8 grams	29 grams
Breast w/o skin	161	4 grams	30 grams
Wing w/skin	238	13 grams	27 grams
Leg w/skin	213	11 grams	28 grams
Dark meat w/skin	232	13 grams	27 grams
Dark meat w/o skin	192	8 grams	28 grams
Skin only	482	44 grams	19 grams



# Pumpkin Pie

## Nutrition Facts

Serving Size: 1 slice • 6.5 oz

### Amount Per Serving

<b>Calories</b>	372.6	<b>Calories from Fat</b>	171
		<b>% DV</b>	
<b>Total Fat</b>	18.99g		29%
<b>Cholesterol</b>	68.53mg		23%
<b>Sodium</b>	502.01mg		21%
<b>Total Carbohydrate</b>	45.61g		15%
<b>Protein</b>	6.85g		11%

Unofficial Pts: 9

[DietFacts.com](http://DietFacts.com)

(Fiber unknown so Pts may be lower)

Percent of Calories from:

**Fat-45.9%** **Carb-49%** **Protein-7.4%**

(Total may exceed 100% due to rounding)

# Apple Pie

Calorie Breakdown	
This table shows you where the calories in this food come from.	
Calories from Fat	116 (41%)
Calories from Carbohydrate	159 (56%)
Calories from Protein	9 (3%)
Calories from Alcohol	0 (0%)

Serving size 1 4.1oz slice

# Ham

Calorie Breakdown	
This table shows you where the calories in this food come from.	
Calories from Fat	69 (47%)
Calories from Carbohydrate	0 (0%)
Calories from Protein	77 (53%)
Calories from Alcohol	0 (0%)

Serving size 3oz.

# Green Bean Casserole

## Cranberry Sauce



Calorie Breakdown	
This table shows you where the calories in this food come from.	
Calories from Fat	1 (1%)
Calories from Carbohydrate	89 (99%)
Calories from Protein	0 (1%)
Calories from Alcohol	0 (0%)

Serving size 1 2oz. slice

## Nutrition Facts

Serving Size 2/3 cup (109.0 g)	
<b>Amount Per Serving</b>	
<b>Calories</b> 110	Calories from Fat 72
<b>% Daily Value*</b>	
<b>Total Fat</b> 8.0g	<b>12%</b>
Saturated Fat 2.5g	<b>12%</b>
<b>Sodium</b> 460mg	<b>19%</b>
<b>Total Carbohydrates</b> 8.0g	<b>3%</b>
Dietary Fiber 1.0g	<b>4%</b>
Sugars 2.0g	
<b>Protein</b> 2.0g	
Vitamin A 4%	Vitamin C 6%
Calcium 2%	Iron 2%
<b>Nutritional Units</b> 3	
* Based on a <u>2000 calorie diet</u>	

## Candied Yams

Calorie Breakdown	
This table shows you where the calories in this food come from.	
Calories from Fat	0 (0%)
Calories from Carbohydrate	184 (96%)
Calories from Protein	8 (4%)
Calories from Alcohol	0 (0%)

Serving size 5oz.

## Fruit Cake



Calorie Breakdown	
This table shows you where the calories in this food come from.	
Calories from Fat	35 (24%)
Calories from Carbohydrate	106 (72%)
Calories from Protein	5 (3%)
Calories from Alcohol	0 (0%)

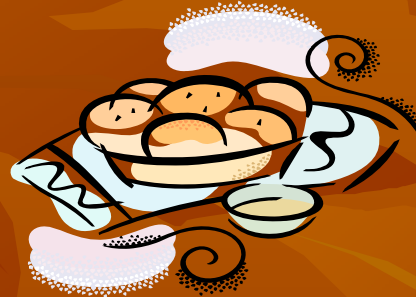
Serving size 1.5oz

# Stuffing

Description	Quantity	Energy (calories)	Carbs (grams)	Protein (grams)	Cholesterol (milligrams)	Weight (grams)	Fat (grams)	Saturated Fat (grams)
from mix, dry type	1 cup	500	50	9	0	140	31	6.1
from mix, moist	1 cup	420	40	9	67	203	26	5.3

Mashed potatoes w/  
whole milk and butter

Serving Size 1 cup (210g)	
Amount Per Serving	
<b>Calories</b> 237	Calories from Fat 80
% Daily Value*	
<b>Total Fat</b> 9g	14%
Saturated Fat 4g	22%
Trans Fat 0g	
<b>Cholesterol</b> 23mg	8%
<b>Sodium</b> 666mg	28%
<b>Total Carbohydrate</b> 35g	12%
Dietary Fiber 3g	13%
Sugars 3g	
<b>Protein</b> 4g	



# Dinner rolls

Serving Size 1 roll (1 oz) (28g)	
Amount Per Serving	
<b>Calories</b> 87	Calories from Fat 16
% Daily Value*	
<b>Total Fat</b> 2g	3%
Saturated Fat 0g	2%
Trans Fat	
<b>Cholesterol</b> 1mg	0%
<b>Sodium</b> 150mg	6%
<b>Total Carbohydrate</b> 15g	5%
Dietary Fiber 1g	2%
Sugars 2g	
<b>Protein</b> 3g	

# Gravy

Nutrition Facts	
Serving Size 1 can (298g)	
Amount Per Serving	
<b>Calories</b> 48	Calories from Fat 5
% Daily Value*	
<b>Total Fat</b> 0.6g	1%
Saturated Fat 0.3g	1%
Polyunsaturated Fat 0g	
Monounsaturated Fat 0.2g	
<b>Cholesterol</b> 0mg	0%
<b>Sodium</b> 149mg	6%
<b>Potassium</b> 241.4mg	7%
<b>Total Carbohydrate</b> 7.5g	2%
Dietary Fiber 0g	0%
<b>Protein</b> 3.6g	7%



Source: <http://www.nutritiondata.com/index.html>

<http://www.thecaloriecounter.com>

[www.diets.com](http://www.diets.com)

# Don't Forget the Drinks



- Soda— 150 Calories on average per can
- Kool-Aid— 770 Calories per 2qt. or  
~96 Calories per 8 oz. serving

## ■ Milk--

1-8oz. Serving	Calories	Fat (g)
Whole	149	7.7
2% Reduced fat	121	4.4
1% Lowfat	104	2.2
Nonfat	90	0.5
Chocolate, Whole	208	8
Chocolate, 2% Reduced fat	178	4.7
Chocolate, 1% Lowfat	157	2.3

- Fruit Juices— ~120 Calories per 8oz. Serving  
Low sugar/diet juices ~ 50 Cal per 8oz. Serving



# Drinks Continued

- Coffee— 9 Cal in a cup  
+ 22 Cal per container (11g) of light cream  
+ 23 Cal per packet (6g) of sugar



- Beer—

Brand 12oz. Can	Calories	Carbs (g)
Budweiser	154	10.6
Bud Light	110	6.6
Bud Select	99	3

Source: <http://www.beer100.com/beercalories.htm>



- Egg Nog— 340 Cal. per 8oz.w/out alcohol  
480 Cal. w/ 1 shot of liquor (1shot=140Cal)

# Some Holiday Tidbits of Info

- The average person eats around 4500 calories and 230 grams of fat on Thanksgiving alone.
- Weight gain is about 1 lb from Thanksgiving to the beginning of the New Year, not the 5-10lbs originally thought to be gained
- However, that 1 lb can stay with you through adulthood
- The reason you are tired after eating is now thought to be from your body working overtime to digest all the food you just ate not from Tryptophan alone.