NUTRITION BASICS

A simple, healthy diet:

Eat a Diversity of locally-grown, unprocessed food (mostly plants) in Moderation, leisurely with friends and family & Exercise (walk to the store or grow and prepare your own food).

Essential Substances

(substances our body cannot produce, therefore we must ingest)

Oxygen (O_2)
Water (H_2O)
Fiber – carbohydrate molecules in plants that cannot be broken down by human digestive enzymes (therefore no calories)
Calorie Sources: Carbohydrate, Protein, Lipid, Alcohol
Glucose ($C_6H_{12}O_6$)
2 fatty acids:
Omega-6 - Linoleic acid or Arachidonic acid
Omega-3 - Linolenic acid or EPA & DHA
9 Amino Acids:
Histidine, Isoleucine, Leucine, Lysine, Methionine (also a precursor to Cysteine), Phenylalanine (also a precursor to Tyrosine), Threonine, Tryptophane, Valine
Supplements
Bilberry, Grapeseed, Saw palmetto, Cinnamon, Ginger

13 Vitamins (probably several more):
Fat Soluble:
Retinol (A), Calciferol (D), Tocopherol (E), Phylloquinone (K)
Water Soluble:
Thiamin (B_1), Riboflavin (B_2), Niacin (B_3), Biotin, Pantothenic Acid, Pyridoxine (B_6), Folate, Cobalamin (B_{12}), Ascorbic Acid (C), Choline [possibly also inositol & carnitine]
16 Minerals:
>100 mg per day: Calcium (Ca), Phosphorus (P), Potassium (K), Sodium (Na), Chloride (Cl), Magnesium (Mg)
Trace elements (very small amounts required): Iron (Fe), Zinc (Zn), Sulphur (S), Copper (Cu), Manganese (Mn), Iodine (I), Selenium (Se), Chromium (Cr), Fluoride (F), Molybdenum (Mo)
[probably also: boron, vanadium]
Phytochemicals:
Carotenes, Flavonoids, Lutein, Lycopene, Allium, Sulforaphane, Zeaxanthin, Lemon bioflavonoid complex

Definitions of Edible Plant Parts

fiber = cellulose: seed coat, stems, leaves, etc.
germ = plant embryo
carbohydrate = starch from storage organs: seed endosperm, cotyledon, roots, tubers, etc.
greens = active metabolic plant parts so more vitamins & minerals, less calories
fruits = organ for dispersal of baby plants (seeds) so often sweet with fewer nutrients than greens
seeds = embryonic plant with nutrient and energy storage

Energy - Calories

1 kcal (Calorie) = energy required to raise 1 kg of H_2O 1°C
carbohydrate = 4 kcal/g
protein = 4 kcal/g
lipid (fat) = 9 kcal/g
alcohol (ethanol) = 7 kcal/g
Caloric intake:
1st - immediate use for energy
2nd - stored in liver & muscles as glycogen (~12-24 hours worth)
3rd - stored as fat (unlimited time)

CARBOHYDRATES

glucose is converted to **glycogen**, 1/3 stored in the liver/ 2/3 stored in muscle cells
glucose is the only energy source used by brain cells, other nerve cells and developing red blood cells
inadequate carbohydrate intake plus accelerated fat or protein breakdown = **ketosis** (energy derived from ketone bodies derived from lipids [glycerol] & protein)

LIPIDS (fats & oils)

Saturated - 18:0 Stearic acid
Monounsaturated - 18:1 Oleic acid
Polyunsaturated - 18:2 Linoleic acid (omega-6)
18:3 Linolenic acid (omega-3)
hydrogenated fat - polyunsaturated oils chemically saturated to produce an oil that is solid at room temperature and resists oxidation
trans-fatty acids found in milk naturally

Set-Point Theory

Homeostasis of the body systems: blood glucose level, blood pH, body temperature, etc.

After weight loss or weight gain the body adjusts its metabolism to restore to the original weight, therefore,
weight gain = higher metabolism
weight loss = lower metabolism . . . So Exercise!!!

PROTEINS

Cells have an **amino acid reserve** of one to three days before removal for deamination & fat storage.
Most likely amino acids to be **limiting**: Lysine, Methionine, Threonine, Tryptophane
Some effects of **High Protein Diet**:
- promotes Ca^{2+} excretion (bone loss)
- affects zinc absorption (impaired immune response)
- causes **dehydration** resulting in more toxic nitrogen wastes & change in osmotic balance (blood pH imbalance)
- **ketosis**: kidney damage, coma, heart failure
- **Weight loss** in the first couple weeks is from loss of glycogen & H_2O, plus proteins & minerals; NOT from fat loss.

SUPPLEMENTS

Synergistic effect of foods rich in a diversity of molecules is lost.
Lecithin is produced by the liver and digested by enzymes in the stomach.
Enzymes are produced by several organs/cells and most are denatured by acid in the stomach.
Cholesterol is produced by the liver, contributing much more than dietary intake. With constant and continuing intake the liver will produce less and the body will begin to take up more from the diet.

Major Regions of Crop Domestication*

- correlation with major ancient civilizations
-many of our most common food plants originated in seasonally dry biomes: Chaparral, Savanna, Tropical Dry Forest
-primary crops are from plants that store energy in long-lasting seeds or underground roots & tubers

Mediterranean Region (including the Fertile Crescent)

fertile crescent:
wheat, oats, barley, rye, lentil, chickpea, green peas, apple, onion, fig, grape, melons, pomegranate, cumin, rapeseed (canola)

other areas:
beet, carrot, turnip, olive, cherry, plum, apricot, pear, garlic, cabbage/broccoli, lettuce, flax, alfalfa, oregano, sage, thyme, parsley, mint, rosemary, artichoke, pistachio, dates

[other products: lupine, digitalis, belladonna, opium poppy, psyllium]

North China Region (Manchuria & Japan)

soybean, buckwheat, cucumber, horseradish, bamboo shoots, tea, peach, litchi, walnut, persimmon, gourds, mulberry

[other products: ginseng, camphor, tung oil]

SE Asia (India, Sri Lanka to Vietnam & nearby islands)

rice, mung bean, sesame, taro, sugar cane, eggplant, mango, banana, citrus, coconut, jackfruit, durian, nutmeg, clove, cardamon, turmeric, black pepper

[other products: hemp, jute, ganga, betel nut, cotton]

African Sahel & Ethiopia

pearl millet, Guinea millet, African rice, teff, cowpea, Bambarra groundnut, yams, watermelon, okra, coffee, oil palm, sorghum, tamarind

[other products: cotton, castor oil, baobab]

MesoAmerica (Mexico, Central America)

maize, dry beans, chiles, squash, sweet potato, prickly pear, vanilla, cacao, papaya, guava, allspice, avocado, jicama

[other products: peyote, sisal, cotton]

South American Andes (and lowlands)

potato, lima bean, amaranth, quinoa, cassava, oca, pumpkin, tomato, cashew, peanut, pineapple

[other products: cotton, cocaine, tobacco, rubber]

taco (Nahuatl [Aztec]) = food
beans, maize, chiles
3 sisters: maize, beans, squash

[the U.S. & Canada are not are a major region of crop domestication, but have contributed: blueberry, cranberry, wild rice, sunflower, sunchoke]

Significant Food Plant Families

Grass Family (Poaceae) maize, wheat, rice, oats, barley, millet, sorghum, rye, triticale, teff, wild rice, sugar cane, bamboo shoots,	starch, E, fiber & B's from whole grain
Legume Family (Fabaceae) soy, green beans, peas, peanuts, pinto bean, lima bean, kidney bean, mung bean, adzuki bean, scarlet runner bean, lentil, chick-pea, black-eyed peas, broad bean, carob, fenugreek, licorice, tamarind	protein, E, B, iron, starch
Potato Family (Solanaceae) tomato, potato, eggplant, peppers (red, green, chili), tomatillo	C, starch
Rose Family (Rosaceae) apples, pear, peach, apricot, nectarine, sour cherry, sweet cherry, plums (several species), almonds, strawberry, raspberry, blackberry, loganberry, gooseberry, currants (black, red, white), loquat, quince, rose hip	C, iron, fiber
Mustard Family (Brassicaceae) broccoli, cauliflower, kohlrabi, kale, cabbage, bok choy, brussel sprouts, turnip, rutabaga, watercress, radish, mustard, horseradish, canola	Ca^{2+}, E, K & many others carotene (when dark green), indoles (cancer inhibition)
Squash Family (Cucurbitaceae) cucumber, gherkin, watermelon, cantaloupe, honeydew, muskmelon, pumpkin, zucchini, summer squash, winter squash, chayote	A, C, starch, fiber, K^{+}
Sunflower Family (Asteraceae) artichoke, sunchoke, salsify, lettuce, dandelion, cardoon, endive, sunflower, tarragon, safflower, chicory	A, C, B's, K, folate, Ca, Fe, Mg, Mn, inulin (low glycemic index starch), lipids
Goosefoot Family (Chenopodiaceae) beets, spinach, quinoa, orache	iron, E, K, amino acids, minerals, fiber, carotene
Citrus Family (Rutaceae) sour orange, sweet orange, lemon, lime, tangerine, grapefruit, pomelo, citron, kumquat, ugli	C, fiber

Top Crops Worldwide
(metric tons)*

1. Sugar Cane
2. Maize
3. Rice
4. Wheat
5. Cow Milk
6. Potatoes
7. Vegetables fresh nes**
8. Cassava
9. Soybeans
10. Sugar Beet
11. Barley
12. Tomatoes
13. Sweet potatoes
14. Indigenous Pigmeat
15. Watermelon
16. Bananas
17. Buffalo milk
18. Indigenous Chickenmeat
19. Onions
20. Apples

*FAO Production Yearbook, 2008
http://faostat.fao.org/site/339/default.aspx

**Including inter alia: bamboo shoots *(Bambusa spp.);* beets, chards *(Beta vulgaris);* capers *(Capparis spinosa);* cardoons *(Cynara cardunculus);* celery *(Apium graveolens);* chervil *(Anthriscus cerefolium);* cress *(Lepidium sativum);* fennel *(Foeniculum vulgare);* horseradish *(Cochlearia armoracia);* marjoram, sweet *(Majorana hortensis);* oyster plant *(Tragopogon porrifolius);* parsley *(Petroselinum crispum);* parsnips *(Pastinaca sativa);* radish *(Raphanus sativus);* rhubarb *(Rheum spp.);* rutabagas, swedes *(Brassica napus);* savory *(Satureja hortensis);* scorzonera *(Scorzonera hispanica);* sorrel *(Rumex acetosa);* soybean sprouts tarragon *(Artemisia dracunculus);* watercress *(Nasturtium officinale)*

Most Nutritious Foods
(nutrient-dense)+

1. Broccoli
2. Dark green leafies: Spinach, Kale, Chard, Collard Greens
3. Brussels sprouts
4. Beans: soy, pinto, lima, lentil, peas, etc.
5. Pumpkin & squash
6. Asparagus
7. Artichokes
8. Cauliflower
9. Sweet potato
10. Carrots
11. Tomatoes
12. Garlic & Onion
13. Sweet & Hot Peppers
14. Watermelon
15. Quinoa & Amaranth
16. Whole grains

+nutrient-density is subjective, but is based on the amount of nutrients per calorie
http://www.whfoods.com/foodstoc.php

*

Sources for Major Regions of Crop Domestication include:

Darwin, C. 1868. *The variation of animals and plants under domestication*. London, UK.

de Candolle, A. 1882. *Origins de Plantes Cultivées*. (English edition 1886). Paris, France [in French].

Harlan, J.R. 1971. Agricultural origins: Centers and noncenters. *Science* 174:468-474.

Harlan, J.R. and J.M.J. de Wet. 1973. On the quality of evidence for origin and dispersal of cultivated plants. *Curr. Anthropol.* 14:51-62.

Harlan, J.R. 1980. Studies on the origin and evolution of plants since N. I. Vavilov. Pp. 35-38 *in* Well-being of Mankind and Genetics. Proceedings of the XIV International Congress of Genetics Volume 1, Book 1. MIR Publications, Moscow, USSR.

Harris, D.R. 1990. Vavilov's concept of centres of origin of cultivated plants: Its genesis and its influence on the study of agricultural origins. *Biol. J. Linn. Soc.* 39:7-16.

Rieseberg, L.H., and J.M. Burke. 2008. Molecular evidence and the origin of the domesticated sunflower. Proceedings of the National Academy of Sciences USA 105:E46.

Vavilov, N.I. 1926. Centres of origin of cultivated plants. *Tr. po Prikl. Bot. Genet. Sel. [Bull. Appl. Bot. & Genet. Sel]* 16(2):139-248 [in Russian].

Vavilov, N.I. 1935. Theoretical Basis for Plant Breeding, Vol. 1. Moscow. Origin and Geography of Cultivated Plants. Pages 316-366 in *The Phytogeographical Basis for Plant Breeding* (D. Love, transl.). Cambridge Univ. Press, Cambridge, UK.

Vavilov, N.I. 1992. *Origin and Geography of Cultivated Plants* (V.F. Dorofeev, ed.). Cambridge University Press, Cambridge, UK.

Zeven, A.C. and J.M.J. de Wet. 1982. *Dictionary of Cultivated Plants and Their Regions of Diversity*. Pudoc, Wageningen, Netherlands.

Michael Hanson Ph.D.
Bellevue College
Science Division L200
1500 Landerholm Drive SE
Bellevue, WA 98007
michael.hanson@bellevuecollege.edu