

Alex & Mike's

World of Chemistry NTC: Food

Lecture 1

January 7 2013

Dr. Schwarcz + Dr. Harpp

Announcements:

- Happy New Year and best wishes for the Winter 2014 semester!
- NTC sign-ups will take place before class outside of Leacock 132.
- Check out our website for more info!

Contact us at mcgillWOCNTC@gmail.com
www.wocntcs.com

World of Chemistry: Food

CHEM-181

Lecture 1: January 8, 2014

Lecture given by: Dr. Joe Schwarcz, Ph.D. & Dr. David Noble Harpp, Ph.D.

Alex & Mike's World of Chemistry NTCs: Information

- A little information about how our NTCs work: every week, using the lecture recordings, we put together highly detailed notes to be used as study aids for this course.
- *We write all of our own NTCs* as we want to ensure high quality and consistency for the entirety of the course.
- **When can you sign up and for how much?** At any of our pickup hours, for 30\$ (one time fee to get all the lectures for the semester on a weekly basis as the lectures are held).
- **When and where are the pickup hours?** From 4:45 until class starts, every Tuesday, at the tables near the main entrance of Leacock 132. We will also have alternate pickup hours on a different day which will be announced shortly on our website.
- **Do I need to pick up my sets every week or can I come once in awhile?** We will have older sets with us at our pickup hours so you don't need to come every week if you don't want to!
- *Pickup hours on the weeks of midterms will be **cancelled**, and instead we will post the last lecture before each exam **online** on a secret link for convenience.*
- You can get more info on our website: www.wocntcs.com and please email any questions to mcgillwocntc@gmail.com
- Good luck and have a good semester!

World of Chemistry @ McGill University: Basic Course Information

- The course coordinator for the Foods course is Dr. Harpp
 - **Dr. Harpp Contact Information**
 - Email: david.harpp@mcgill.ca
 - Office: 212 Otto Maass Chemistry Building
 - Please direct any administrative questions about the course in general to Dr. Harpp, unless it is related to specific lecture material given by one of the other professors.
- There are two other lecturers for the WOC: Drugs course; they are Dr. Joe Schwarcz and Dr. Ariel Fenster.
 - **Dr. Joe Schwarcz Contact Information**
 - Email: joe.schwarcz@mcgill.ca
 - Office: 110 Otto Maass Chemistry Building

- **Dr. Ariel Fenster Contact Information**
 - Email: ariel.fenster@mcgill.ca
 - Office: 110 Otto Maass Chemistry Building
- The course is recorded using two systems: an automatic recording system as well as the **COOL recording system** (<http://cool.mcgill.ca>)
- *For the full syllabus and all relevant information, please see the course information documents on myCourses.*
- *There is NO textbook for the course.*
- Dr. Schwarcz suggests attending the class because students get the most benefit (and perform better) when they attend
- **There will be 2 Midterm exams worth 30% each:**
 - **Monday February 3, 6:15-8:30 PM (lecture coverage to end of Jan 28)**
 - **Wednesday March 19, 6:15-8:30 PM (lecture coverage to end of Feb 25)**
 - Dates are non-negotiable—alternative arrangements can be made in certain situations (illness, etc.)
- **FINAL EXAM (40%): TBA**
- **Tests are cumulative: each examination will have a small percentage (approx. 10%) of questions from previous material.**
- There are 4 total WOC courses offered by McGill University, two of which operate each semester. The Drugs and Technology courses are offered in the fall, while the Food and Environment courses are offered in the Winter semester.
- The WOC: Food course is operated under the **McGill Office for Science & Society**. Its goals are:
 - Demystify science
 - Keep people up to date on scientific progress
 - Foster critical thinking
 - Separate sense from nonsense
 - Keep people out of the clutches of charlatans.
- The Office for Science & Society has recently released a smartphone app that releases information periodically.
 - Dr. Schwarcz encourages everyone to download the app to satisfy their own curiosity and get informed!

Lecture Topic: Food – An Introduction (Dr. Schwarcz)

- We spend a lot of time thinking about food, talking about food, consuming food.
- What types of food are healthy? Which are best?
 - Advice about nutrition comes from many sources: which source is best?!
- In the US, the **USDA** (United States Department of Agriculture) are charged with providing the general population with nutritional advice.
 - Their current suggestions for a healthy diet are depicted by a representative plate containing several components, including grains, protein, fruits and vegetables.
 - This “healthy eating plate” has been highly scrutinized as there is not much detail about particular food types (example: types of fats, types of grains, etc.).
 - Harvard has generated a version of the “plate” with more details.
- In the UK, a similar “eatwell” plate exists, containing similar but different suggestions for food consumption.
- Other “food plates”
 - High fat/low carb diet proponents try to limit carbohydrate consumption.
 - High carb/low fat diet proponents try to get rid of fatty foods.
 - Vegans avoid all foods derived from animal sources.
 - Paleo diets focus on meats and “primal” foods
 - Other nutritionists suggest reducing calories in general to promote longevity and health.
- In spite of years and years of research in nutrition, there remain **many controversies**—there are many points of view, and accompanying research that supports components of several diet paradigms.
 - In the information age, it is difficult to decipher the truth from the wealth of information on food.
 - The more foods we have to choose from, the more complex the discussion is.
 - Every food has its enemies as well as its supporters. There are often arguments for both sides!
- Different cultures have different diets—German diets are different from Polish diets, which are different from Italian diets, etc.



- There is much research studying different populations (via epidemiology) to understand better the relationship between diet and health in the population. However, it is still difficult to make conclusions about food in this manner.
- There is an abundance of literature on the subject of nutrition. Experts suggest staying away from: wheat, milk, oil, soy, meat, sugar, artificial sweeteners. **Does this mean we cannot really eat anything at all?**
 - The surplus of information and the difference in opinions leaves the public largely confused about this topic.
- **Eating has become a clinical experience:** what is the vitamin content, what is the cholesterol content, what will it do to my blood sugar?
- **Ultimately: YOU ARE WHAT YOU EAT.**
 - We are built (biologically and chemically) by the food that we consume.
 - However, there are many different components to health, including water, environment, and genetics.
 - Food is important because **we can control what we eat**, thereby affecting our health in the process.
- **YOU ARE WHAT YOU READ.**
 - Information will dictate how an individual will act with regards to food—it is therefore important to know what information is credible/useful and what is not.
- Some nutrition suggestions involve pointing out specific foods that should be avoided.
 - Example: **poutine** (high in fat, contains trans fats, etc.)
- Other suggestions promote the use of “miracle” foods that have significant beneficial properties that improve health.
 - Example: **pomegranates** are claimed to be healthy for their “anti-aging” powers.
 - Many similar suggestions offer substantial history of use/consumption as evidence for a particular food having a health benefiting property: these rationalizations are incorrect, as the food might have no benefits despite being eaten for a long time in history.
 - Dr. Schwarcz suggests that the fruit of the tree of knowledge in the biblical story of Adam & Eve may have very well been a pomegranate instead of an apple based on geography.
 - **Pomegranates** contain naturally occurring **aromatase inhibitors**, which are compounds used in the treatment of **breast cancer**.
 - The cancer-treating compound is manufactured on a large scale basis, whereas pomegranates synthesize their own naturally (albeit at significantly lower levels).
 - Observation: in the laboratory, breast cancer cells cultured with pomegranate juice **grow less**.
 - **Implications:** does this mean that pomegranate juice can be used to treat cancer?
 - The observation is only limited to the conditions that have been described: **in the laboratory, in a petri dish, and using cells that are grown outside of the body.**
 - One should **NOT** extrapolate such information to suggest that pomegranate juice can treat cancer, because these two conclusions are **VERY** different.
 - Many health “claims” are pure exaggerations/extrapolations of limited scientific data used to manipulate the public into buying products: example: marketing for pomegranate juice that claims it can help you “**cheat death**”.
 - In 2010, POM (the company producing pomegranate juice and advertising it so) was brought to court for “deceptive advertising” derived from their false claims about their products.
- As we will come to learn: **there is no such thing as a “miracle” or “super” food.**
 - One could support the health properties of any food using a select set of scientific articles (often ignoring any evidence to the contrary).
- **James Hilton** wrote a book called **Lost Horizon**, where he describes the natives of the lower Himalayas as people who have been blessed with longevity. (although, this claim has not been properly tested).
 - Himalayans often eat dried apricots.
 - One could make a claim that the Himalayans live long because the apricots they eat contain beta-carotene.
 - This an example of how easy it would be to create false claims.
 - Books have been write about how apricot pits can save patients from cancer. Baloney!
- The **National Cancer Institute (NCI)** is a fantastic resource for getting information about cancer and any treatments.
- **Peer-reviewed literature** is the current standard for releasing scientifically accurate information. Controlled by academic scientists that are able to critique work and ensure proper conditions/controls are used.
 - **Not fool-proof:** sometimes, false claims slip through the cracks of this highly regulated review system.
- **Hippocrates:** “Let thy food be thy medicine”.



- Interesting and advanced way of thinking—Hippocrates (known as the father of western medicine) was very much ahead of his time despite limited understanding of chemistry and biology.
- Hippocrates also claimed:
 - “Lettuce cools the body and curbs the passion”—no evidence for this
 - “Pigeon droppings are great for baldness”—no evidence for this
 - “Flax is great for the intestines”—might have some truth, as flax is a natural laxative.
 - Flax contains:
 - Omega-3 fatty acids – anti-inflammatory properties
 - Lignans – have been shown to have anti-cancer effect (in the laboratory)
 - Fiber – good for intestinal health
- Since the time of Hippocrates, science has been a mix of **sense and nonsense**. This has **NOT CHANGED!**
 - These days, we have more of both! It is very important to decipher these.
- Common way science has attempted to identify the health properties of foods: **test for properties in the laboratory**, then **follow-up with epidemiological evidence** of benefit in the population.
 - **Flaw:** many epidemiological studies involve **recall**, in which subjects are required to remember what they ate and how often. This is likely inaccurate and not very useful for the purpose of the study.
- One study out of the University of Toronto claimed “risk of breast cancer is reduced by **phytoestrogen** intake but only in premenopausal overweight women”
 - Phytoestrogens are a type of lignan, found in flax
 - Here, the conclusion is not very strong although it might be perceived that way by some.
- **Omega 3** fatty acids are found in many foods, including **eggs**.
 - Farmers raising chicken that **produce omega-3 eggs** are able to charge more for their product—good for business.
 - Since eggs recently had a bad image (due to the perception that cholesterol is a negative thing), so farmers and marketers were able to change the image by incorporating the popular omega-3 fatty acid into the egg.
 - They did this by introducing flax seeds to the chicken feed.
 - The amount of omega-3 fatty acids gained by doing this is **not substantial**, and will likely **not make a difference**, despite the fact that they are present. However, the marketing works!
- Flax seeds have been incorporated into many foods due to the popularity of omega-3s, such as breads, bagels, etc.
- Cholesterol is a compound that has been portrayed as dangerous and unhealthy by the popular media.
 - Doughnuts, the bagel’s “cousin”, are harmful because of their high caloric content, high sugar and high fat (including trans fat) content.
 - **Trans fats increase cholesterol content in the blood—this leads to increased risk of heart disease.**
 - Cholesterol in itself is not as “bad” as popular media claims it is—more on this at a later date.
 - Scientific studies that demonstrate cholesterol-lowering effects of a particular food are employed to make exaggerated claims about that food—claims that extend to lowering risk of heart disease!
 - Example: **Oat bran**
 - Originally, oat bran was used as animal feed, but following this study it was rapidly incorporated into the western diet because of its cholesterol-lowering properties.
 - However: one must always ask: **how MUCH oat bran do I need to get the benefits of the food; how MUCH of a particular product do I need to eat to get the benefit?**
 - Oat Bran contains **beta-glucan**, a form of fiber that is responsible for its cholesterol-lowering properties. (assuming these properties are even useful, which is currently being debated).
 - **We require 3 grams of beta-glucan to have any impact on blood cholesterol.**
 - Translates to:
 - **1 cup** of oat bran hot cereal
 - **3-5 muffins** oat bran muffins
 - **1.5 cups** of oatmeal.
 - **General Mills** claims that the “O” shape of their **Cheerios** cereal is for “Oat Bran”
 - **Not a fantastic food to be consuming for beta-glucan: need 5 servings per day to get 3 grams of it!**
- **“Fit for Life”** is a book written by Harvey and Marilyn Diamond.
 - It is a book full of false claims about nutrition, chemistry and biology—despite this it has become very popular.



- Claims that “within atoms and molecules reside the vital elements we know as enzymes. Enzymes are not things or substances. They are the life principle in the atoms and molecules of every living cell.” **Pure absurdity!**
- Dr. Schwarcz particularly dislikes this book as it represents a terrible source of misinformation.
- The authors also believe that the food industry is a horrible technological development.
 - They claim that slice white bread is a terrible food (it is likely not all that great, in reality) because it contains several **preservatives**, which are equated to **chemicals**, which in turn are equated to **toxins**.
 - However, preservatives are often required to ensure certain foods are not contaminated by malicious organisms (example: mold).
 - Example of a preservative: **calcium propionate**.
 - Before an ingredient (such as a preservative) is added to a food, it must be subjected to strict regulatory mechanisms (example: Health Canada, FDA, etc.). This is to ensure that the ingredient is safe according to rigorous scientific testing before bringing it to the market.
- The **French Paradox** is an observation that despite a high smoking rate and widespread consumption of French pastries, breads, and fatty foods (cheese, foie gras), the French population has a much lower incidence of cardiovascular disease than the US or Canada.
 - The **CAD (coronary artery death) rate is four times higher in the US than France**.
 - **Correlation does not imply causation:** French people watch the highest amount of Jerry Lewis films per capita, so this is “correlated” with low incidence of cardiovascular disease. However, there is no causative relationship here.
 - **Another correlation:** French people drink 30 times more red wine than Americans. Is there a causative relationship here?
 - **Red wine contains resveratrol, an antioxidant compound that has been shown to reduce cholesterol and have anti-cancer effects.**
 - However, there is no current study that proves that resveratrol improves or prevents cardiovascular disease! This is despite widespread belief that it has significant health properties.
 - This does not mean that there is no benefit to resveratrol, but marketers do not wait for science to make conclusions about this claim.
- The secret of eating healthier is not as attractive as the claim that a particular food has “superfood” status.
- The “ideal diet” has not been identified and is likely a very complicated problem to solve (if there is an answer to it).
- **Obesity is linked to cancer.**
 - Despite not knowing which combinations of foods might be best, we DO know that being overweight or obese is linked to the development of heart disease, diabetes and cancer.
 - Historically, the focus has been on **fat consumption**. However, lately experts have agreed that **excessive sugar consumption** is the biggest driver of obesity.
 - Americans drink a lot of the excess sugar in the form of **soft drinks**.
 - Similar amounts of sugar found in many fruit juices, although these have vitamins and minerals.
 - Drinking fruit juice instead of soft drinks is not a big difference in terms of sugar consumption.
- Cooking is an important component to food.
 - High temperature cooking causes the creation of certain compounds that are hazardous.
 - Example: charcoal cooking of meats causes the formation of **polycyclic hydrocarbons** and **advanced glycation end products**. These cause a variety of health issues.
- Food processing is another important component of food.
 - Consuming an average of **60 grams** of processed meat a day increases the risk of developing colorectal cancer by 50%! **Nitrites** (a preservative) may be the causative agent here.
- A safe conclusion is the more vegetables you eat, the better off you will be.
 - Fruits are a different story because of their sugar content.
- The story on fats is complex: **type** of fat matters more than **amount**, and **saturated fats** are not as bad as they are perceived to be. **Trans fats** are definitely culprits that cause increased blood cholesterol.
- **Amounts matter.** It is also about HOW MUCH of a particular food one eats, in addition to what type of food.
- What about supplements? Recently, multivitamins have been shown to have no health benefit—which vitamins are useful then?
 - Vitamin D is likely a useful supplement, particularly in the winter time if you live in a northern climate.
- Exercise is a key factor that promotes health; Dr. Schwarcz believes it is not promoted enough.



- Despite the huge focus on nutrition in the western world, there exists many places where food is not plentiful.
 - Every 3.6 seconds, someone dies from hunger.

Part 2: Perspectives on Food(Dr. Harpp)

- **1922:** Jackie Coogan played in a silent movie based on the book *Oliver Twist*
 - “Please, sir, I want some more.” Is a well-known phrase from the Charles Dickens book.
 - The food being distributed in those times was not particularly pleasant.
 - Currently, we have the best food supply in the world (and the history of the world)—we should feel **lucky**.
 - **Orthorexia**
- **Goals for the Course: gain some perspective on food!**
 - Imagine the 7 billion people on the planet are represented by 100 people.
 - 50 are male, 50 are female.
 - 17 are illiterate
 - **16 are malnourished**
 - 21 are overweight
 - 7 have a university education (this has risen dramatically very recently).
- The goal of this course *is not* to induce **Orthorexia Nervosa**, which is the obsession in eating only the “*right*” foods.
- The whole course could be summarized by the following: “**Eat food. Not too much. Mostly plants.**”
 - Taken from a book called The Omnivore’s Dilemma by Michael Pollan
- **Why this course?**
 - What types of food are safe?
 - The food pyramid is a government suggestion on the optimal breakdown of our food.
 - However, the recommendations are not necessarily correct—much is unknown!
 - Dr. Harpp recalls a comment he heard on the radio in 1989, referring to the good old days “way back when there weren’t that many problems with health”.
 - However, this is not accurate—things are as good as they have ever been **right now!**
 - In recent history, people have had to eat from unimaginable sources (ex.: garbage dumps).
- **Plumpy nut** is a high protein peanut based paste that is being used in starving countries.
 - This product, produced by the **World Health Organization** and **UNESCO**, has a **high shelf life** of a couple of years and it works, while tasting great.
- There is some truth in the old adage, “You are what you eat.” You are, in part, what your mother ate as well.
- In this course, we will discuss the chemistry of food, including the molecules that are common when discussing food.
- **Weight gain and obesity** is a huge issue these days.
- Food Issues are very much in the press
 - **Salt** now contains **iodine**, which we will further discuss at a later time. Too much salt in the diet is another problem in today’s society.
 - **Iodine** is a mineral that is required by the body—if it is absent, **goiters** (enlarged thyroid gland) develop.
 - Historically, Midwesterners were at relatively higher risk of goiter because they did not have access to the seafood (containing iodine) that the East coast population had
 - **Recombinant Bovine Growth Hormone (rBGH)** has become a topic of debate recently.
 - This hormone *increases* the amount of milk produced by cows.
 - Many products these days display that they are “**rBGH free**”.
 - **Milk** has been criticized recently due to its high fat content. There are many advertising campaigns (Got Milk?) that try to get the population to drink milk.
 - **Popcorn** served at movie theatres was criticized some time ago due to it being cooked in **coconut oil**, which is mostly saturated fat.
 - A large serving of popcorn contained approximately the same amount of calories as **3 big macs!**
 - Most movie theatres changed to a different, unsaturated oil after this – but today, some switched back because people prefer the taste of coconut oil to other oils.
 - In the movie “*Super Size Me*”, the individual eating only McDonalds for a month went from **11% body fat** to **18% body fat!**
 - He gained **over 24 pounds**.



- **Don Gorske**, a retired Wisconsin prison guard, has been eating *at least* one Big Mac a day since May 17 1972, and ate his 25000th Big Mac in 2011.
 - He has, however, maintained his weight at 170 pounds.
- Much effort is taken to reduce caloric intake, such as with the use of diet drinks—as we will see, the effects are negligible here.
- We have the notion that there are “good foods” and there are “bad foods”.
 - Bottom line: most things can be eaten, but in moderation!
- The U.S. market for **functional foods** has been growing steadily for the past decade or so.
 - Functional food: foods with added substances that are said to be ‘good’ for the health. Also known as “fortified foods”
 - The market is now at approximately 60\$ Billion per year.
 - Another example is omega-3 fatty acids, or probiotics.
- **Freeganism** is an anti-consumerism movement.
 - These people try to find perfectly good food that restaurants throw out by rummaging through the trash.
- **Rawsome food movement:** raw and organic foods at all times!
 - People who follow this movement drink raw (unpasteurized) milk, which is actually illegal to sell in most places.
- Other movements in food:
 - “Insects are food”—there is a popular movement promoting consumption of insects.
 - McGill students were recently awarded a \$1 million prize for a plan to transform insects into food (including ‘lime cricket chips’)
 - They also had developed a plan to make flour out of insects!
- % of Household Expenditure for Food by country: (an important perspective to have)
 - US/Canada: 7%
 - UK: 9%
 - Australia: 11%
 - Brazil: 35%
 - Russia: 28%
 - China: 33%
 - India: 35%
 - Kenya: 45%
 - Pakistan: 46%
- **Dr. Harpp suggests that GOOGLE is generally good for question answering**, but think carefully when using it!
- **Renoir** made many paintings of food, including onions.
- **Maureen Bourque**, an artist from New Brunswick, painted a very detailed yet tiny picture of mushrooms.
- In the late 1700s, **Antoine-Laurent Lavoisier** measured the **CO₂ gas** produced on eating.
 - He measured this by having a person breathe into a tube, and CO₂ was precipitated as an inorganic salt which could then be weighed.
 - Conservation of mass was also demonstrated this way.
 - He was painted by **Jacques-Louis David**.
- **Van Gogh** painted “The Potato Eaters” in 1885, in which people are having potatoes and coffee.
 - Van Gogh was always poor and always dealt with poor people in his life.
- During the last few centuries, there has been a significant reduction in the number of farmers per capita, as most people were involved in farming just a couple hundred years ago.
- As technology improved, less people would become farmers, and money became important in the farming industry.
- There was a lot of cheating going on in food production back then.
 - **Plaster of Paris (CaSO₄)**, a relatively harmless salt, was used to dilute foods to make a higher profit.
 - This would sometimes kill people.
 - Upton Sinclair’s book The Jungle described practices of the meatpacking industry in Chicago where humans would be used and processed as food.
 - The quote “*Quick Jurgis, we must recover the body from the lard vat*” comes from this book.
- **The Federal Food and Drug Act of 1906** caused many of these practitioners to stop their illegal activities.
 - This has been modified several times to accommodate the changing times.



- Food can be produced in many different types of geographical areas.
- Much more than enough food is being produced on the planet to *feed everyone*: the problem is **distributing** the food to everybody.
- Another important issue is the *destruction* of food by **insects**, such as the **cabbage looper**.
 - **About 40% of the total food produced is destroyed by insects or fungi!**
- Different foods are consumed in different parts of the world. In many parts of the world, certain foods are plentiful – but are they nutritious?
 - In **India**, for example, a *very large amount of rice* is consumed, but a *very small amount of meat*.
 - This is *opposite* in **North America**.
 - **Much more sugar** is also consumed in the North America, as well as **fats and oils**.
 - ***** People in the U.S. consume 1.5 times more protein and 7 times more fat than people in India.**
 - In terms of calories:
 - USA: 1.2M calories per year per person vs. 0.8M calories per year per person.
 - **The nutritional differences reflect the differences in diseases seen in the different populations!**
- The study of food and how it moves and is broken down into molecules in the body is *extremely complicated*.
 - Many components of these general pathways are at the cellular level.
 - Cellular machinery that governs this include enzymes, transporters, linkers, receptors, etc.

Water

- An **Apple** contains a few main components:
 - **Fiber**
 - **Flavors**
 - **Sugar**
 - **Water**
 - There are many, many molecules that play a role in the **flavor** of apples. Some of them are perceived as 'dangerous':
 - **Ethanol**
 - **Formaldehyde**
 - **Acetone**
 - **Methanol**
 - However, the relative amounts of these substances contained in an apple are very low, thus eating an apple will *not* make you go blind (too little methanol for this).
 - The concentrations of these components will give an apple its specific flavor.
 - An artificial green apple flavour also exists, which contains chemicals not even found naturally in apples.
- An apple contains approximately **6 cubes of sugar** (15-20 grams total).
- If you puncture a hole in an apple and place it in a **vacuum dessicator** to remove all the water, you can measure how much water is found in the apple.
 - **You get a small cork of dried apple, which weighs almost nothing, and a large amount of water (~ 120 ml).**
 - **Apples contain approximately 85% water by weight.**
 - Food in general contains a large percentage of water, including meats, veggies, and everything in between.
- The food that has the highest percentage of water is the **Radish**, which is composed of about **98% water**.
- **Watermelon** has a bit less at **96% water**.
- **Basic Food Facts:**
- The food areas we will talk about in the first few weeks of the course are the following:
 - **Carbohydrates** (macronutrients)
 - **Fats** (macronutrients)
 - **Proteins** (macronutrients)
 - **Minerals** (micronutrients)
 - **Vitamins** (micronutrients)
- The **macronutrients** are those in which we eat in large amounts, whereas the micronutrients are those of which we eat very small amounts (**microgram quantities**: millionths of a gram) *but that are still required*.



- By consumption, calorie breakdown should follow this breakdown (**% of total calories, NOT weight**), for an average sized person:

○ Fat	30% of total calories	65 grams per day
○ Protein	12% "	60 g/day
○ Complex Carbohydrates	48% "	240 g/day
○ Sugar	10% "	50 g/day
- Fat has a higher calorie content per gram. **415 grams total, which translates to 1 lb of dry food.**
- **Proteins and carbohydrates contain 4 calories per gram, while fats contain 9 calories per gram.**
 - It is **easier** for the body to **store fat** than it is to store **carbohydrates or protein**.
- This course is about understanding scientific information about food *better*.
 - From 1996-2011, 15 million active researchers have produced over 26 million publications on a variety of subjects (not limited to food/nutrition). The question is: **how do we keep track and consolidate all of that?**
 - The Half-Life of Facts is a book by Samuel Arbesman that discusses how **facts change** and **evolve**
 - Facts about our surroundings change over time:
 - The language of science has gone from Latin to Germany to English
 - In 100 years the planet has increased population from 2 to 7 billion people.
 - In less than 50 years we have gone from earthbound to walking on the moon.
 - Popeye was an interesting cartoon character in the early 1900s.
 - "I'm strong to the finish, 'cause I eats me spinach".
 - Popeye got his strength from spinach—but this is not actually correct!
 - In 1870, German chemist Erich von Wolf calculated the iron content in spinach as 3.5mg in a 100g serving. However, this was reported as 35mg instead (10x more)!
 - People mistakenly thought that spinach contained more iron.
 - In Dr. Mike Sutton's "Spinach, Iron and Popeye: Ironic lessons from biochemistry and history on the importance of healthy eating, healthy scepticism and adequate citation":
 - **Student:** "Why does Popeye eat spinach?"
 - **Professor:** "For Iron."
 - **Student:** "Show me the evidence."
 - It turns out that in the original cartoon, Popeye claims that he eats spinach for **Vitamin A**, not the iron content.
 - Technically, there is no vitamin A in spinach—it is already converted to beta-carotene
 - This is an example of a situation in which a lie about something is stated enough times, that everyone believes it to be true. In this case it is about why Popeye eats spinach, but can be extrapolated to many discussions about food!
 - In debunking these scientific situations, references must be checked: **"SHOW ME THE EVIDENCE"**.
 - **Bottom line:** be sceptical!

