Stimulating Beverages
Coffee, Tea, Chocolate
Caffeine Drinks

• Beverages that contain caffeine or purine derivatives, are used world wide for their stimulating and refreshing qualities.
• Caffeine is an alkaloid that is a diuretic and nerve stimulant
• Tea originated in southeastern Asia
• Coffee originated in Ethiopia
• Cocoa from tropical America
• Lesser known stimulants
  – Cola – south Africa
  – Khat – Arabs
  – Mate – South America
Caffeine and Theobromine – Mild Stimulants

- alkaloids (note N, ring structure)
- “methylated xanthines” = methylxanthines

Effects of Caffeine:
- central nervous system stimulant
- mild diuretic

Mode of action:
- interferes with enzyme, so that adrenaline remains active => alert feeling
- blocks adenosine receptors => inhibits sleep signals

Note: latter activity also interacts with dopamine receptors
Caffeine

- The world's most widely consumed psychoactive drug
- In North America, 90% of adults consume caffeine daily
Health Effects of Caffeine

Most widely used psychoactive drug

- small amounts -> no long term effects have been noted
- even small amounts taken regularly can produce withdrawal if stopped (often manifested as headaches)
- large amounts -> adverse symptoms such as anxiety, insomnia
- dose-dependent, so that has greater effects on young, unborn

NOTE: current recommendations, pregnant women should reduce or eliminate caffeine consumption during pregnancy

- addictive, withdrawal symptoms, headaches
- effects on other animals can be different, e.g. dogs, cats, birds
Major Plant Sources of Caffeine

Coffee – *Coffea arabica* and related species

Tea – *Camellia sinensis*

Chocolate – *Theobroma cacao*

Other sources of caffeine:

- Mate, *Ilex paraguariensis*
- Guaraná, *Paullinia cupana*
- Kola, *Cola nitida*
Coffee
Coffee, *Coffea arabica* or *C. canephora* (Rubiaceae)

- The dried, fermented fruits of *Coffea arabica* or *C. canephora* (Rubiaceae)
- Second only to petroleum in the value of the material traded annually on the international market.
Coffee - *Coffea arabica*

*Coffea* – member of Rubiaceae

- Shrubs

- Fruit = berry (called a bean)

- Pericarp, seed coats removed

=> seed used (not a bean!)
Arabica = *Coffea arabica*
- Accounts for about 90% of world's trade in coffee.
- Harder to grow.
- Higher elevation, “mountain grown”
- Has the best flavor.

Robusta = *Coffea canephora*
- Accounts for about 9%.
- Flat, neutral taste. Higher caffeine
- More productive, hardier plants. Low elevation.
- Used to make instant coffee, cheap ground coffee.
- Preferred in some parts of Africa.

*Coffea liberica* accounts for about 1%.
Robusta: 1.8 – 4.0% caffeine, Arabica: 0.9-1.4% caffeine
Coffee Cultivation - Shade

The plants are often shaded in plantations, but open orchards are used as well. Many of the shade trees are legumes and fix nitrogen.
Coffee “Bean” is a Berry

The coffee fruit is a berry, sometimes called a “cherry”

The “bean” is the interior of the seed, with the seed wall removed

Hand-picking selects the best quality fruits
Coffee “Beans”
Coffee Processing - Dry Method

Dry Process - fruits are dried in the open while pulp ferments, and the husk is rubbed off mechanically.
Coffee Processing – Wet Method

Wet Process - fruits are thrown into pool, bad fruits float and are removed, pulping machine removes husk, residue on beans allowed to ferment for 24 hours..
Coffee Drying
Coffee Roasting
Coffee Roasting

DROP:
The room temperature green beans are dropped from the hopper into the pre-heated roaster.

FIRST CRACK:
The green beans are beginning to turn brown and grow in size as the interior of the bean heats and audibly cracks from the inside out.

SECOND CRACK:
This is where cooking the complex starches fully matures into pleasing caramelized sugars. All the flavors are present at this point; from here to the production roast is the art of roasting. Each type of bean will yield its best cup of coffee at a different point.

PRODUCTION ROAST:
The fruition of countless hours of preparation to ensure the beans will yield the best brewed cup of coffee possible.
Coffee Roasting Stages

1. City/Light (first crack, a volatile sound of the beans cracking, has finished)
2. City+/Medium (shortly after first crack is complete)
3. Full City/Medium Dark (second crack is about to happen at any moment)
4. Full City+/Dark (the first few moments into second crack, a quieter snapping sound)
5. Vienna/Light French Roast/Very Dark (second crack is happening) – (if roasted any darker, the coffee would taste burnt and bitter)
6. French Roast/Extremely Dark (second crack is almost done)
Coffee Grinding and Brewing

- Espresso Grind
- Coarse Grind
- Whole Bean
Coffee originated in Ethiopia, taken to Yemen by Arabs, taken to Java by Dutch, then taken to Europe by Dutch, then to Americas.

Figure 16.1 *Coffea arabica*, native to the mountains of Ethiopia, was spread through many tropical areas. Plantations became well established in the New World early in the eighteenth century.
Coffeehouses

Figure 16.2  The London Coffee House, opened in the 1750s, was a major center of mercantile and political life in Philadelphia during the colonial period.
Coffee Issues

1. Pollution
   - processing of coffee requires large amount of water

2. Disease
   - fungal diseases wiped out coffee production in Sri Lanka (Ceylon) completely, switched to tea.
   - fungal diseases still threaten crops in Brazil and other places

3. Shade vs. sun coffee
   - traditionally, coffee grown under shade coffee plantations preserve biodiversity, open sun yields more beans

4. Decaffeination – solvent vs. water extraction vs. CO2 CP
   - solvent extraction, caffeine recovered, sold
De-caffeinated Coffee

- Solvent extraction
  Methyl acetate
  Ethyl acetate
- Supercritical CO2 Process
Fair Trade Coffee

- Fair trade means a fair price for products
- Focuses on requiring companies to pay prices at or above market price
- A worker receives a price on their goods that allows them to make a decent living

http://www.fairtrademag.com/
Coffee YouTube Videos

A Day in the Life of a Coffee Farmer.mov
https://www.youtube.com/watch?v=frbSo59xGkw
Meet Atandi: a Coffee Farmer in Kenya
https://www.youtube.com/watch?v=_ebTi2KSRuM
On the Farm: Coffee Farming in Uganda
https://www.youtube.com/watch?v=E6oXx8hZojA
India Coffee Tour - Part I
https://www.youtube.com/watch?v=Tc8asXSKxF4
India Coffee Tour - Part II
https://www.youtube.com/watch?v=DB3bclYKuCg
Coffee Production Process
https://www.youtube.com/watch?v=SvBj4O44Fnw
How coffee is made
https://www.youtube.com/watch?v=FcV2GJOAEbl
Fair Trade: Every Purchase Matters
https://www.youtube.com/watch?v=7K4G5-ydhS0
How To: Secrets of a NYC Coffee Roaster
https://www.youtube.com/watch?v=akAO0fK2-vI
Coffee Roasting Basics - Color Changes
https://www.youtube.com/watch?v=aYy47C0Xw0I
All about how to make a good coffee with Gwilym
https://www.youtube.com/watch?v=M-l_F2CBELo
27 Drinks Made From Coffee
https://www.youtube.com/watch?v=CeTyXKanY_4
Coffee Around The World
https://www.youtube.com/watch?v=aBLYSO0DSVI
Tea
Tea – Beverage of the World

Camellia sinensis – Theaceae
Shrub, native to China
Tea, *Camellia sinensis*, Theaceae

- Tea is drunk by a larger number of people than coffee, but does not have as high dollar value.
- Most tea is consumed locally and comparatively small quantities enter international trade.
Tea – In the Field

• Tea Shrubs are grown in large plantations

• Picking is done by hand – only the shoot tips are taken
• The exact origin of tea, *Camellia sinensis* (Theaceae), is obscure, but the plant appears to have arisen in China.
• The first book on tea was written in 780 B.C. Tea came to Japan in 593 B.C.
• The Mongols got tea from the Chinese and traded it across Asia. The Russians got tea in this way.
Tea harvesting in Sri Lanka

 Courtesy Dr. Guido Holzkamp
• Europeans first got into tea when the Portuguese brought it back from China.
• In the 1700's tea had become an important item of trade. Both the British and Dutch bought tea in the Orient and sold it in Europe.
• People drank tea predominately in the English colonies in America until the Boston Tea Party; then coffee became a more popular beverage.
• Tea is of course still very popular in England.
Tea harvesting

- During harvesting, only the top 1-2 inches of the plant are picked.
- These buds and leaves are called “flushes.”
- A plant will grow a new flush several times during the growing season.
- The flavor of the tea leaf changes with each flush throughout the summer and into fall.
- The best teas typically come from the 1st or 2nd flushes.
Tea harvesting

- High quality tea is made from the bud and/or 1st set of leaves on the tea plant during the 1st and 2nd flush.
- Mass-produced teabags are made from the older, coarser leaves of late season harvests.

Tea bag invented in 1904
Tea Types

- Black tea – leaves are withered, rolled, fermented, dried; strong. 90% of tea in U.S.
- Green tea – leaves are steamed (destroys fermentation enzymes), dried, and rolled; weak
- Oolong tea – intermediate between black and green – short fermentation
- White tea – leaves are dried only; weak
White tea is made from baby tea leaves and is the rarest and least processed of all tea varietals. Buds and leaves have white hairs.

As a result of minimal processing, green tea retains its natural appearance and vibrant color as well as high levels of the plant's healthy properties.

In-between green and black. During production, leaves are lightly bruised. The outer part of the leaf is allowed to oxidize, but the center is kept green.

Leaves are withered until they are pliable, rolled, releasing juices and enzymes that react with oxygen. The bruised and sticky leaves are spread out and begin to turn brown.
Tea Processing - Plucking
Tea leaves begin to wilt soon after picking. This process is called withering, and is used to remove excess water from the leaves and allow slight oxidation.
Tea Processing - Rolling

Rolling shapes the leaves brings out all the juices. The damp tea leaves are rolled and shaped by hand which causes the important oils and juices inside the leaves to ooze out - which enhance and better the taste.
Tea leaves are heated very carefully to stop the oxidation process and seal the natural flavors till the tea is brewed in during actual preparation. The drying process is responsible to finish the creation of the new compounds for flavor - especially important in green tea. This job must be done with great skill and care.
Boston Tea Party

- Tea Act of 1773. British didn’t have to pay taxes on tea.
- Taxation without representation.
- Led to declaration of Independence
BASIC DIRECTIONS:

1. Bring fresh, cold water to a rolling boil. Always start with the freshest, purest source of water available as this will heavily impact tea's flavor ... it is the main ingredient, after all!

2. Add tealeaves to a teapot, fill-your-own teabag or infuser basket. Use 1 teaspoon – 3 teaspoons (1 tablespoon) per cup (8 oz) of water depending upon desired strength. Adjust to taste.

3. Pour boiling water directly over black, oolong and herbal tea. Allow water to cool slightly before brewing green tea, white tea or yerba maté. Cover.

4. Infuse (steep) leaves for 2-5 minutes; 3.5 minutes is a good standard steep time that works well for most teas. Do not oversteep or tea may become bitter. If you prefer strong tea, do not over steep; simply use more leaves.

5. Remove tea sachet, bag or infuser from water or strain leaves. ENJOY!
Japanese Tea Ceremony
Famous Teas

• Earl Gray – bergamot oil added, favorite British tea
• Darjeeling is a blend of light teas from the Darjeeling region of India
• Lipton Tea – blend of 20 different teas.
• Jasmine Tea – addition of jasmine blossoms

Charles Grey was Prime Minister of England from 22 November 1830 to 16 July 1834. Not only was he Prime Minister, he was an Earl.

Thomas Lipton opened a series of stores in 1880s, became chain, purchased tea gardens in Ceylon. Big hit in U.S.
Tea YouTube Videos

How It's Made - Tea
https://www.youtube.com/watch?v=jaHrUfRjmqE

How tea is made - the whole process! India
https://www.youtube.com/watch?v=ZJFaYKEDle4

How Tea is Processed
https://www.youtube.com/watch?v=m6yiKKXRs2o

Tea Harvest and Processing in Doi Mae Salong, North Thailand
https://www.youtube.com/watch?v=dPIBfjVJKTk

Traditional Japanese Tea Ceremony
https://www.youtube.com/watch?v=IL9BiNuImws

Tea Ceremony Explained
https://www.youtube.com/watch?v=K6_KC3OuZEk

Japanese Tea Ceremony
https://www.youtube.com/watch?v=K4t4s8P1uVE
Chocolate
Food of the Gods

Theobroma cacao – Malvaceae (formerly Sterculiaceae)

Understory tree, native to New World
Chocolate Tree and Pods
Cauliflorous tree
Chocolate Pods

Two Main Varieties:

- **Criollo** ("native") – best quality, worst yield, worst disease tolerance
- **Forastero** ("foreign") – worst quality, best yield, best disease tolerance
Cacao Flowers and fruit
A typical pod has 20 to 50 cream-colored beans.

Pulpy seeds are scooped out and allowed to ferment to develop flavor, then dried.
Cacao fruit, *Theobroma cacao*, Malvaceae
Chocolate Chemistry

Caffeine – less than coffee (chocolate bar 30 mg; cup coffee, 100 mg)

Theobromine – stimulates heart muscle

Phenylethylamine – reputed to be “mood elevator”, antidepressant
- found in brain; low levels linked to depression; chocolate contains low levels of PEA; knowledge of chemistry still incomplete

Chocolate Myths:
- chocolate does not cause acne
- chocolate is not a trigger for migraines
- chocolate is probably not an aphrodisiac

NOTE: chocolate “craving” is probably real; reasons, mechanism are unclear
Origin in Amazonia, Central America
Chocolate – from Aztec word *Chocolatl*

Maya lord forbids a person to touch a container of chocolate.

Figure 16.6  The Aztec god Quetzalcoatl, envisioned as a plumed serpent, was believed to have given cacao beans to the Aztec people.
Cocoa Producing Countries
Cacao - the Tropical Crop
The pods are cut from the trees and sliced open manually using machetes.
Harvesting the beans from the pod
Cacao - Processing

1. Seeds are spread out and allowed to ferment
2. Fermented seeds are dried and roasted
3. Seed coats are removed
4. “Nibs” are ground, which produces a thick liquid called chocolate liquor (non-alcoholic)
5. Chocolate liquor is fed through a high pressure press which separates the fat (cocoa butter) from the solids (cocoa powder)
6. The cocoa butter and cocoa powder can be recombined together with sugar or milk to produce chocolate
The seeds are left to ferment; flavor develops, bitterness subsides, and cocoa beans are born. It is during fermentation that the cacao beans start to develop the typical cacao flavors.
Fermenting in the sun – no temperature control
Drying can take place for 5 to 12 days, depending on the humidity, during which time the moisture content of the bean is substantially reduced.
Delivery of Cacao Beans
Chocolate YouTube Videos

Hershey's chocolate making process
https://www.youtube.com/watch?v=0TcFYfoB1BY

The Story of Chocolate
https://www.youtube.com/watch?v=VS0-IaKIRg

On the Farm: Growing Cocoa
https://www.youtube.com/watch?v=JD8r02e9xn8

Cacao Organic growing and harvesting
https://www.youtube.com/watch?v=_u4Laz4u1lU

Guatemala: Chocolate Making Part 1 - Roasting Cocoa Beans the Traditional Way
https://www.youtube.com/watch?v=qMaTJly1VI8

Guatemala: Chocolate Making Part 2 - Cracking the Beans and Extracting the Nib
https://www.youtube.com/watch?v=ny8o_D3CCY8

Guatemala: Chocolate Making Part 3 - Rolling the Beans Using a Metate
https://www.youtube.com/watch?v=qMaTJly1VI8

Guatemala: Chocolate Making Part 4 - Adding Ingredients (Mayan bartender)
https://www.youtube.com/watch?v=2-Yb-jS-dYw

Making Chocolate
https://www.youtube.com/watch?v=PXFLlsqVgbY

The Dark Side Of Chocolate
https://www.youtube.com/watch?v=7Vfbv6hNeng
Raw Chocolate

What’s in the cocoa bean?

54% Fat (Cocoa Butter)

31% Carbohydrates

11% Protein

3% Polyphenols

< 1% Minerals

34% Oleic Acid
33% Stearic Acid
26% Palmitic Acid
6% Other

~1% Sugar, 16% Fiber

Arginine, Glutamine, Leucine

Flavanols, Proanthocyanins

Fe, Mg, P, K, Cu

Nutrition Facts

Serving Size: 1 oz. (28 g)
Servings Per Container:

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>% Daily Value*</th>
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<tr>
<td>Calories</td>
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<tr>
<td>Calories from Fat</td>
<td>120</td>
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<td>Total Fat</td>
<td>13g</td>
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<tr>
<td>Saturated Fat</td>
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<td>0g</td>
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<tr>
<td>Cholesterol</td>
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<tr>
<td>Sodium</td>
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<tr>
<td>Total Carbohydrate</td>
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<tr>
<td>Dietary Fiber</td>
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</tr>
<tr>
<td>Sugars</td>
<td>0g</td>
</tr>
<tr>
<td>Protein</td>
<td>4g</td>
</tr>
</tbody>
</table>

*Percentage daily values based on a 2,000 calorie diet. Your Daily values may be higher or lower depending on your calorie needs.
Roasting Chocolate Beans

Once in the factory, the beans are roasted for a few hours at about 225 degrees which brings out the flavor (similar to toasting almonds or roasting coffee). Both dried and roasted beans don't taste very good... yet.

As for coffee, roasting is an important part of development of cacao flavor. The chocolate flavor only develops during this part of the processing. The seed coats are removed.
Cacao beans are then roasted, and then ground into non-alcoholic chocolate liquor.

The nibs are then ground under heavy stone which separates the colorless cocoa butter and the remaining cocoa liquor.
Cacao – Processing

• **Chocolate liquor** is intensely flavored, bitter – diluted with water and flavored it provides a drink – this is how Montezuma and other Aztec royalty would have consumed it, flavored with vanilla and chili pepper.

• **Cocoa powder** contains the chocolate flavor – it can be darkened and the flavor intensified by treating with alkalinization = “Dutching”

• **Cocoa butter** is the fat – it is tasteless but has the distinctive property of melting at about the human body temperature.
Cocoa Powder

Chocolate liquor which has been ground to powder. The product is only contains a small amount of cocoa butter so it is inherently low in fat. Unsweetened cocoa powder is used for baking and for making hot beverages.

Natural
Very acidic, bitter

Dutch processed
alkali-treated
pH neutralized
• The English devised adding milk to cocoa as a beverage.

• The Swiss started adding milk to the cocoa to make milk chocolate. Cocoa butter is re-added to make the product more creamy.

Ingredients such as sugar and milk are added, and the liquid is conched (a mixing process that develops texture and flavour).

Figure 16.8 The conching process imparts smoothness to chocolate.
Finally, it is molded, packaged and distributed to a shop near you.

**Figure 16.9** Far removed from the tropical cacao tree, these delectable chocolate confections gladden the heart of many “chocoholics.”
Chocolate – the Products

Unsweetened: Chocolate liquor + cocoa butter, no sugar

-- mole sauce etc.

Semisweet and bittersweet
– sugar added

Milk chocolate – has milk solids + sugar + unsweetened chocolate
Economics, Diseases, now we are consuming more than produced

By 2030, the world consumption is forecast to exceed production by 2 million metric tons.

By 2020, the world is expected to consume 1 million metric tons more cocoa than it produces.

In 2013, the world ate roughly 70,000 metric tons more cocoa than it produced.

Price will probably continue to go way up.
Other Stimulating Beverages
Kola Nut Tree - *Cola nitida*,

- Malvaceae (formerly Sterculiaceae), relative of cacao
- Used to prepare the flavor of cola beverages.
- The seeds of the plant are fermented in manufacture of the flavoring.
- Cola is native to West Africa where it has been used for a long time.
Kola Nut Tree, *Cola acuminata*
Kola fruits, *Cola nitida*

Knobby green pods of *Cola nitida*
Kola Nuts

- The pulp of the fruits is also eaten in many African countries.
- The seeds are dried and ground to make a beverage in West Africa.
- This plant also contains caffeine.
Kola Nuts
Coca Cola

Invented by John Pemberton, Pharmacist, 1886
- Carbonated water
- Caramel coloring
- Kola nut extract
- Coca leaf extract (cocaine)
- Sugar
- Vanilla
- Cinnamon
- Lime juice
- Secret ingredients

1904 - Cocaine prohibited from soft drinks in U.S. Kola nuts not used anymore either
Yerba Maté

- *Ilex paraguariensis*, Aquifoliaceae, Holly Family
- Maté is a common beverage of southern South America.
- The Indians of much of South America used maté before Europeans arrived.
- The leaves, small twigs, and stems are crushed and used to make a tea like beverage.
- Caffeine

![Yerba Maté plant](www.herbalistics.com.au)
Ilex paraguariensis, Aquifoliaceae
Yerba maté

• Maté is traditionally drunk from a gourd, or maté, filled with plant material.
• Hot water is added.
• The "straw" is called a bombilla.
Yerba Mate for sale in market Mercado de la Boqueria in Barcelona, Spain
Yaupon – *Ilex vomitoria*
Yaupon – *Ilex vomitoria*

- *Ilex vomitoria*, native to the southeastern U.S.
- Aquifoliaceae, Holly Family
- Contains caffeine
- Used to prepare “black drink” and used ceremonially by Indians of Southeastern U.S.
- Limited use by Americans in Civil War
- Maybe making a come-back?
Native Americans made “Black Drink”, used ceremonially, involved fasting, tea and other herbs, vomiting, visions. But also used it everyday.

Shaman with shell cups for drinking Black Drink from *Ilex vomitoria*

Yaupon Holly, Black Drink, Ethnobotany YouTube
https://www.youtube.com/watch?v=ztxYp6HBmyo
Aucuba japonica  Nicotiana alata  Asparagas densiflorus
Primula  Ilex vomitoria  Ilex vomitoria
End