


Secondary Plant Metabolites

FYE Two-Column Note Taking Exercise and
"Talk to text"

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Secondary Plant Metabolites

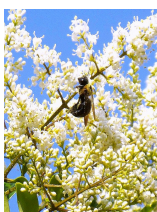
- Plants photosynthesize to make sugar
- That sugar is mostly used for growth, or reproduction
- Some chemicals are solely made for the purpose of defense or pollination
- What are they used for by the plant?
 - Plant-Insect Communication
 - Plant-Plant Communication
 - Defense against pathogens and herbivores
 - Defense against other plants (some are dual purpose)




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Stop and Smell the Roses (or not)



CCCCC(=O)C=C
NCCCCN
 Jasmine
vs.
The Corpse Flower




- Flowers make complex, volatile chemicals to lure insects to them to maximize pollination

Plant-Animal Communication (Pollination)

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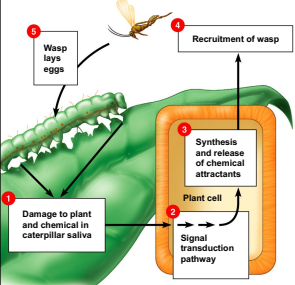
what we see.....vs.....what a bee sees




Same flower but under natural vs. UV light. Patterns on flowers serve as "bulls-eye targets" for allowing bees to land in the center of the flowers to collect pollen from the stamen

4

Wasp SOS! Plant-Insect Communication



"INCOMING" Plant-Plant Communication


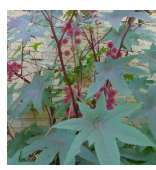


The Talking Tree Hypothesis- Plants "down wind" from other plants being attacked by insects rapidly increased their plant chemical defenses before being attacked (Baldwin & Schultz 1983)

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How to plants "communicate"?
CHEMISTRY!!!

- There are several main "chemical families" that secondary metabolites fall into:
 - Terpenes
 - Phenolics
 - Glucosinolates
 - Alkaloids

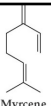



What we use them for: Cancer treatment and prevention, Anti-viral agents, Pain relief, Poisons, Stimulants, Perfumes, Cosmetics, Colorings (food, dyes), Bioweapons

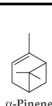
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Terpenes

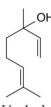
- Simple Structure
- Smell "piney" & are sticky
- Serve as anti-insect, antimicrobial, and anti-fungal agents
- Pyrethrin used to kill mosquitoes



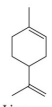
Myrcene



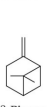
α-Pinene




Linalool



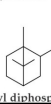
Limonene



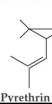
β-Pinene





1,8-Cineole



Bornyl diphosphate



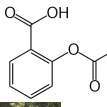
Pyrethrin I





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Phenolics & Flavonoids

- Defined by rings with an OH (alcohol) group
- Are good antioxidants
- Main component of tannins (found in wood, and give wine its flavor)
- Have many uses for cancer, cardiac and anti-viral treatments in humans
- Prevents plant bacterial & viral infections
- Can be irritants (prevent chewing by critters)



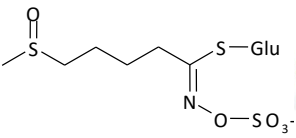
Salicylic Acid
From willow (aspirin)


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Glucosinolates

- Found in Cabbage family plants (cabbage, broccoli, radish, wasabi)
- Also found in garlic, onions
- Found to prevent colon cancer, antioxidants
- Are released by biting into the plant
- TOXIC to insects



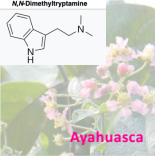
4-Methylsulfinylbutyl-glucosinolate



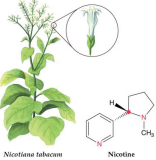
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Alkaloids

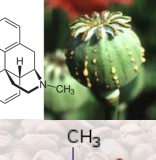
- Craziest chemically of all plant chemicals (N)
- Can serve as toxins, neurostimulants, hallucinogens, depressants
- At least 16,000 alkaloids are known from 20-30% of all plant species
- More common in nightshade family plants (gypsum weed, nightshade, tomato, potatoes, peppers, eggplant)




N,N-Dimethyltryptamine



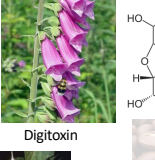
Ayahuasca



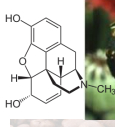
Nicotiana glauca




Nicotine



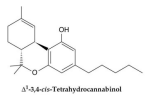
Digitalis purpurea




Digitoxin




Caffeine



3',5,4-tri-Tetrahydrocannabinol































Cannabis Hemp



HClC

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Plants that can kill (or poison) you

						
POISON IVY	POISON OAK	GIANT HOGWEED	POISON SUMAC	WILD PARSNIP	DEATH CAMAS	WHITE HELLEBORE
						
MOUNTAIN LAUREL	OLEANDER	FOXGLOVE	MONKSHOOD	WHITE BANEBERRY	CORN COCKLE	LARKSPUR
						
DEADLY NIGHTSHADE	ANGEL'S TRUMPET	WHITE SNAKEROOT	ROSARY PEA	POKEWEED	WILD POINSETTIA	JACK-IN-THE-PULPIT
						
IRIS	WATER HEMLOCK	DAFFODIL	ELDERBERRY	CASTOR BEAN	STINGING NETTLE	MANCHINEEL

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Four Corners Activity

- Each of you got to smell a different plant secondary metabolite during class.
- We are going to call each of them by name
- Based on your notes and how well you paid attention, when we call them out, you have to decide if the chemical you smelled was used in the following and go to each corner of the room.
 - Plant-Insect Communication
 - Plant-Plant Communication
 - Plant Defense against Bacteria and Viruses
 - Plant Defense against Insects

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