Master Gardeners Clark County
Latin is a Language: As Dead As It Can Be?

January 27, 2022

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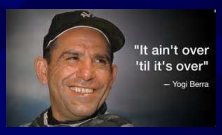
First Things, First

- **“What gets us into trouble is not what we don't know. It's what we know for sure that just ain't so.”**
- — Yogi Bearr(a)



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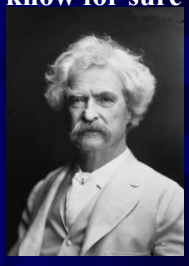
First Things, First

- **“What gets us into trouble is not what we don't know. It's what we know for sure that just ain't so.”**
- — Mark Twain



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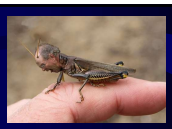
This I Know



- …In Nature’s infinite book of secrecy…
- We are ignorant of almost everything
- You don’t know until you know
- Remember what it was like not to know

4

Truth is Power

- *We are all ignorant of almost everything…but not everything.* – Chatmandu.
- The world is not flat
- We landed on the moon
- Sandy Hook happened
- The Holocaust happened
- The Sun does not orbit the Earth
- Global warming/Climate change is real.

5

"If you have remarked errors in me, your superior wisdom must pardon them. Who errs not when perambulating the domain of nature? Who can observe everything with accuracy? Correct me as a friend, and I as a friend will requite with kindness."

- Linnaeus

6

Paul McCartney sang which of the following lyrics (sort of)?

A. "Scuse me while I kiss this guy."
B. "The ants are my friends."
C. "The girl with colitis goes by."
D. "The Lady Mondegreen."

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Items for Today

- A Bare Minimum of the Basics
- A Family Affair
- A Case Study
- Insects/Diseases and Namenclature
- Organismania
- FORM AND FUNCTION

8

"Latin is a language,
as dead as dead can be.
First it killed the Romans:
Now it's killing me."

9

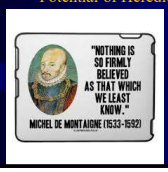
"The beginning of wisdom is calling things by their right name."

Krishtalka

10

The Light Trifle of His Substance

- "It is likely I inherited the gravel from my father, for he died sadly afflicted by a large stone in the bladder…While he was still so remote from the disease how could the light trifle of his substance out of which he built me convey so deep an impress. Where could the propensity have been brooding all this while.
  - Michel de Montaigne
  - "Of the Resemblance of Children to Their Fathers" (1571).
  - From: She Has Her Mother's Laugh: The Powers, Perversions, and Potential of Heredity" by Carl Zimmer (2018)



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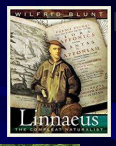
The Mother/Father of Our Botanical Nomenclature System Is:



- Carolus Linnaeus
- Pammius Bennettius
- Johannes Boggesiana
- LeBronus Jamus
- *Phycomyces blakesleeanus*
- *Daucus carotus,* PhD

12

The Father of our Latin binomial system is:

Carolus Linnaeus, who developed this system with his **Species Plantarum** in 1753.

Before screaming - which do you prefer?

- A. *Dianthus floribus solitaris, squamis calycinus subovatus brevissimis*

OR

- B. *Dianthus caryophyllus* L.

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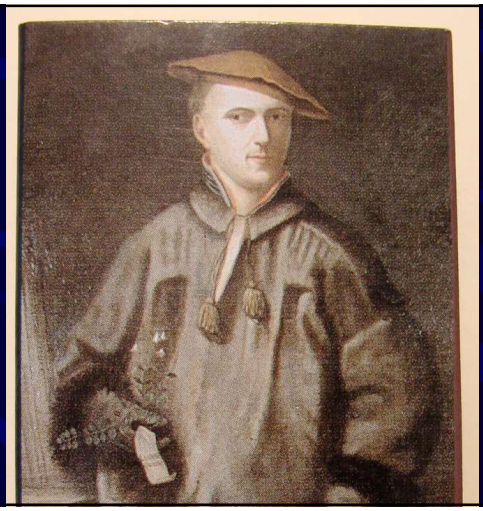

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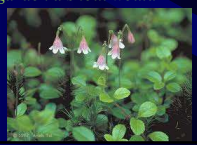
Linnaeus in Uppsala

- "*What forays they must have been! Botanizing with Linnaeus would have been the equivalent of studying geometry with Euclid, or taking a writing class from Shakespeare. In keeping with Linnaeus' orderly disposition, the expeditions were organized with the precision of a military campaign, with designated note takers, specimen collectors, and bird shooters. A bugle would sound when rare species were found. At the end of the ramble - up to 12 hours during the Baltic summer months - the party would troop back to town, waving banners, blowing horns, and beating kettledrums. At the botanic garden a shout would go up,* ***Vivat Linnaeus!***" – Kennedy Warne
-



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Who Is This Man?

- He was born on May 23, 1707
- He named over 4000 animals and over 8000 plants

- He said: "*If you have remarked errors in me, your superior wisdom must pardon them. Who errs not when perambulating the domain of nature? Who can observe everything with accuracy? Correct me as a friend, and I as a friend will requite with kindness.*"

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Point Counter Point In The Time of Linnaeus

- Linnaeus: (waxing poetic about floral morphology) *"The flowers leaves…serve as bridal beds adorned with such noble bed curtains, and perfumed with so many soft scents that the bridegroom with his bride might celebrate their nuptials with so much the greater solemnity…"*
- Johann Seigesbeck: "…Loathsome harlotry…"
- Linnaeus: Classified a "small, useless European weed" in the genus *Seigesbeckia*

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The Two Sides of Linnaeus

- He was full enough of his organizing abilities to intone: "*Deus creavit, Linnaeus disposuit*" {God created, Linnaeus organized}
- Yet, when welcomed to the Swedish nobility and given the name of von Linne in 1762 he chose for his heraldic emblem the plant *Linnaea borealis*, which he himself described as "*lowly, insignificant, disregarded, flowering but for a brief time."*

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Dianthus caryophyllus L.

- *Dianthus* is the genus
- *caryophyllus* is the specific epithet
- Together they are the species, expressed as a Latin binomial
- "L." stands for Linnaeus, who is the authority who first named this plant.

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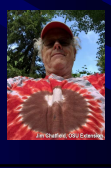
What is a species?

"A natural group of plants composed of similar individuals which can produce similar offspring, usually including minor variations." - Michael Dirr

"The primary or fundamental concept in the understanding of the forms of life; the basic unit of classification." - from Hortus Third

"Plants of one kind." - from How to Identify Plants

"A reproductively isolated population of plants." - common usage



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What is a species?

- Human beings
- The fungus that causes apple scab
- The emerald ash borer
- Dawn redwood trees
- Coast redwood trees
- Red maple trees
- Silver maple trees

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Latin binomials for selected organisms

- Human beings --- *Homo sapiens*
- Apple scab fungus --- *Venturia inaequalis*
- Emerald ash borer --- *Agrilus plannipennis*
- Dawn redwood --- *Metasequoia glyptostroboides*
- Coast redwood --- *Sequoia sempervirens*
- Red maple --- *Acer rubrum*
- Silver maple --- *Acer saccharinum*

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But What about Freeman Maples?

They are crosses between red and silver maples: *Acer rubrum* x *Acer saccharinum*

For example: *Acer* x 'Autumn Blaze'

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Basic Classification Scheme

- Species
- Genus
- Family
- Order
- Class
- Subphylum
- Phylum
- Kingdom

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Example: Cinnamon rose
(Rosa cinnamomea)

- Specific epithet --- *cinnamomea*
- Genus --- *Rosa*
- Family --- Rosaceae
- Order --- Rosales
- Class --- Dicotyledonae
- Subphylum --- Angiospermae
- Phylum --- Spermatophyta
- Kingdom --- Plantae

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According to the International Code of Botanical Nomenclature:

The first letter of the genus is capitalized; the first letter of specific epithet usually is not.

EXAMPLES: *Dianthus caryophyllus*
Rosa cinnamomea

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Name These Maples

A. *Acer platanoides*	Norway maple
B. *Acer griseum*	Paperbark maple
C. *Acer saccharum*	Sugar maple
D. *Acer ginnala*	Amur Maple
E. *Acer campestre*	Hedge maple

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REVIEW: Which of the following is a plant species?

A. *Pyrus*
B. *calleryana*
C. *Pyrus calleryana*
D. Rosaceae

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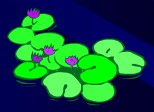
Why Not Just Use Common Names?

EXAMPLE: from **Dirr's Manual of Woody Landscape Plants**

Nymphaea alba L. has:

15 common names in English (including European white waterlily)
44 common names in French
105 common names in German
81 common names in Dutch
245 total common names--but only one Latin name



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Which of the following is a true rose in the genus *Rosa* and in the rose family(Rosaceae)?

- A. Moss rose
- B. Rose-of-Sharon
- C. Lenten rose
- D. Hairy alpine rose
- E. Derrick Rose
- F. Multiflora rose

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Answer: F.

- A. Moss rose is in the genus *Portulaca* in the purslane family (Portulacaceae).
- B. Rose-of-Sharon is in the genus *Hibiscus* in the cotton family (Malvaceae).
- C. Lenten rose is in the genus *Helleborus* in the buttercup family (Ranunculaceae).
- D. Hariy alpine rose is in the genus *Rhododendron* in the heath family (Ericaceae).
- E. Derrick Rose is in the genus *NBAcius* in the hominid family (Hominidae).
- F. Multiflora rose is in the genus *Rosa* in the rose family (Rosaceae).

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Why Names Matter

- For clarity in communication
- To explain plant relationships
- To understand pest/pathogen host ranges
- To remember…

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Why We Get Names Wrong

- *Names are constantly referenced incorrectly*
  - On plant labels
  - In catalogues
  - In books
  - In newspapers
  - By speakers

…Sometimes it is just too cumbersome

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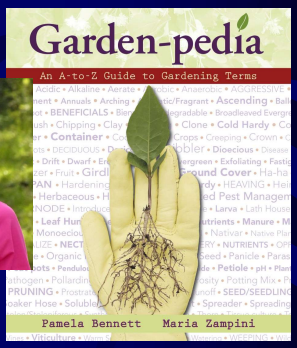
Defining Moments for Gardeners



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Plant Names Are Challenging

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The Many Names of Trees

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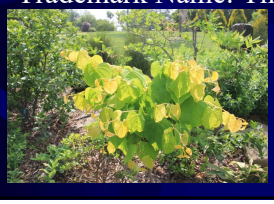
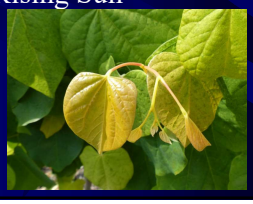
The Many Names of Trees

- Common Name: Redbud or Eastern redbud
- Botanical Name: *Cercis canadensis*
- Cultivar Name: 'JN2' PP#21451
- Trademark Name: The Rising Sun ™

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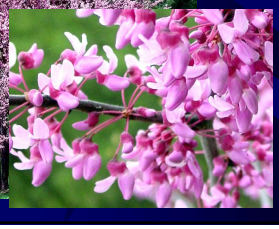
Cercis canadensis- REDBUD

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Redbud *(Cercis canadensis)*

- Native tree
- Understory tree
- Wide geographic range
- Wonderful new cultivars
- *Verticillium* and *Botryosphaeria* if in open locations with roots in hot, dry environment

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Zig-zag growth pattern


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Little Woody™ and Lucious Lavender™ Redbuds

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Forest Pansy™ Redbud

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Cercis canadensis- Forest Pansy™ REDBUD

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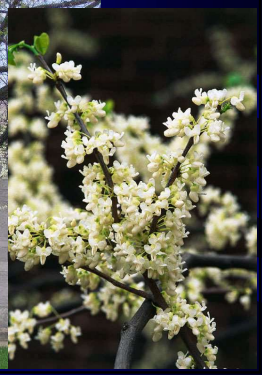
Cercis canadensis var. *alba* WHITE REDBUD



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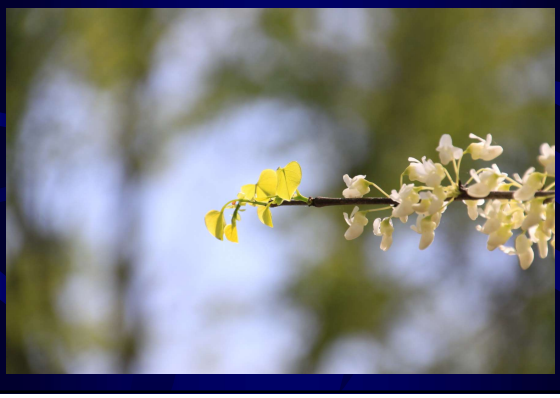
White Redbud



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White Redbud in Central Park

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Cercis c.
'Covey'

Lavender Twist™
Redbud

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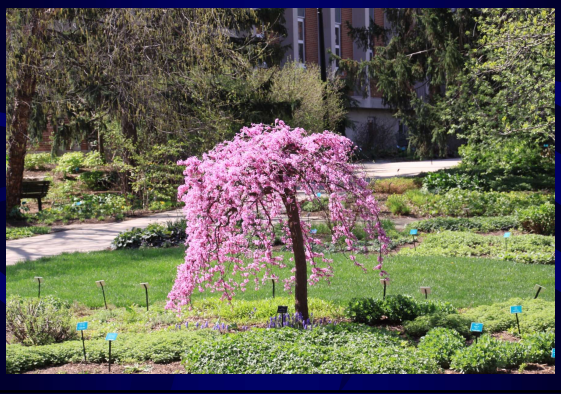
Lavender Twist™ Redbud



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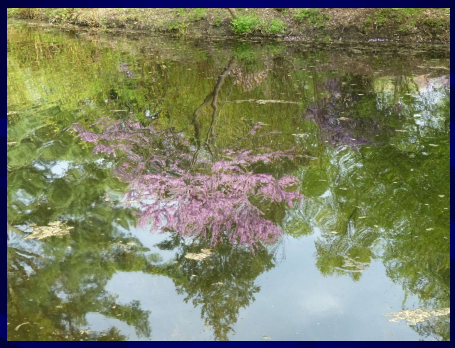
Redbud Reflection



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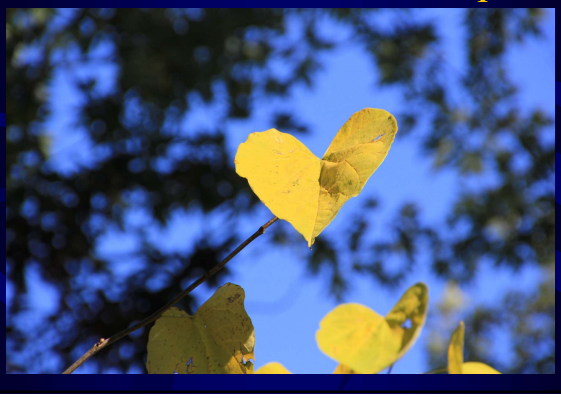
Love From the ChatScape



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"Flower: Floral leaves grouped together on a stem and adapted for sexual reproduction in the angiosperms"

- Robbins et al, *Botany*

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"Stokes Wildflower Book"

52

"The flower is a leaf mad with love."

- Goethe

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The Plant Parts – Flowers and Seeds

Flowers:

A: Are the main feature that attracts most buyers, but other features, i.e. fruit, leaf color, disease resistance, should also be considered;

B: Add beauty and color the landscape;

C: Are the way that plants perpetuate themselves;

The mechanisms of plant reproduction are many and complex. This subject alone could fill an entire book!

Crabapple Bloom and Fruit, Photo Credit: OSU Extension Nursery, Landscape and Turf Team

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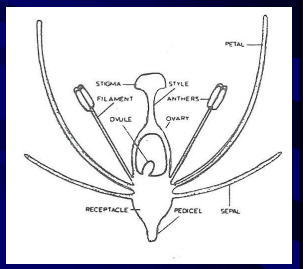
The Plant Parts – Flowers and Seeds

Basic Parts of A Flower:

A: A typical flower is composed of four whorls of modified leaves, the sepals, petals, stamen, and pistils.

B: All of these parts are attached to and supported by the receptacle;

C: Before the flower is opened, the sepals enclose the flower and are usually green.



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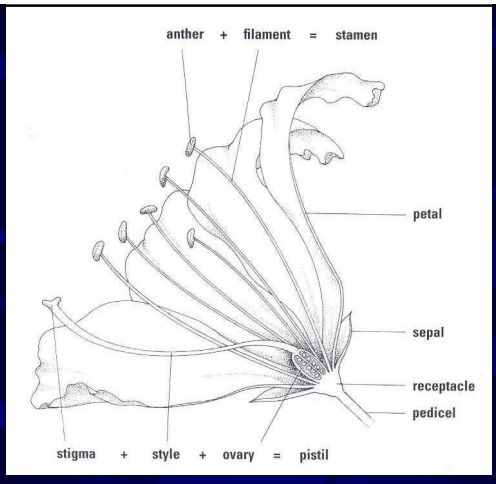

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The Plant Parts – Flowers and Seeds

Basic Parts of A Flower:

A: Male parts: Within the petals are one or more sets of stamens. Stamens are composed of pollen sacs (anthers) supported by a filament.

A Daylily Flower, Photo Credit: OSU Extension Nursery, Landscape, and Turf Team

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The Plant Parts – Flowers and Seeds

Basic Parts of A Flower:

Female Parts: At the center of the flower are one or more pistils. Pistils consist of the ovary containing fertile egg, and the style, a long slender stalk supporting the stigma.

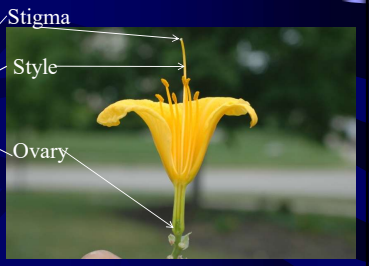

Photo Credit: Gary Gao, OSU Extension

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The Plant Parts – Flowers and Seeds

Pollination: Pollination is the transfer of the pollen from the anther to the stigma by insects, wind, water, or mechanical means. This begins the development of the seed within the ovary.

Photo Credit: Ken Chamberlain, OSU Comm. Tech.

Photo Credit: Gary Gao, OSU Extension

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The Plant Parts – Flowers and Seeds

"Imperfect" Flowers:

A: Dioecious (two houses):
A plant that a male flower one plant and female flower on another plant. Example: Hollies and Gingko.

A female holly with fruit,
Photo Credit, Ken Chamberlain, OSU Comm. Tech.

B: Monecious (one house):
If both sexes of the plant occur on the same plant, but on different part of the plant. Example: Pine and spruce.

Photo Credit: Gary Gao, OSU Extension

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The Plant Parts – Flowers and Seeds

Dioecious vs. Monecious:

A: It is very important for a landscape designer and installer to know that some plants are dioecious;

B: If a plant of wrong sex of a particular plant is selected, the desired flower and/or fruit effect will may not be achieved;

C: Example: Both male and female American hollies need to be planted in the close proximity in order for female hollies to produce fruit. On the other hand, male Gingko should be selected to avoid fruit production since Gingko nuts have a very offensive odor when rotten.

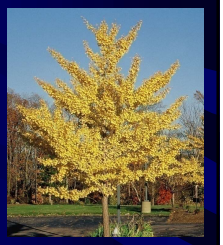

Photo Credit: OSU Extension Nursery, Landscape and Turf Team

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The Plant Parts – Flowers and Seeds

Cross Pollination:

A: In fruit production, some plants require cross pollination, or pollen from another plant of the same type, or a different cultivar or even different species for successful fruit set;

B: Apple, pear, plum, and cherry all require cross pollination, i.e., a black Tatarian cherry is a good pollinator for all sweet cherries;

C: Hawthorns, crabapples, serviceberries, and viburnums are all self-pollinating.

Photo Credit: Ken Chamberlain, OSU Comm. Tech.

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The Plant Parts – Flowers and Seeds

Flowers, Fruit, and Seeds as Identification Features:

A: Variations in the number and arrangement of flower parts;
B: Presence or absence of sex organs in one flower;
C: Number of seeds in the ovary;
D: Arrangement of flowers on the stem.

Photo Credit: OSU Extension Nursery, Landscape and Turf Team

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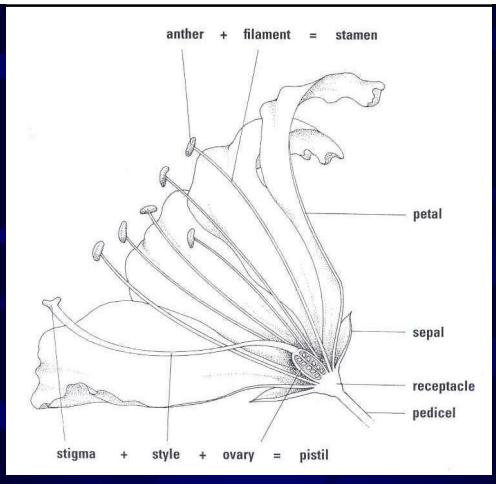

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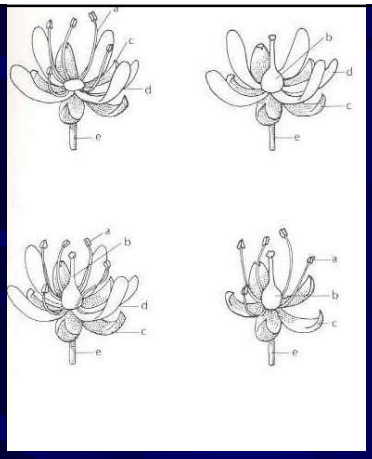

stamen (a)
pistil (b)
sepals (c)
petals (d)
peduncle (e)

Botany Illustrated
Glimn-Lacy and Kaufman
1984

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Botany for Gardeners, revised edition
Brian Capon, 2005

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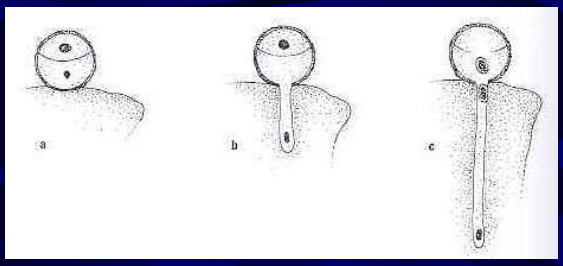
Germination of a pollen grain



(a) When a pollen grain lands on a stigma, it contains two cells.
(b) The nucleus of one cell controls the growth of the pollen tube.
(c) The pollen's second cell divides to form two sperm that move down the pollen tube.

Botany for Gardeners, revised edition
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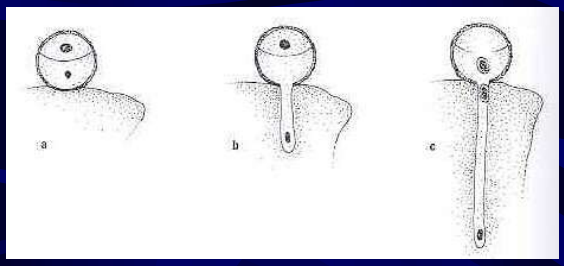
Germination of a pollen grain



(a) When a pollen grain lands on a stigma, it contains two cells.
(b) The nucleus of one cell controls the growth of the pollen tube.
(c) The pollen's second cell divides to form two sperm that move down the pollen tube.

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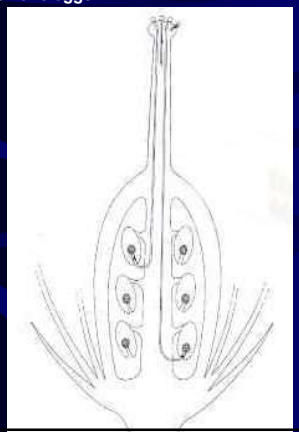
Events leading to the fertilization of a flower's eggs



1. Pollen grains land on the stigma and germinate.
2. Pollen tubes, through which the sperm move, grow through the style. A tube nucleus precedes the sperm in each pollen tube.
3. A pollen tube enters each ovule to deliver the sperm to an awaiting egg.

Botany for Gardeners, revised edition
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Basic Classification Scheme

- Species
- Genus
- Family
- Order
- Class
- Subphylum
- Phylum
- Kingdom

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Basic Classification Scheme

- Species
- Genus
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- Order
- Class
- Subdivision
- Division
- Kingdom

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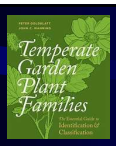

Plant Families Defined:

- "A group of related genera or single genus; a unit in classification." – *Plant Classification* (1979) – Lyman Benson
- "A taxonomic unit between the higher rank of order and the lower rank of genus" – *Contemporary Plant Systematics* (1979) – Dennis W. Woodland
- "Combinations of morphological features, particularly those of flowers and fruits, *Taxonomy of Flowering Plants*" (1959) - Porter

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Lets Learn Plant Families

- By definition, what is a plant family?
- Name five prominent plant families
- What family is ash in? Mountainash?
- Family?: Rose-of-Sharon; Moss Rose; Hairy Alpine Rose; Lenten Rose; Derrick Rose; Multiflora Rose: Lois Rose

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What Family Relationships Teach Us

- Host ranges for diseases (fireblight only in Rosaceae)
- Graft compatibility (*Syringa* on *Ligustrum* in Oleaceae)
- Horticultural needs (acid-loving ericaceous plants)
- Sensitivity to chemicals (Ronstar does not work on Caryophyllaceae)
- Plant identification (cruciform flowers in Cruciferae = Brassicaceae)
- Special characteristics (nitrogen-fixing root nodulations in the Leguminosae = Fabaceae)
- Poisonous tendencies (Anacardiaceae, Solanaceae)

74

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75

Brassicaceae

76

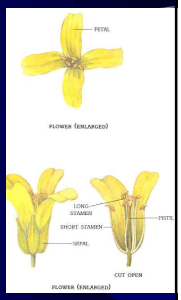
The Mustard Family Brassicaceae

Alliaria	Garlic mustard
Alyssum	Alyssum
Brassica oleracea	Broccoli, cabbage, cauliflower, brussel sprouts
Hesperis matronalis	Dame's rocket
Iberis	Candytuft
Lunaria	Money plant
Nasturtium	Nasturtium

77

Cruciferae = Brassicaceae

- Four petals arranged in a cross-like (cruciform) fashion
- Six stamens arranged with two short stamens across from each other and two pairs of taller stamens along the other axis in a cruciform pattern;
- Or two pairs of taller stamens as inner ring inside outer ring of shorter stamens
- Seedpods often slender and angled upward; unique fruit splitting (silique, silicle)
- Plant juices often bitter



From: *Plant Families* – Carol Lerner

78

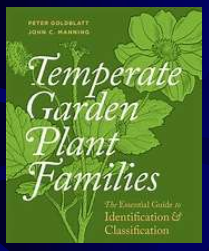
What is the difference between broccoli and boogers?

79

Haaavuud and the Glass Flowers

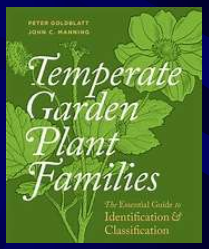
80

Plant Families



81

Resources:
Ann Chanon & Jason Veil



82

Rosaceae

83

The Rosaceae (BBC)

- The rose family is home to many garden favourites and edible crops. It includes roses but also many fruit genera, such as apples, pears, blackberries, apricots and raspberries. Plants can be identified by their open, bowl-shaped flowers with five petals and a cluster of stamens at the centre.

84

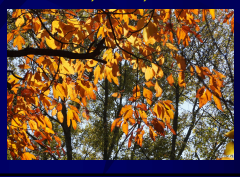
Case in Point:
Plant Lovers Almanac: 11/13/21

- Ashes in CO & EAB
- Winterberry hollies: fruit and foliage
- Witch-hazel blooming now
- Serbian spruce & blue spruce
- Larch, goldenlarch, baldcypress & dawnredwood
- *Populus*
- Rose madder & Rubiaceae
  - Sassafras

85

A Most Wonderful Time…

- *"The little trees, the sapling sugar maples and the baby red oaks squatting close to the ground, were the first to turn, as if green were a feat of strength and the smallest weaken first. Early in October, the Virginia creeper had suddenly drenched in alizarin crimson the tumbled boulder wall at the back of her property, where the bog began; the drooping parallel daggers of the sumac then showed a red suffused with orange. Like the slow sound of a great gong, yellow overspread the woods, from the tan of beech and ash to the hickory's spotted gold and the Hat butter color of the mitten-shaped leaves of the sassafras, mitten that can have a thumb, or two, or none."*
  – John Updike



86

Rose Madder & Rubiaceae

87

Oh, and One Other Member of the Rubiaceae

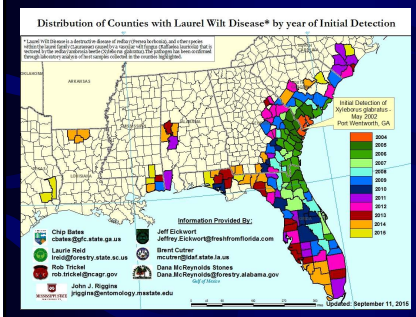
88

Sassafras is in the…




89

Laurel Wilt & The Lauraceae



90

Family Matters: A Neat Resource

https://www.youtube.com/c/Fiveminutefamilies


- Caryophyllaceae, commonly called the pink family or carnation family, is a family of flowering plants. It is included in the dicotyledon order Caryophyllales in the APG III system, alongside 33 other families, including Amaranthaceae, Cactaceae, and Polygonaceae. It is a large family, with 81 genera and about 2,625 known species.
- Rosaceae, the rose family, is **a medium-sized family of flowering plants, including 4,828 known species in 91 genera.** The name is derived from the type genus Rosa. Among the most species-rich genera are Alchemilla (270), Sorbus (260), Crataegus (260), Cotoneaster (260), Rubus (250)

91

True or False

Plant families all end in **"aceae"**

For Example: Ros**aceae**
Eric**aceae**
Lili**aceae**

92

Is ”aceae” the gold standard for all family endings?

- NO. It is for the Plant Kingdom and for fungi and certain other organisms.
- For Insects, for example, the ending is ”ae”

Curculionidae ~ weevils, eg., black vine weevil (*Otiorhynchus sulcatus*)

Buprestidae ~ metallic wood-boring beetles, eg., emerald ash borer (*Agrilus planipennis*)

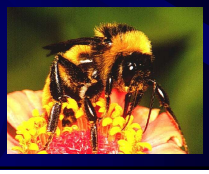
93

Insect Taxonomy

A family though is still, a group of related genera, even though for insects it is Buprestidae, and for plants it is Rosaceae

Additionally, for insects the taxon most used to describe groupings is the ORDER

Lepidoptera – butterflies and moths
Colepotera – beetles
Hymenoptera - ?



94

So what about these families?

- Compositae
- Cruciferae
- Gramineae
- Guttiferae
- Labiatae
- Leguminosae
- Palmae
- Umbelliferae

- Aster**aceae**
- Brassic**aceae**
- Po**aceae**
- Clusi**aceae**
- Lami**aceae**
- Fab**aceae**
- Arec**aceae**
- Api**aceae**

95

What do you think that the followin Homo sapiens have in common?

A. Baron Claus Alstroemer
B. Michael Begon
C. Louis Antonie de Bouganville
D. Anders Dahl
E. J.F. Dieffenbach
F. William Forsyth
G. Alexander Garden
H. Gottlieb Gleditsch
I. Nicolas Tomas Host
J. George Josef Kamel
K. Pierre Magnol
L. Jean Nicot
M. And good old Johann Gottfried Zinn

96

Root meanings of plant names:

- *Ageratum* from the Greek *'a'* (without) and *'geras'* (age) for long-lasting flowers.
- *Gypsophila* from the Greek *'gypsos'* (lime) and *'philos'* (loving) for alkaline soil preference.
- *Hemerocallis* from the Greek *'hemera'* (day) and *'callos'* for the flowers that each last but for a day.
- *Philodendron* from the Greek *'phileo'* (to love) and *'dendron'* a tree for the many plants in this genus that have a vining growth habit.

97

What are the common names of these plants?

A. *Liquidambar styraciflua*

B. *Liriodendron tulipifera*

C. *Narcissus poeticus*

D. *Zizyphus jujube*

98

Latin habitat meanings:

scopulorum -- on rock faces	*Juniperus scopulorum*
silvaticus -- of woods	
campestre -- of fields	*Fagus sylvatica*
pratensis -- of meadows	*Acer campestre*
palustris -- of marshy ground	*Poa pratense*
	Quercus palustris

99

Latin prefix/suffix meanings:

A. *atro*--dark	*Buxus thunbergii var. atropurpurea*
B. *calli, calo*--beautiful	*Callicarpa japonica*
C *salici*--willow	*Magnolia salicifolia*

phyllus, folius--leaf
rhhizus--root
stemon--stamen

From: 'A Gardener's Latin' by Richard Bird

100

Latin color meaning

alba -- white

niger - black

Pinus nigra

ruber -- red

Acer rubrum'

sanguineus -- blood-red

Geranium sanguineum

sempervirens -- always green

Buxus sempervirens

101

Latin shape meanings:

campanulatus -- bell-shaped

Enkianthus campanulatus

stellatus -- star-shaped

Stellaria media

palmatus -- palm-shaped

Acer palmatum

rotundifolium -- round

Hepatica rotundifolia

sessile -- without stems

Trillium sessile

dentatus -- tooth-shaped

Viburnum dentatum

alatus -- winged

Euonymus alatus

102

Name these wildflowers:

A. *Dentaria lacianata*
B. *Sanguinaria canadensis*
C. *Commelinia communis*
D. *Jeffersonia diphylla*
E. *Orchis spectabilis*

103

Fun with Fungi

A. *Chaos fungorum*
B. *Venturia inaequalis*
C. *Phallus rubicundus*
D. *Phycomyces blakesleesanus*

104

The Genus *Phytophthora*

Phytophthora infestans	Late blight of potato
P. cinnamomi *P. citrophthora* *P. citricola*	Rhododendron pathogens
P. ramorum	Sudden oak death

Phytophthora and *Pythium* were long known as "water mold" fungi, once in the Plant Kingdom and then in the Kingdom Fungi. Now due to their mode of reproduction and cell wall composition they are classified in their very own kingdom, the Kingdom Oomycota.

105

A Few Publications on Plant Names

- Combes, Allen J. - Dictionary of Plant Names, Timber Press
- Cope, Edward A. - Cultivar Nomenclature. American Conifer Society Bulletin 4 (1), 1986.
- Dirr, Michael A. - Manual of Woody Landscape Plants, Stipes Publishing
- Neal, Bill – Gardener's Latin. Algonquin Books of Chapel Hill.
- Munson, Richard, H. – Trademarks: The End of Cultivars? American Conifer Society Bulletin 10 (2), 1993.

106

Now will you agree with Liberty Hyde Bailey when he says?

" 'What's in a name?' cries Juliet; 'that which we call a rose by any other word would smell as sweet.' Yet Shakespeare might admit that a rose is not less sweet because we know its name."

107

And remember…

- *Semper ubi…*

sub-ubi!

108

An Interesting Problem

Sooty Bark Disease

"The fungus *Cryptostroma corticale* has been causing dieback primarily in **sycamore maples** (*Acer pseudoplatanus*), although box elders (*A. negundo*) and Norway maples (*A. platanoides*) can also become infected."

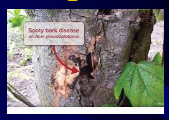
109

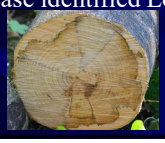
Sooty Bark Disease

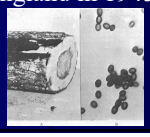
110

Sooty Bark Disease of Maple

- Pathogen: *Cryptostoma corticale*
- Native to Ontario, Great Lakes
- Does not cause disease in native area
- Causes branch dieback/wilt in Europe, GB, PNW
- Pathogen identified in 1898 in London, Ontario
- 3' x 15 x stem ~15 trillion spores
- Disease identified London England in 1945







111

Sooty Bark Disease of Maple

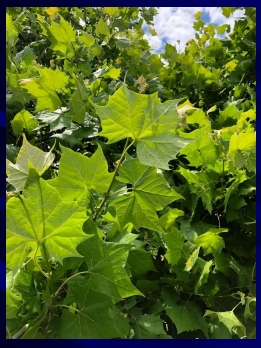
- Host plants: Maples, especially sycamore maple, *Acer pseudoplatanus*.
- In PNW on other maples, horsechestnut, Pacific dogwood.
- Last few years in PNW. Bigger story this year after 100+ heat. Heat/drought known predisposing factors.

112

Sycamore Maple, *Acer pseudopatanus*

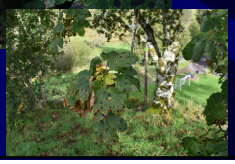
113

Sycamore/American planetree, *Platanus occidentalis*



114

Maple Tar Spot on "Sycamore"



115

Sooty Bark Disease of Maple

- An unusual twist: *Cryptostroma corticale*, the infectious pathogen (sometimes) of trees can cause a non-infectious disorder of humans.

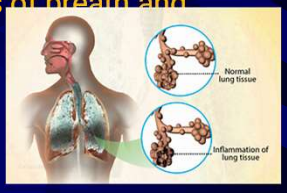
116

Sooty Bark Disease

117

Pneumonitis 0f Humans

- Mainly refers to inflammation of lung tissue due to non-infectious causes, which results in cough without mucus or phlegm, shortness of breath and



118

Sooty Bark Disease: A Facet-inating Story

A Multitude of Facets

The Name Game

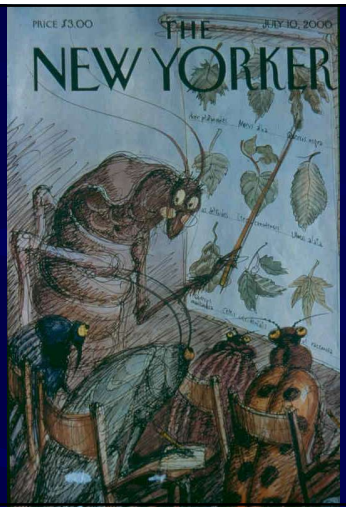
When Worlds Collide

Host Range

Plant and Animal Disea

Climate Change

119



120

Lepidoptera: Butterflies / Moths

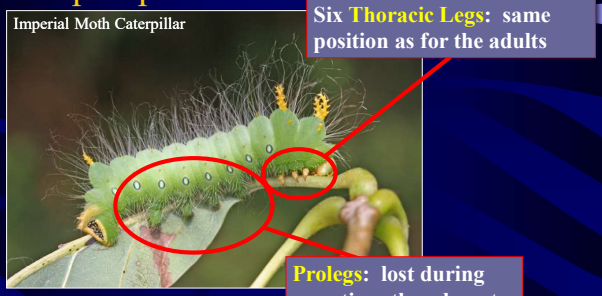
Lepidoptera: lepido = scale; ptera = wing

121

Some Examples of Common Lepidoptera:

122

Lepidoptera Larvae = Caterpillars



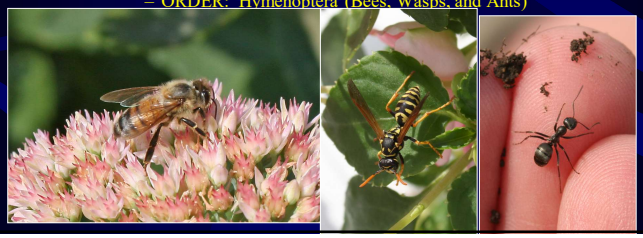
123

Some Examples of Lepidoptera: Caterpillars

124

Hierarchy of Taxonomic Categories:

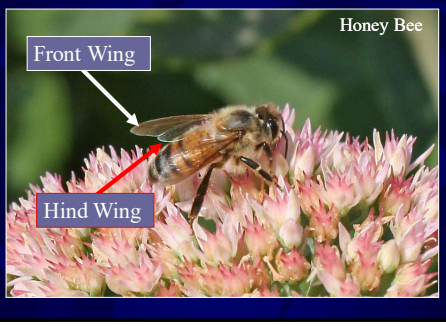
- KINGDOM: Animalia
  - PHYLUM: Arthropoda (Arthro-Poda)
    - CLASS: Insecta (Hexapoda)
      - ORDER: Hymenoptera (Bees, Wasps, and Ants)



125

Order Hymenoptera:

Hymenoptera: hymen = membrane; ptera = wing



126

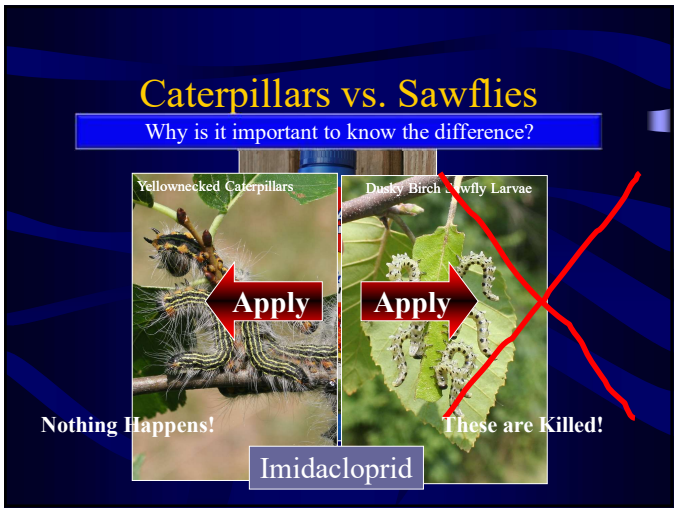
Some Examples of Hymenoptera

127

Hymenoptera: Larvae

- Some larvae are legless, and can be easily mistaken for maggots (Diptera)
- Others have legs and look like caterpillars (Lepidoptera)

128



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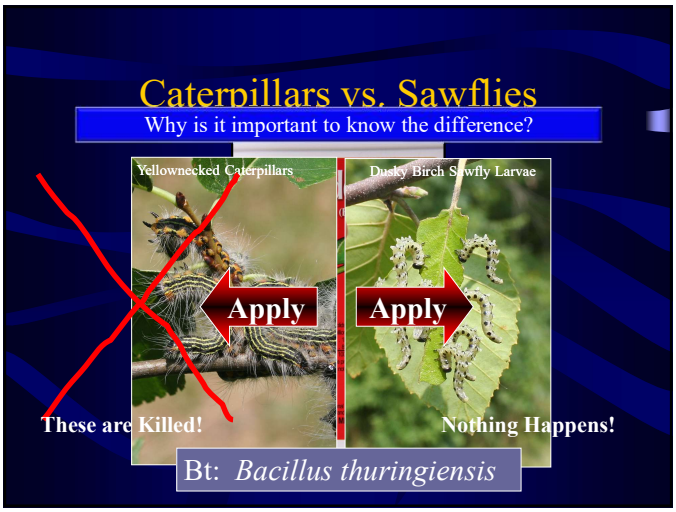

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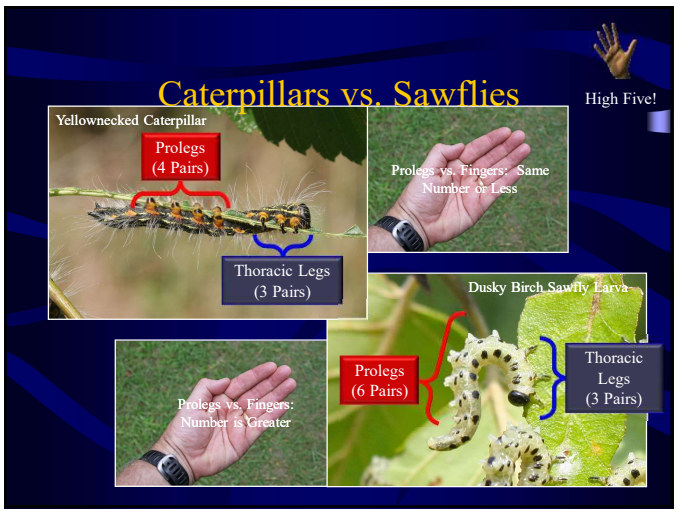

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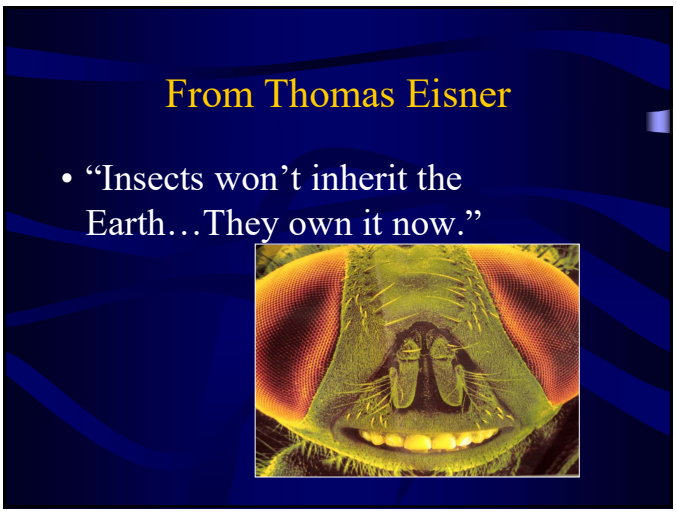


132

Why Names Matter

- Species and Botanical Classification
- A Family Matter
- The Importance of a Flower
- Order In The Court
- An Ash By Any Other Name ***
- A Milkweed Story
- Precious Jewel or Cubic Zirconium
- What Do You Know About Lime Disease
- Host Range Matters
- The Many Names of Trees
- Natural Selection Matters

133

First…Why Names and Genetics Matter

134

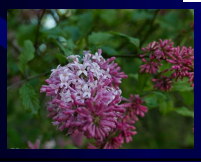
Green Ash and Mountainash

135

136

Oleaceae — Olive Family

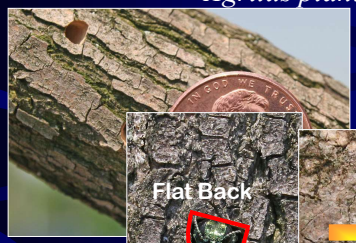
Chionanthus — Fringetree
Forsythia — Forsythia
Fraxinus — Ash
Ligustrum — Privet
Syringa — Lilac

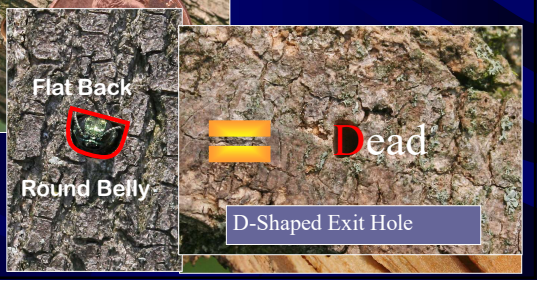


137

Emerald Ash Borer (EAB)

Agrilus planipennis



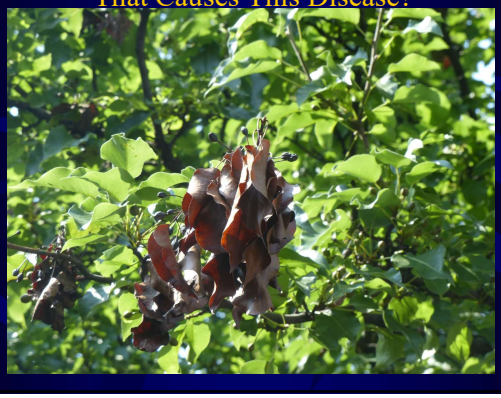


138

Green Ash and Mountainash

139

What Is The Host Range of the Pathogen That Causes This Disease?



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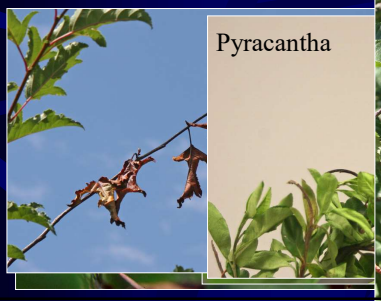
What Family Relationships Teach Us

- Host ranges for diseases (fireblight only in Rosaceae)
- Graft compatibility (*Syringa* on *Ligustrum* in Oleaceae)
- Horticultural needs (acid-loving ericaceous plants)
- Sensitivity to chemicals (Ronstar does not work on Caryophyllaceae)
- Plant identification (cruciform flowers in Cruciferae = Brassicaceae)
- Special characteristics (nitrogen-fixing root nodulations in the Leguminosae = Fabaceae)
- Poisonous tendencies (Anacardiaceae, Solanaceae)

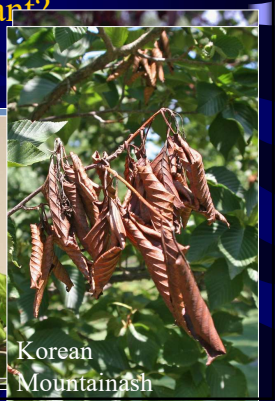
141

What are the Common Problems with the Plant?

Bacterial Fire Blight Plant
Family: Rosaceae



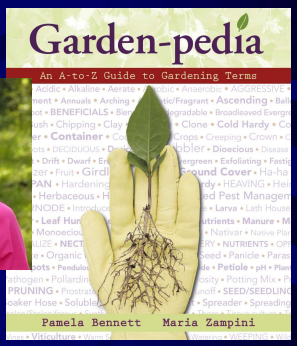
Pyracantha



Korean Mountainash

142

Defining Moments for Gardeners



143

How Do We Navigate This

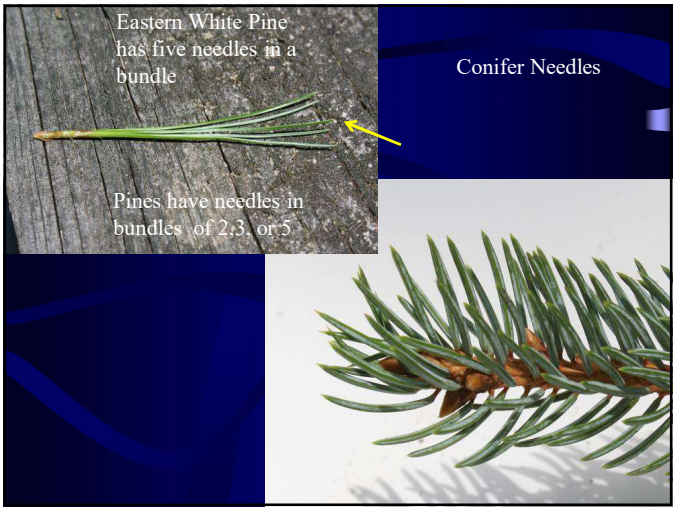
An Example From Garden-Pedia

"We know we should use scientific Latin names for all the plants throughout this book. We wrestled (*literally*)…For the purposes of this book, we will use the Latin name as often as possible and necessary for clarity, accompanied by the common name –e.g. *Quercus alba* (white oak)…But if we have a list of plants within a term definition we will use the name most often used by gardeners…"

144

Plant Names Are Challenging

145



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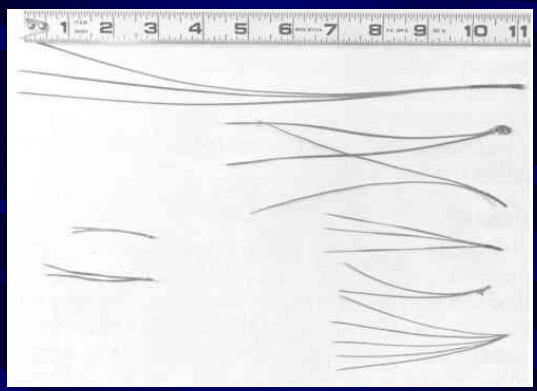
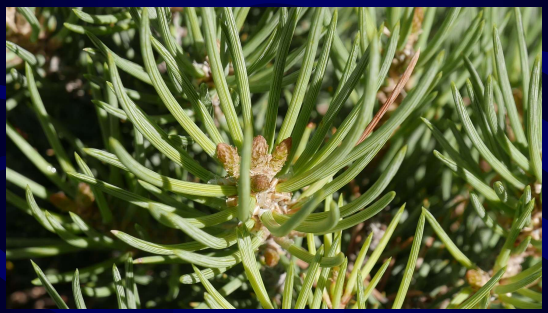


From:
'Woody Ornamentals' (Partyka, et al)

147

So, what is this?



148

A One-Needled Pine!

149

Basic Classification Scheme

- Species
- Genus
- Family
- Order
- Class
- Subphylum
- Phylum
- Kingdom

150

The Plant Kingdom: Divisions or Phyla

A. Thallophyta -- algae
B. Bryophyta -- mosses, lierworts
C. Pteridophyta -- ferns, club mosses, horsetails
D. Spermatophyta -- seed plants

151

The Spermatophyta (seed plants)

A. Gymnosperms:
- naked seeds
- no vessels in vascular system
- no flowers

B. Angiosperms:
- seeds enclosed in fruits
- vessels typically present
- flowers

152

The Gymnosperms (naked seeds):

- Pine
- Fir
- Dawnredwood
- Baldcypress
- Larch
- Spruce
- Taxus
- Arborvitae
- Juniper
- Ginkgo

153

The Angiosperms (enclosed seeds):

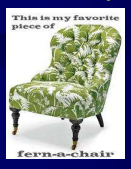
- Monocots
  Grass Family - Gramineae or Poaceae
  Lily Family - Liliaceae
  Orchid Family - Orchidaceae
- Dicots
  Rose Family - Rosaceae
  Maple Family - Aceraceae
  Heath Family - Ericaceae

154

Fernlandia

- *Ring-ting! I wish I were a primrose, A bright yellow primrose blowing in the spring! The stooping boughs above me, The wandering bee to love me, The fern and moss to creep across, And the elm-tree for our king!*

William Allingham



155

What Is a Fern?

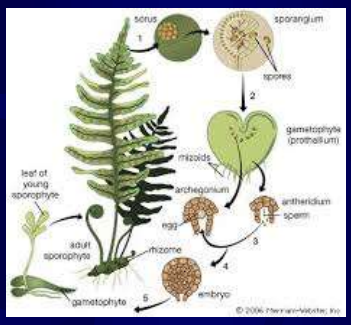
- Fern: A fern is a member of a group of vascular plants that reproduce via spores and have neither seeds nor flowers. They differ from mosses by being vascular, i.e., having specialized tissues that conduct water and nutrients and in having life cycles in which the sporophyte is the dominant phase. Higher classification of ferns is a bit tricky: Pteridophyta (Filicophyta) or as a subdivision of Tracheophyta (vascular plants) or as Polypodiophyta.

156

Fern Sori

157

Fern Life Cycle



158

Pteridiphytes I: Ferns/Allies

- Archaic term for:

Ferns
Horsetails
Lycopods
Selaginella and others

Vascular plant that reproduces by spores.

159

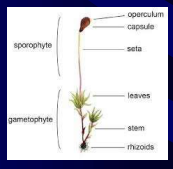
Pterdiphytes II

- Q. – How do pteridiphytes differ from seed plants? A. – Sporophyte generation (diploid) and gametophyte generation (haploid) are independent and free-living.
- Q. – How do pteridiphytes differ from bryophytes Mosses and liverworts)? A. – Sporophyte generation is branched and more conspicuous. And: bryophytes are non-vascular

160

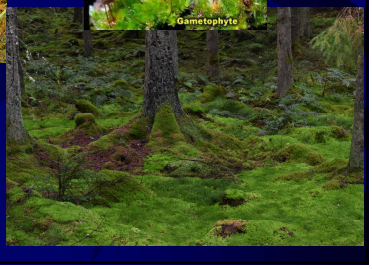
What Is A Moss?

- Sporophyte and gametophytes, with gametophytes the main generation of mosses.



161

Mosses



162

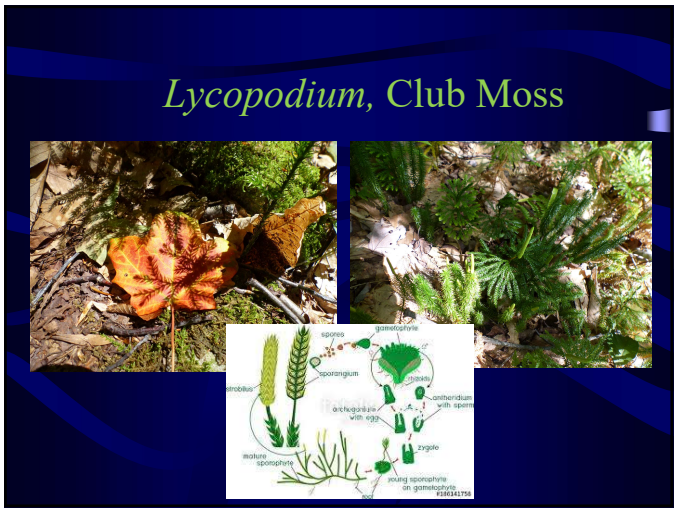
Ferns

- *The harebell nods as she passes by,*
  The violet lifts its tender eye,
  The fern bends her steps to greet,
  And the mosses creep to her dancing feet.
  - Julia C.R. Dorr, *Over the Wall*

163

Horsetail, *Equisetum*

164



165

166

167

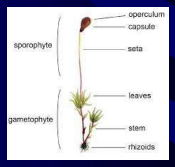
168

Lycopodium Reproduction

169

What Is A Moss?

- Sporophyte and gametophytes, with gametophytes the main generation of mosses.



170

Moss in Northern England

171

Liverwort at Long Island HREC

172

Liverworts on Trees

173

Wow

174

Moss in Northern England

175

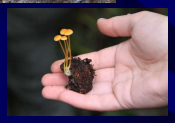
Moss in Southern Ohio

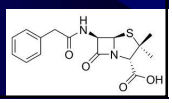
176

Ten Tales of the Kingdom Fungi

- From Parasites to Poisons: To Penicillium and Pinots
- The Perfect Picnic
- The Honey Mushroom…
- …And the Aborted Entoloma
- A Selected Symbiosis
- The Beech Blight Aphid Poop Eater
- Dryad's Saddle
- Apple Scab & OARDC
- Pathogenesis & An Ode To Rot
- The Amazing Cedar Rusts…

…And The Final Fungal Lineup

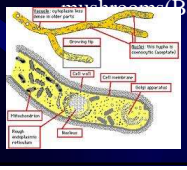




177

What Are Fungi?

- Plants? Animals? Why and why not?
- Fungi have nuclei? What does not?
- Fungi do not have chlorophyll? What does?
- Possess chitinous cell walls? All fungi?
- Reproduce by spores; most have filamentous asexual structures. Fruiting bodies include sacs (Ascomycetes) and [illegible](Basidiomycetes)



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Fungal Fruiting Bodies

179

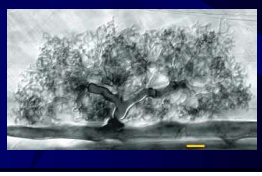
The Many Faces of Fungi

- From Saprophytes to Parasites…
- From Soloists to Partners…
- From "Beneficial" to "Harmful"…
- From Rot…
- …To Roquefort.
- From Toxins…to Intoxicants
- For Composters…A Key to Decomposition…

180

Fungus Amongus

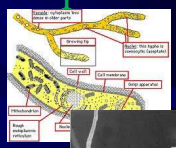
- Foodstuffs
- Plant Parasites (Pathogens)
- Symbionts
- Animal/Human Pathogens
- Saprophytes/Decomposers
- Toxin Producers
- Intoxicants
- Medicines
- More Fungi Amongi



181

Ode To Rot – John Updike

Let rot
proclaim its revolution:
the microscopic hyphae sink
their fangs of enzyme into the rosy peach
and turn its blush a yielding brown,
a mud of melting glucose:
once-staunch committees of chemicals now vote
to join the invading union,
the former monarch and constitution routed
by the riot of rhizoids,
the thalloid consensus.



182

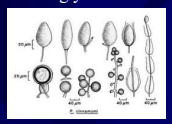
Fungus Amongus

The numbers of species of fungi in the world are estimated to be over 5 million, but only about 40,000 of these are considered plant pathogenic fungi. As with all diseases there is a difference between the pathogen and the disease and this is important to remember.

183

Water Molds vs. Fungi

- Water molds have cellulose cell walls; fungi have cell walls made of chitin. Water molds (Oomycetes) include *Phytophthora, Pythium,* downy mildew pathogens. Fungi include rusts, powdery mildews, anthracnose fungi, et al.
- Water molds have diploid nuclei; fungi have haploid nuclei.
- Water molds have motile cells with two flagella; fungi have one-celled spores
- Metabolism of glycine different & different enzymes.



184

Phytophthora Primer

- Translated: "Plant Destroyer"
- Water Molds: Oomycota
- Phytophthora
- Pythium
- Hall of Shame: Phytophthora infestans – potato
- Phytophthora ramorum – oaks
- Phytophthora spp. - many species on many plants

185

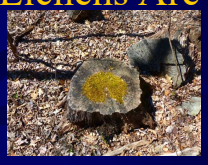
What Are Lichens?

In the words of Irwin Brodo, Sylvia and Stephen Sharnoff, in their wonderful "Lichens of North America: " They are a "*composite of a fungus and an organism capable of producing food by photosynthesis*."

186

What Lichens Are Not

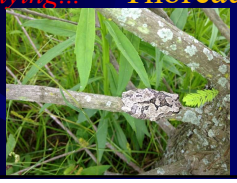
- Mosses
- Lycans
- Lichen planus



187

Lichen Lore

"I find myself inspecting little granules as it were on the bark of trees - little shields or apothecia springing from a thallus - such is the mood of my mind - and I call it studying..." Thoreau

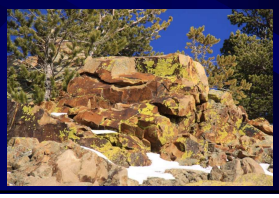


188

Lichens, with their symbionts are…

"fungi that have discovered agriculture."

- Trevor Goward



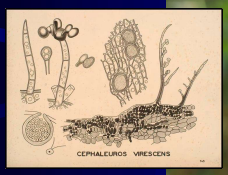
189

A Lichen By Any Other Name

- Rock pimples, earth wrinkles, angels hair, freckle pelts, fog fingers, dragons funnel, tar-jelly and old man's beard.
- Powder-tipped antler lichen; black-eye lichen; bloody heart lichen; cowpie lichen; elf-ear lichen; five-o-clock shadow lichen.
- Hairball lichen; naked kidney lichen; tattered rag lichen; and blackened toadskin lichen.
- Candy lichen, rock licorice lichen, and chocolate chip lichen.

190

Lichens as a plant pathogen?



191

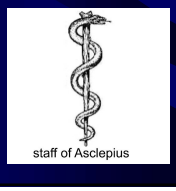
Lichens on a Frog?

192

Who knew…

"In nature's infinite book of secrecy
A little I can read"

- Shakespeare



staff of Asclepius

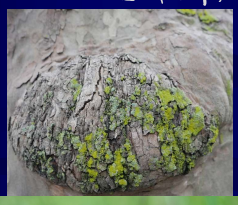
193

Breaking News:Lichenology

- Pre 1860's Lichens are plants
- 1868 Lichens are sac fungi enslaving algae (Schwendener)
- Lichens soon seen as mutualistic symbiosis between the two
- 2016 Lichens are sac and club fungi symbiotic with alga (Toby Sbrilla)
- *"Biology textbooks tell us that lichens are alliances between two organisms—a fungus and an alga. They are wrong…But really, we don't know what they do"*

194

Lichens!



195

Mosses Not: Spanish-Moss (*Tillandisa usneoides*)

196

Usnea Lichens



197

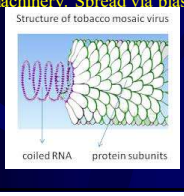
Tillandsia usneoides flowers



198

What Is A Virus?

- RNA or DNA + Protein coat + sometimes a lipid membrane
- Obligate parasite. May be latent (asymptomatic). Infect all organism types: bacteria (bacteriophages), amoebas, plants, primates.
- Intracellular. Enter plant cells through wounds. Hijacks host cell machinery. Spread via plasmodesmata. Systemic via phloem



199

ARE VIRUSES ALIVE?

- Contentious, probably forever.
- DO NOT replicate on their own or make own energy or have own metabolism – need host cells to do it. Some say these attributes are needed to be alive. Cannot live on own.
- DO contain nucleic acid: DNA or RNA that code for proteins. Essential to our understanding of all life.
- ARE clearly players in story of life: Mutate. Many think originated from living cells; others think viruses are origins of nucleus; evolution of eukaryotes from prokaryotes.


200

What Are Viruses?

- Viruses are the border of biochemistry and biology.
- Viruses are on the verge of life.
- Viruses code for genes.
- Viruses are part of the web of life.

Check it out: https://www.scientificamerican.com/article/are-viruses-alive- by Luis Villarreal, *Scientific American*

201

Viruses I Often See Outside

202

How Important Are Plant Virus Diseases?

- Billions of $ in Damage Annually
- $600 million worldwide annually from plum pox disease
- "*Almost 50% of pathogens causing emerging plant diseases are viruses* (Anderson et al.)
- Perhaps viral diseases are the most common plant

203

Plant Virus Diseases of Note

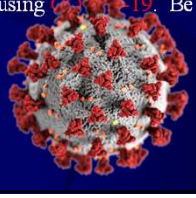
- Tobacco Mosaic Disease (TMV)

- Impatiens Necrotic Spot Disease and Tobacco Ringspot Virus Disease
- Geranium Viral Diseases (CVI)
- Hosta Virus X Disease
- Tulip Flower Break Disease (Tulipmania)
- Plum Pox
- Cucumber Mosaic Virus
- Rose Rosette Disease

204

Human Coronavirus Diseases

- four of these viruses cause common cold symptoms
- SARS-CoV causes SARS: Severe Acute Respiratory Syndrome
- MERS CoV causes MERS: Middle East Respiratory Syndrome
- And now SARS-CoV-2, causing COVID-19. Be safe.

205

How Important Are Plant Virus Diseases?

- Billions of $ in Damage Annually
- $600 million worldwide annually from plum pox disease
- "*Almost 50% of pathogens causing emerging plant diseases are viruses* (Anderson et al.)
- Perhaps viral diseases are the most common plant diseases of all, more than fungal!



206

Cacao Swollen-Shoot Disease





207

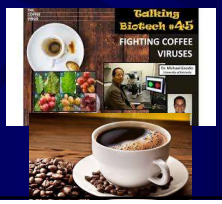
Citrus Greening

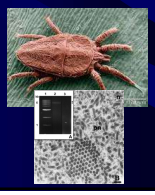


208

Coffee Ringspot Disese (CoRSV)

- **Coffee** ringspot is characterized by conspicuous ringspot symptoms on leaves, berries, and less frequently on twigs. It is caused by **coffee** ringspot **virus** (CoRSV), a short, bacilliform **virus** (40 nm x 100-110 nm). The **virus** is not seed borne and is transmitted by Brevipalpus phoenicis. "*Coffee (Coffea arabica and Coffea canephora), the most widely traded agricultural commodity in the world."*

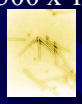




209

How Big Are Viruses?

- Tobacco Mosaic Virus (TMV), which causes Tobacco Mosaic Disease is: 300 x 18 nm in size. As in nanometers.



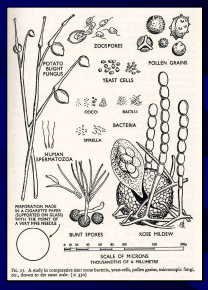
- The SARS-CoV-2 virus that causes COVID-19, is 70 by 90 nanometers in size.

Bacterium: ~100 time bigger. Electron microscopes rather than light microscopes

210

Plant Pathogens are Micro-Organisms

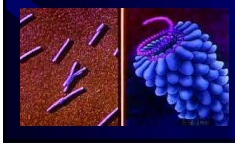
You can't see them with the naked eye! So take a look at "The Advance of the Fungi"(1940) and this great drawing: Which leads us the story of Dr. Charles Krause and the greatest performance in OSU Plant Pathology Department PhD general exam history:

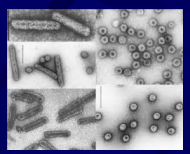


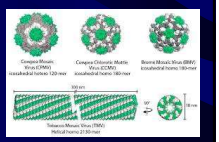
211

What Shapes Are Viruses?

- "*Shapes of viruses are predominantly of two kinds: rods, or filaments, so called because of the linear array of the nucleic acid and the protein subunits; and spheres, which are actually 20-sided (**icosahedral**) polygons. Most plant viruses are small and are either filaments or polygons, as are many bacterial viruses.*"







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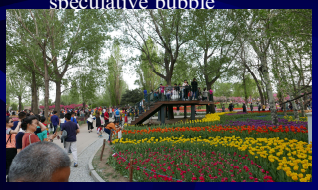
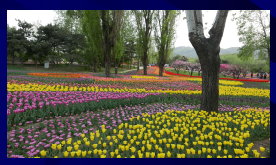
Tulipmania

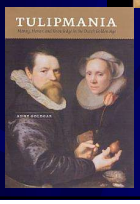
- Tulip mania was a period in the Dutch Golden Age during which contract prices for some bulbs of the recently introduced and fashionable tulip reached extraordinarily high levels and then dramatically collapsed in February 1637. It is generally considered the first recorded speculative bubble

213

Tulipmania





214

Tulipmania

- Tulip-breaking virus and four others involved in flower “breaks” streaks, flames. One with great name of Rembrandt bulip-breaking virus.
- Virus, vectored by aphids, infects bulbs and causes pigment irregularities. Debilitates bulbs

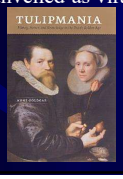
nes
mic a ia




215

Tulipmania

- Carolus Clusius, botanist at the University of in (1585), first to note that "broken" plants slowly degenerated…”*ruined afterwards and so wanted only to delight its master's eyes with this variety of colours before dying, as if to bid him a last farewell.*” Thought to be environmental condition, waited 20th century to be unveiled as viral disease.



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Positive Viruses

"*The word, virus, connotes morbidity and mortality, but that bad reputation is not universally deserved,*"

- Marilyn Roossinck, PhD, Professor of Plant Pathology and Environmental Microbiology, Pennsylvania State University.

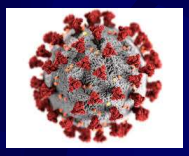
"*Viruses, like bacteria, can be important beneficial microbes in human health and in agriculture,*"

217

From February *Landsculptor*

Nature constantly evolves, and our rational process of progressively trying to better understand nature, known as science, results in the challenge of keeping up with our level of knowledge and understanding nature.

We are living through a good example of evolving science. In our efforts to defend against the SARS-CoV-2-Virus we are taking lessons from how bacteria defend against their own viral pathogens (bacteriophages) and we are taking lessons from CRISPR technology to develop RNA-based vaccines, churning them out in record time."



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I Love Viruses

- Nuclear Polyhedrosis Virus (NPV) to control gypsy moth caterpillars
- Clover cryptic virus that limits excess *Rhiozobium* nodulation of legumes
- Gamma-herpesvirus increases resistance to *Yersinia pestis* in mice
- A tropical panic grass at Yellowstone requires symbiosis of a fungal colonizer and a virus infecting it to survive hot temperatures

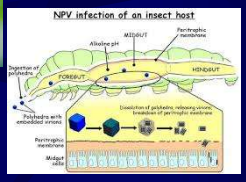
219

Gypsy Moth Control I

- Lymantria dispar multicapsid **nuclear polyhedrosis virus** or LdMNPV is a **viral** infection in **gypsy moths** (Lymantria dispar) that causes infected larvae to die and disintegrate. Infected larvae climb to the top of a tree and die. ... Gypchek is an **insecticide** which uses the **virus** to **control** the **gypsy moth** population.

220

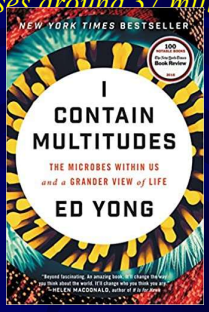
Gypsy Moth Control II



221

From: I Contain Multitudes

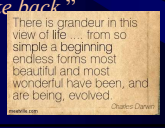
- "*Every person aereolises around 37 million microbes per hour*"



222

From "Pandemic Century" - Rene Dubos

- "*Modern man believes that he has achieved almost compete mastery over the natural forces which molded his evolution in the past and that he can now control his biological and cultural destiny…but this may be a delusion.*
- *Like all living thangs he is part of an immensely complex ecological system and is bound to all its components by innumerable links…at some unpredictable time and in some unforseeable manner nature shall strike back."*



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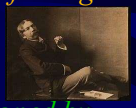
Perspective. . .

- "*All change in Habits of life and of thought is irksome*" – Thorsten Veblen



- "[all the species] "*have been assigned by Nature fixed limits, beyond which they cannot go.*" [their number…"*is now and always will be the same.*" – Linnaeus.

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Life and Lichens…

- Tony Spribille: Science paper 2016 pulled rug from under the dual hypothesis. Yeast. And fourth – bacteria. Every time we try to figure out what the players do we find more players. "The deeper we dig, the more we find."
- "Lichens are remarkable examples of innovation emerging from partnership…The association is far more than the sum of its parts."

"Lichens tell us things about life…they inform us". Lynn Margulis "intimacy of strangers": eukaryotes from single cell organisms snared a bacterium, mitochondria were its descendents of these bacteria. Chloroplasts were descendants of photosynthetic bacteria that engulfed a eukaryotic cell.

- *"A portion of the minerals in your body is likely to have passed through lichens at some point."*

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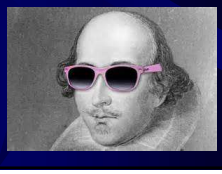
Who knew…

"In nature's infinite book of secrecy
A little I can read"

- Shakespeare



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Now will you agree with Liberty Hyde Bailey when he says?

" 'What's in a name?' cries Juliet; 'that which we call a rose by any other word would smell as sweet.' Yet Shakespeare might admit that a rose is not less sweet because we know its name."

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And remember…

- *Semper ubi…*

sub-ubi!

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