Clark County Master Gardeners Basic Botany

January 27, 2022

Jim Chatfield
Ohio State University Extension

1

Seasons of Time

"At Christmas I no more desire a rose
Than wish a snow in May's new-fangled mirth;
But like of each thing that in season grows."

- William Shakespeare, *Love's Labour's Lost*

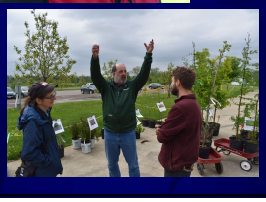
2

"The day the crow shook down on me
the dust of snow from a hemlock tree
has given my heart a change of mood
and saved a part of a day I had rued".

- Robert Frost

3

The Messenger: With An "E For Effort



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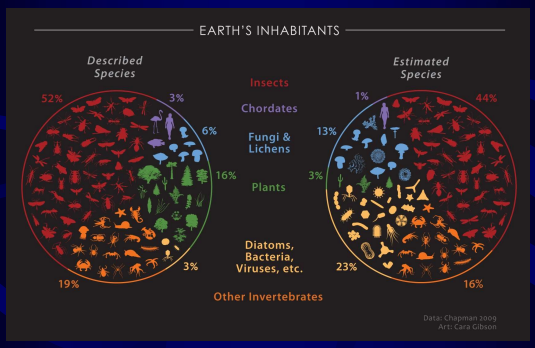
Life on Earth



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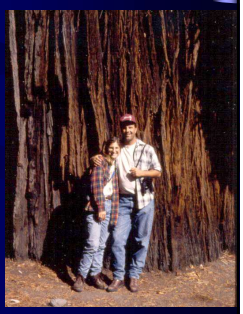
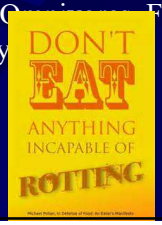
Plants Rule The Earth?



6

Solar Power

- Let us set the scene…
- Venue: 2000+ students+ at Oberlin College
- Vibe: rockstar energydrink amazing sauce
- The act: Desire, G… Food, Cooked… Energy



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Is it another discussion of green roofs or solar panels?

After all that is what the Greening of America and the World usually references…

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8

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"The core feature of planthood is autotrophy, that is, the happy ability to make one's own food. Plants essentially eat the sun, transforming solar energy into sugars and starch through the stepwise enzymatic stitchery of photosynthesis. Animals, by contrast, are heterotrophs, defined by their need to devour other organisms - the hard-won fruit and fiber of the suneaters, or the once-removed flesh of herbivores." – Natalie Angier

"The most important chemical reaction on earth is photosynthesis...We are all parasites upon it." – Robert DeFeo

9

Photosynthesis

Leaf Function:

The Process of Photosynthesis

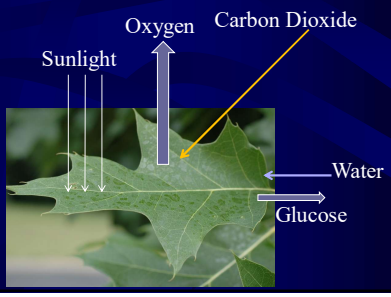


Photo Credit: Gary Gao, OSU Extension

10

Photosynthesis

- So join with me and those 2000 students and Michael Pollan and arborists everywhere, at this Trees on Tap program, by screaming…

11

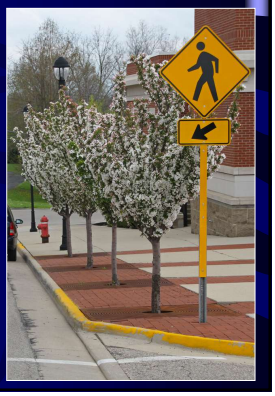
Why How Plants Work Matters

- Roots are shallow and need oxygen which decreases with soil depth
- Plants produce their own food in leaves and transport it to roots just inside the stem
- Plants with male flowers only will not

12

The Healthy Plant

- Needs a good balance between root and shoot
  - The root system supplies water and minerals to the stem and leaves
  - The foliage must produce enough food to sustain the root system
- This balance can be upset by drought, waterlogging of the soil, damage to the roots, and defoliation by insects or diseases



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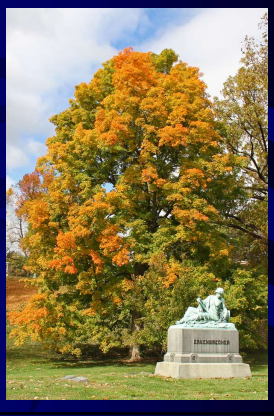
The Parts of A Plant – Overview

Plant Organs: A group of cells and tissues that carry out life processes in plants.

14

The Parts of A Plant – Overview

A plant needs to have both a healthy shoot system and a healthy root system to work together to thrive.



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The Parts of A Plant – Overview

Example: Iron Chlorosis in the leaves of a river birch is caused by insufficient iron uptake by tree roots in alkaline soils.

Though difficult, iron chlorosis may be corrected by adding chelated iron to the soil or lowering soil pH with elemental sulfur.

16

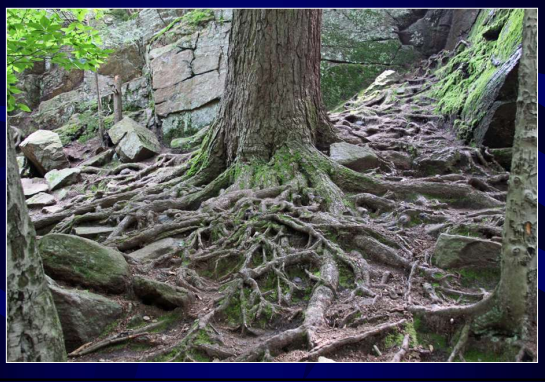
Horticulture Axiom:

Plant'em high - watch'em die;
Plant'em low - never grow
Plant'em right - sleep at night!

- Erik Draper-

17

Remember Your Roots!



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The Parts of Plant – Roots

Primary Functions:

- ✓Anchoring the plant to the soil
- ✓Absorbing water and mineral nutrients
- ✓Store certain amount of food to be used when needed by various plant processes

19

Tree Root Morphology

of soil.

der roots"

s crown

drip-line.

Source: Dr. Nina Bassuk, Professor of Horticulture Physiology, Head of the Urban Horticulture Institute, (Dr.) Susan Day, Department of Horticulture, Cornell University.

20

The Parts of a Plant - Stems

Primary Functions:

- Transport of water, nutrients, and carbohydrates (plant food)
- Structural support
- Growth
- Food storage
- Food production (some plants)

21

A Graphic Depiction

Stem Anatomy and Function The Basics

22

Tree Trunk Basics

Sugars / Carbohydrates flow down and up the tree through the Phloem

Cambium cells divide to become Phloem and Xylem

Water and nutrients flow up the tree through the Xylem

Graphic by Joe Boggs, OSU Extension

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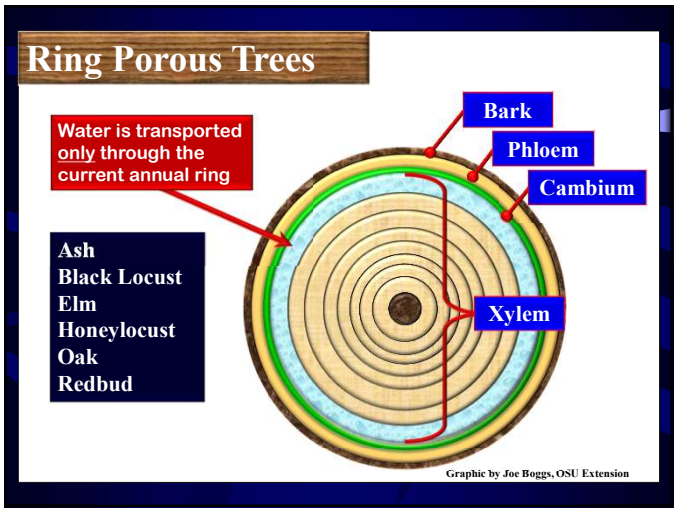
Ring Porous Trees Versus Diffuse Porous Trees

24


Ring Porous Trees
Water is transported only through the current annual ring
Ash
Black Locust
Elm
Honeylocust
Oak
Redbud
Bark
Phloem
Cambium
Xylem
Graphic by Joe Boggs, OSU Extension

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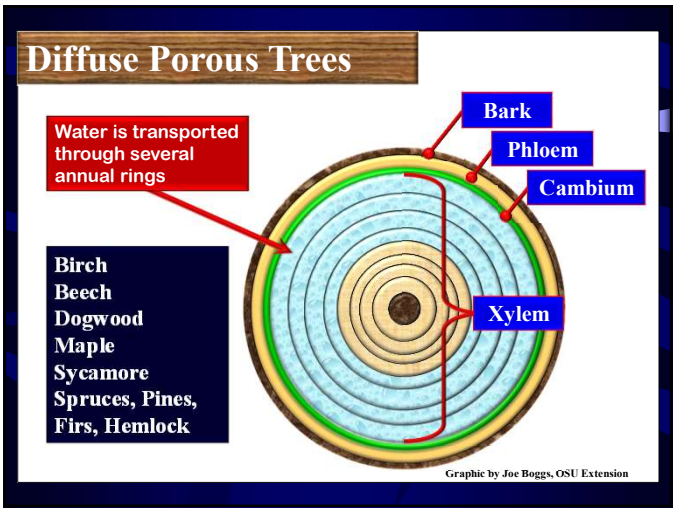
Diffuse Porous Trees
Water is transported through several annual rings
Birch
Beech
Dogwood
Maple
Sycamore
Spruces, Pines, Firs, Hemlock
Bark
Phloem
Cambium
Xylem
Graphic by Joe Boggs, OSU Extension

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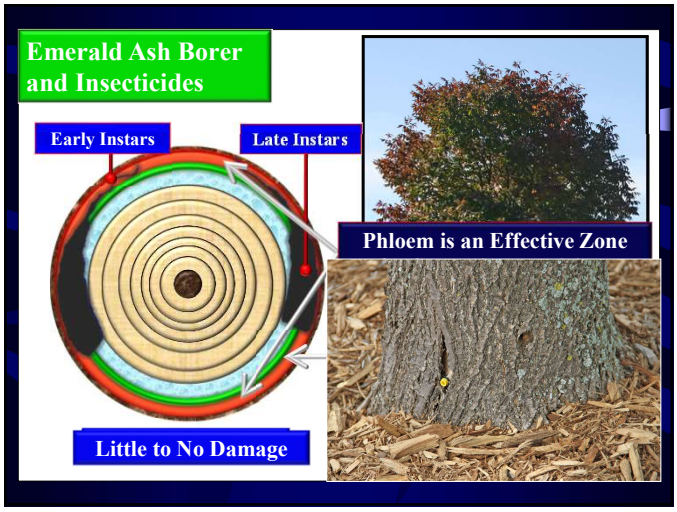
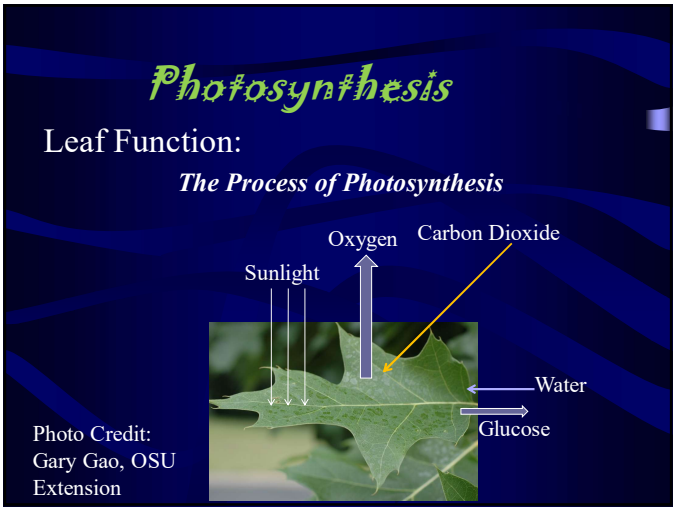

Emerald Ash Borer and Insecticides
Early Instars
Late Instars
Phloem is an Effective Zone
Little to No Damage

27


Photosynthesis
Leaf Function:
The Process of Photosynthesis
Oxygen
Carbon Dioxide
Sunlight
Water
Glucose
Photo Credit: Gary Gao, OSU Extension

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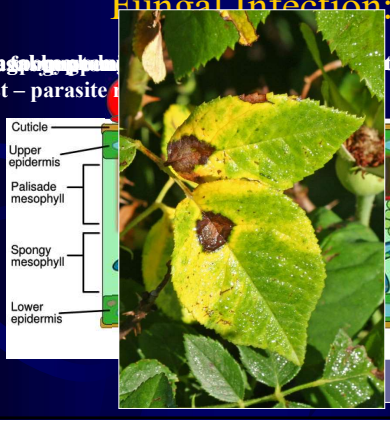
Fungal Infection:

host – parasite



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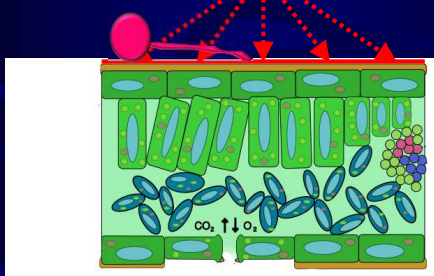
Disease Prevention:



Leaf Cross-Section

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Calico Scale

31

Soft Scales vs. Armored Scales

Soft Scales

Armored Scales

32

Armored (Hard) Scale:

Insec Damaged cells die producing (styl leaf symptoms

33

Soft Scales:

Black Sooty Molds: Honeydew from Calico Scale Nymphs

Voids th sticky "honeydew"

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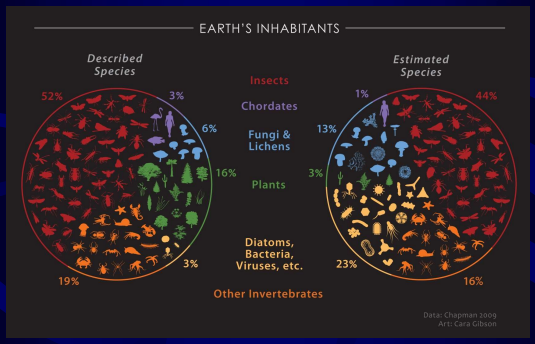
Life on Earth



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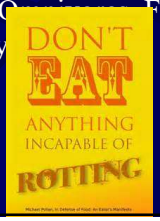

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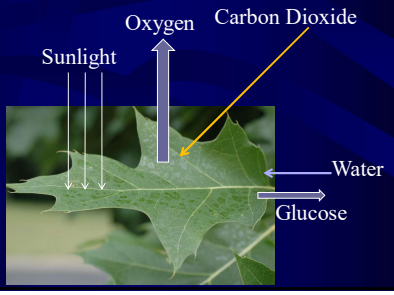

Photo Credit: Gary Gao, OSU Extension

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Photosynthesis

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chemistree

41

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

- Robbins et al, *Botany*

42

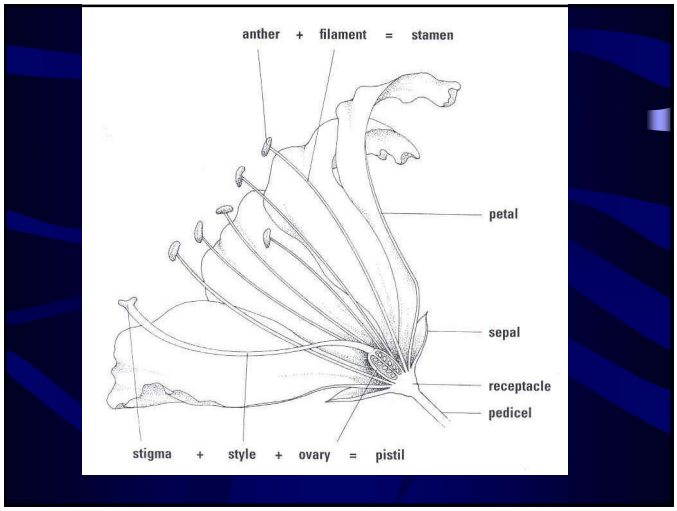
"Stokes Wildflower Book"

43

"The flower is a leaf mad with love."

- Goethe

44



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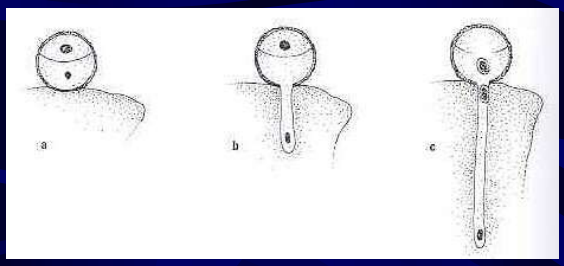
Germination of a pollen grain



(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
Brian Capon, 2005

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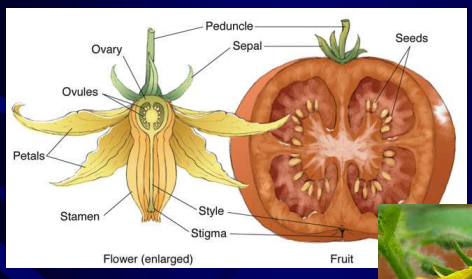
Tomato flower



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

Krishtalka

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Plant Names Are Challenging

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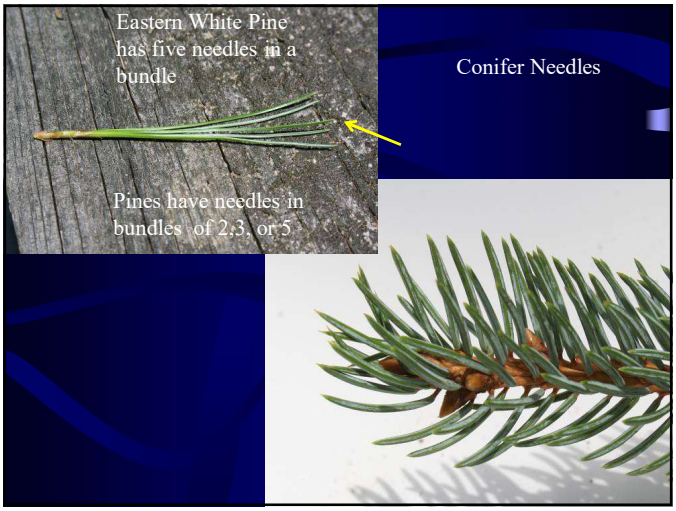

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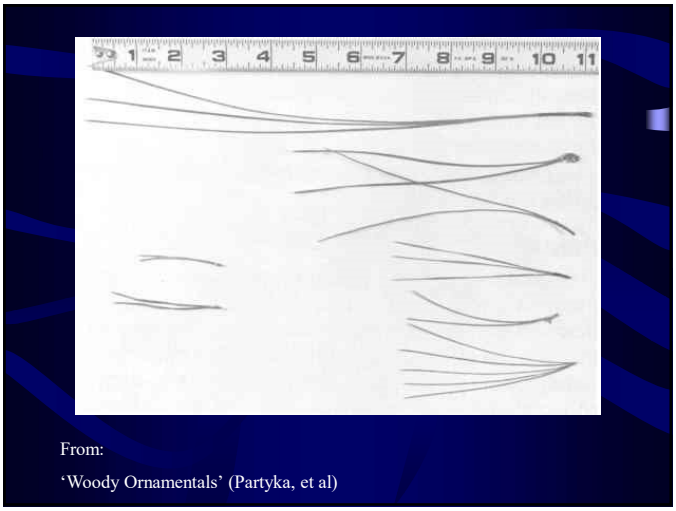

51

52

Why are those pines losing their inner needles? Is it some kind of disease?

Pines and other narrow-leaved evergreens such as spruces and firs are "evergreen" only in the sense that they have green needles on the trees year-round. These trees do, however, lose their older (inner) needles every Autumn. These older needles yellow, brown and fall. That is why there are brown needles under the tree. People often notice the yellowing of inner needles, for example, on white pine trees *(Pinus strobus)* in the Autumn and become suddenly concerned that something is wrong with the trees. It seems to them that this is the first time this has ever happened and perhaps they have heard somewhere that there is a disease going around on pines.

53

Why are those pines losing their inner needles? Is it some kind of disease? (cont.)

However, this needle coloration and drop is simply normal "seasonal needle coloration". It occurs on all pines, spruces, firs, hemlock and other needled-evergreens, but is most noticeable on white pines. This is because this pine keeps only 1 ½ years of needles, losing the older needles each fall. Other pines, spruces and firs keep each needle 2 ½ years, 3 ½ years, or sometimes even longer before the oldest needles discolor

54

Why are those pines losing their inner needles? Is it some kind of disease? (cont.)

and drop. So, the needle drop is more evident on white pine since fewer annual crops of needles remain green during the Autumn. This is ever true, but nonetheless observers often are convinced that since they have never noticed it before, therefore it must never have happened before. *Au contraire.* As Marcel Proust said: *"The true voyage of discovery lies not in finding new landscapes, but in having new eyes."*

- Jim Chatfield , *Akron Beacon Journal*, 2003

55

Why are those pines losing their inner needles? Is it some kind of disease?

"Pines have earned the reputation of being 'evergreen' by the same device that governments use to achieve the appearance of perpetuity: overlapping terms of office. By taking on new needles on the new growth of each year, and discarding old needles at longer intervals, they have led the casual onlooker to believe that needles remain forever green.

56

Why are those pines losing their inner needles? Is it some kind of disease? (cont.)

"Each species of pine [and spruce, and fir, etc.] has its own constitution, which prescribes a term of office for needles appropriate for its way of life. Thus the white pine retains its needles for a year and a half; the red and the jackpines for two years and a half. Incoming needles take office each June and outgoing needles write their

57

Why are those pines losing their inner needles? Is it some kind of disease? (cont.)

farewell addresses in October. All write the same thing, in the same tawny yellow ink, which by November turns brown. Then the needles fall, and are filed in the duff to enrich the wisdom of the stand. It is this accumulated wisdom that hushes the footsteps of whoever walks under pines."

- Aldo Leopold, *Sand County Almanac*

58

Who said:

"A tree's leaves
may be ever so good,
so may its bark,
so may its wood;
But unless you put
the right thing to its root,
It never will show
much flower or fruit."

59

Ten Tales Of Disease Management

- Host Resistance: Crablandia and Apple Scab
- Biological Control: Phytophthora Root and Crown Rot
- Epidemiology: Impatiens downy mildew
- Cultural Factors: Death & Taxus
- Environment: Black Spot and Powdery Mildew of Rose
- Interaction With Insects: Thousand Cankers Disease
- Diagnosis: Beware of Mimics
- Protection: The Infection Process & Fungicides
- Host range: The Importance of Taxonomy
- Disease Cycles: Rust Never Sleeps

60

A. Robert Frost
B. Joyce Kilmer
C. Jerry Baker
D. Martha Stewart

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In an Average Cup of Healthy Forest Soil, There Are:

- Arthropods:
  - 50,000
- Nematodes:
  - 100,000
- Protozoa:
  - 20 million
- Bacteria:
  - 200 billion
- Fungi:
  - 60 miles of fungal hyphae

Source: Serita Frey, OSU School of Natural Resources

62

The Living Soil

63

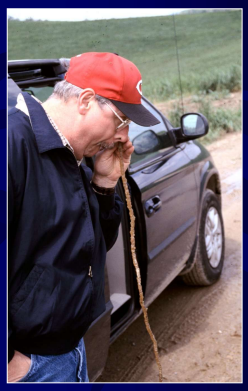
A Soil Aggregate

A Soil Aggregate is a Group of Soil Particles Stuck Together by Microbial Glue

64

Microbial Glue

it's a little bit like…



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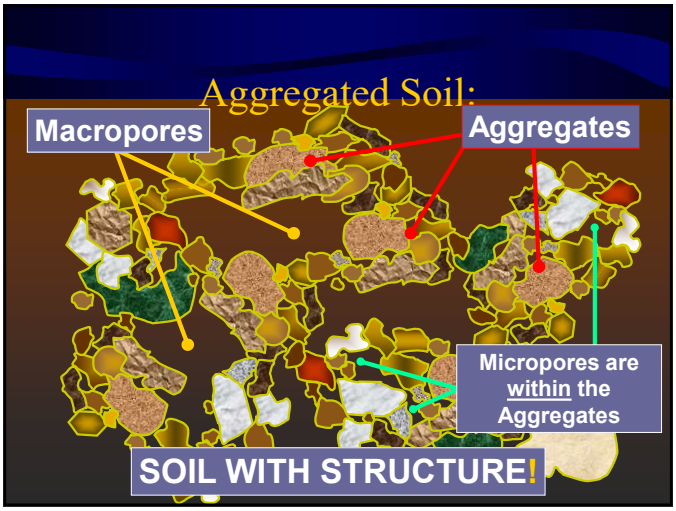


66

- S
  a
  s
- M
  C
- S
  p
- Y

Increasing Microorganisms

⇩

Increases Microbial Glue

⇩

Increases Soil Aggregates

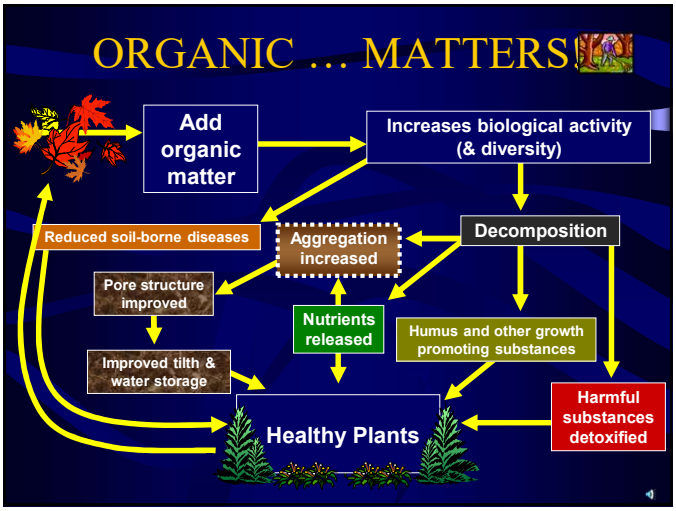
⇩

Increases Macropores

⇩

Improves Soil Structure

67



68


Treatments: 1) Shredded wood, 2) Composted wood, 3) Control, ….and + and – fertilizer.
(Herms et al, 2002)
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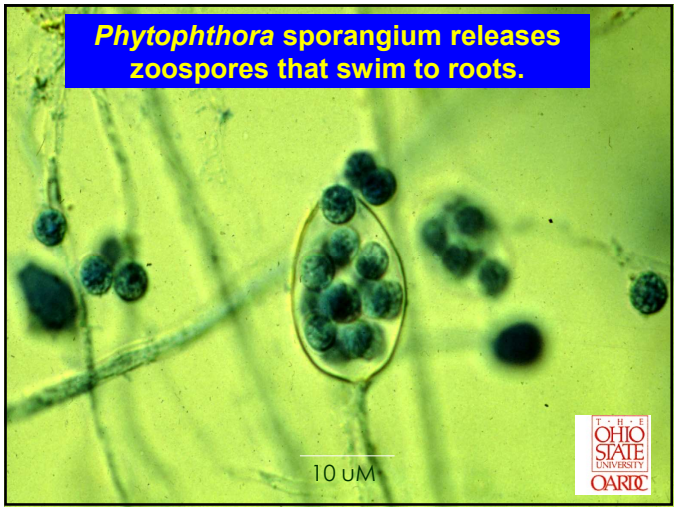
69


Spores on wet overwintered infected leaf debris

70


Phytophthora sporangium releases zoospores that swim to roots.
10 uM
THE OHIO STATE UNIVERSITY
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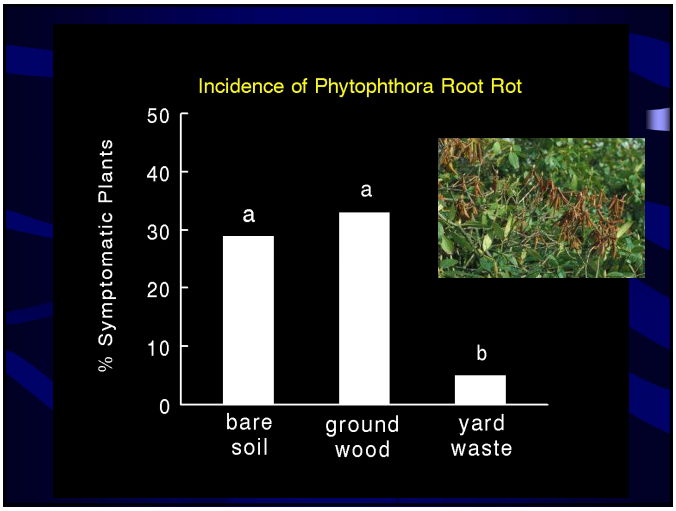
71


Incidence of Phytophthora Root Rot
% Symptomatic Plants
50
40
30
20
10
0
a
a
b
bare soil
ground wood
yard waste

72

1. Which of the following is not a key function of plant roots?

A. Structural support
B. Water and mineral uptake
C. Food uptake
D. All are key functions of plant roots.

73

2. Which of the following trees are relatively tolerant of wet soil sites?

A. Baldcypress
B. Red maple
C. *Quercus palustris*
D. All of the above.

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3. For which of these plants is it a common horticultural practice to bury some of the stem when planting?

A. Rhododendron
B. Tomato
C. Taxus (yew)
D. Meserve hybrid hollies

75

4. Which of the following plants will *not* thrive in exposed, unirrigated sunny sites?

A. Katsuratree
B. Astilbe
C. Hosta
D. None will thrive in such sites.

76

5. Which of the following correctly reflects the comparative tolerance of the listed plants to wet sites?

A. *Taxus* is more tolerant than *Taxodium*.
B. Winterberry holly is more tolerant than American holly.
C. Norway maple is more tolerant than red maple.
D. Daylily is more tolerant than white water lily.

77

6. Which of the following is an example of a symbiotic mutualism between a fungus and plant roots?

A. Mycorrhizae
B. *Rhizobium* nodulations on plants in the Fabaceae (Leguminosae).
C. *Phytophthora cinnamomi* on *Taxus* roots.
D. Allelopathy of black walnuts to tomatoes.

78

7. Which of the following is typical of the roots of a mature tree?

A. The majority of the absorbing roots are within the top 12 inches of soil.
B. The spread and depth of the root system is approximately a mirror image of the canopy.
C. The spread of the root system in an open field is about as far as the "drip-line."
D. The taproot is the most important absorbing portion of the root system of mature oaks.

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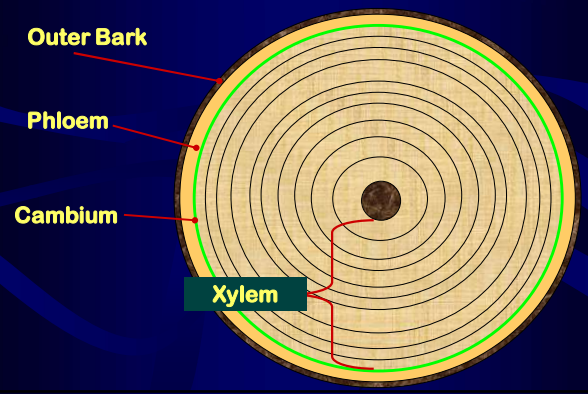
Tree Trunk Basics

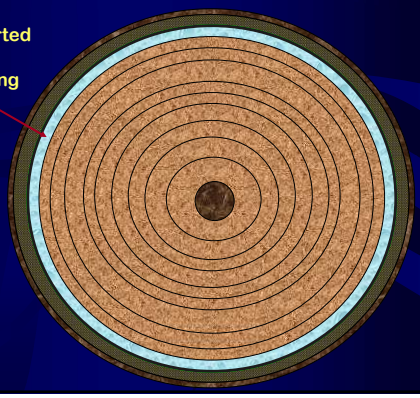


80

Ring Porous Trees: Ash

Tree decline and death is rapid — 1-3 years

Water is transported only through the current annual ring

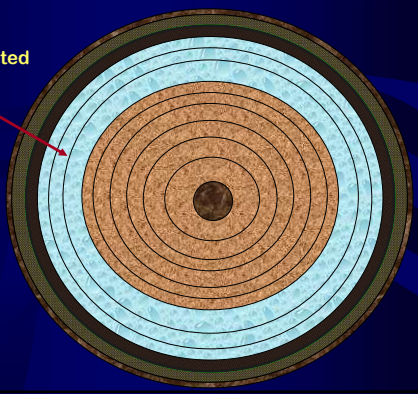


81

Diffuse Porous Trees: Birch

Tree decline and death is gradual

Water is transported through several annual rings



82

8. The vascular system of a stem does *not* include which of the following?

A. Xylem
B. Pith
C. Phloem
D. Cambium

83

9. From the center of a maple outward, which is closest to the bark?

A. Vascular cambium
B. Xylem
C. Pith
D. Phloem

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10. Which of the following are the first effects of a girdling wire or hose on the lower stem?

A. Stem dieback
B. Poor root health
C. Leaf wilting
D. Flowering

85

11. If you carved your initials (boo!) 3 feet up the trunk of a 10 foot, 10 year old beech in 1964, how high up the trunk will they be after the tree has grown 50 feet by the year 2004?

A. 53 feet
B. 3 feet
C. 50 feet
D. No way to know.

86

12. Who said: "Prune the barren branch away that bearing boughs may live?"

A. Corporal Klinger
B. William Shakespeare
C. Amy Stone
D. Admiral Stocksdale
E. Jacques le Mauvais

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13. The leaf arrangement of a maple is?

A. Opposite
B. Alternate
C. Whorled
D. Sub-Opposite

88

14. The products of photosynthesis do not include:

A. Carbon dioxide
B. Carbohydrates
C. Oxygen
D. They include all of the above.

89

15. An evergreen with two needles in a cluster must be a:

A. Fir
B. Larch
C. Pine
D. Not enough information is provided.

90

16. Photosynthesis can occur in which of the following plant parts?

A. Bark
B. Leaf
C. Needle
D. All of the above.

91

17. Which of the following is true of photosynthesis?

A. It does not occur at night.
B. One byproduct is oxygen.
C. It is greater at 95 degrees than at 75 degrees.
D. All of the above.

92

18. The pigment involved in photosynthesis is:

A. Anthocyanin
B. Carotene
C. Chlorophyll
D. Chloroform

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93

19. Who said:

"A tree's leaves
may be ever so good,
so may its bark,
so may its wood;
But unless you put
the right thing to its root,
It never will show
much flower or fruit."

94

A. Robert Frost
B. Joyce Kilmer
C. Eldon Miller
D. Martha Stewart

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95

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

- Robbins et al, *Botany*

96

"Stokes Wildflower Book"

97

"The flower is a leaf mad with love."

- Goethe

98

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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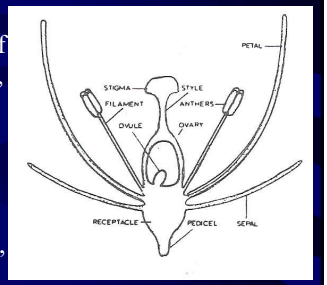
The Plant Parts – Flowers and Seeds

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.



100

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

101

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.

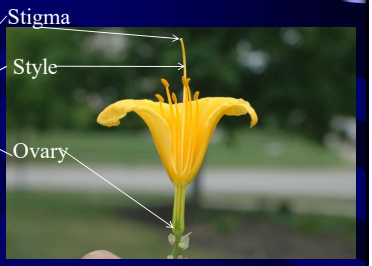


Photo Credit: Gary Gao, OSU Extension

102

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.

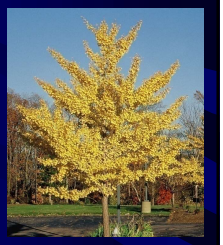

Photo Credit: OSU Extension Nursery, Landscape and Turf Team

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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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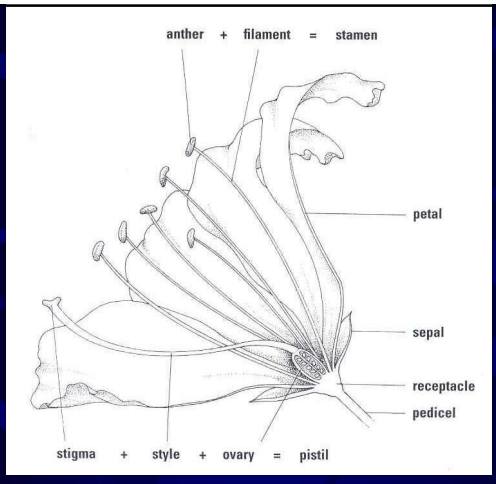

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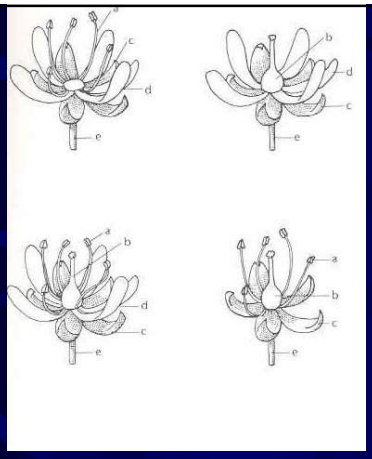


stamen (a)
pistil (b)
sepals (c)
petals (d)
peduncle (e)

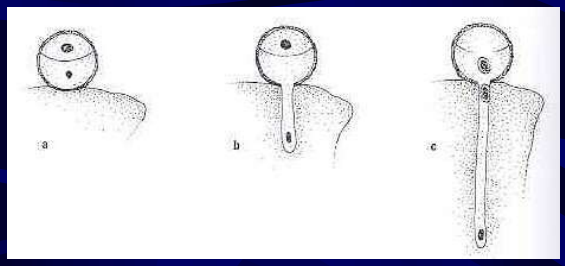
Botany Illustrated
Glimn-Lacy and Kaufman
1984

109

Botany for Gardeners, revised edition
Brian Capon, 2005

110

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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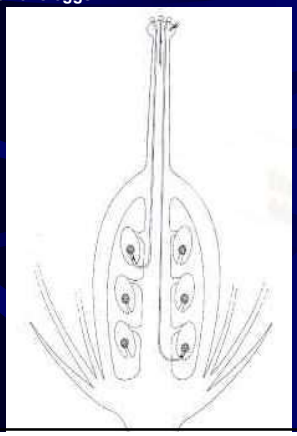
111

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
Brian Capon, 2005

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31. Crossing the pollen of 'Dolgo' crabapple and the ovules of 'Red Delicious' apple results in:

A. A sour 'Red Delicious' apple.
B. A normal 'Red Delicious' apple.
C. A larger than normal 'Dolgo' crabapple.
D. They will not cross.

113

32. Who said: "Time flies like an arrow, but fruit flies like a banana."

A. Karl Marx
B. Groucho Marx
C. Harpo Marx
D. Herman Muller

114

20. Which of the following is not a male flower part?

A. Pistil
B. Stamen
C. Pollen grain
D. Filament

115

21. Female parts of the flower include which of the following.

A. Stigma
B. Style
C. Ovary
D. All of the above

116

22. For which of the following do we eat the flower parts?

A. Broccoli
B. Brussel sprouts
C. Cabbage
D. Leaf lettuce

117

23. Ash flowers are pollinated by:

A. Bees
B. Wind
C. Hummingbirds
D. Beetles

118

24. A dioecious plant has:

A. Male and female flowers on the same plant.
B. Male flowers on one plant; female flowers on another plant.
C. Both male and female flower parts in each flower.
D. All of the above.

119

25. 'Jim Dandy' winterberry holly is recommended as a companion plant for 'Red Sprite' winterberry holly because:

A. These two hollies flower at the same time.
B. 'Jim Dandy' will deter holly leafminers.
C. One has yellow fruits; the other has red fruits.
D. All of the above.

120

26. In what play did Shakespeare intone:

"At Christmas I no more desire a rose
than wish a snow in May's new-fangled mirth;
But like of each thing that in season grows"

121

27. A tomato is a:

A. Falling object
B. Fruit ("ripened ovary")
C. Vegetable
D. All of the above.

122

28. Which of the following plants never have fruit?

A. Kentucky blue grass
B. Japanese maple
C. Dieffenbachia (dumb cane)
D. All have fruits.

123

29. To germinate a seed must have:

A. Light
B. Fertilizer
C. Stored energy
D. All of the above

124

30. Who said: "The weakest kind of fruit falls earliest to the ground."

A. Bo Schembechler
B. William Shakespeare
C. Arnold Schwarzenegger
D. General Schwarzkopf

125

31. Crossing the pollen of 'Dolgo' crabapple and the ovules of 'Red Delicious' apple results in:

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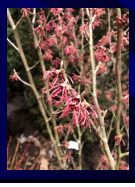
C. A larger than normal 'Dolgo' crabapple.
D. They will not cross.

126

Which Witch Is It?







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First the howling winds awoke us
Then the rains came down to soak us
Now – before the mind can focus –
Crocus.

- Lilja Rogers

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