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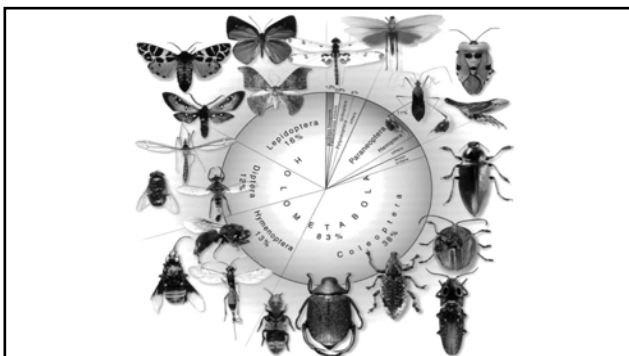
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### The Diversity of Insects

- Before diversity, there was evolution...
- ...and insects are the most diverse organisms in the history of life!
- Insects are unmatched in:
  - Longevity

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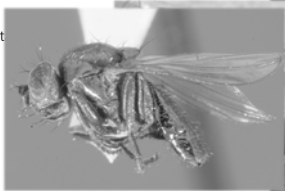

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### The Diversity of Insects

- Before diversity, there was evolution...
- ...and insects are the most diverse organisms in the history of life!
- Insects are unmatched in:
  - Longevity
  - Diversity of adaptation

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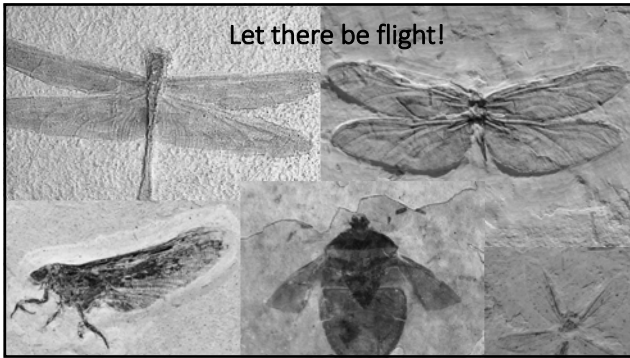
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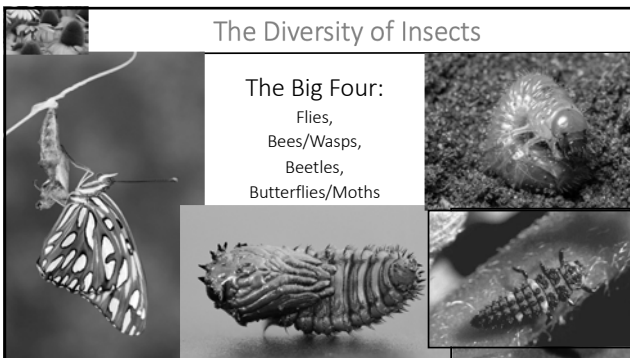
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### The Diversity of Insects

- **Phytophagous**
  - ‘Phyto’ ==plant
  - Phagous—feeding
- **Of the big four:**
  - 100,000 species of beetles feed on plants
  - 150,000 species of butterflies and moths

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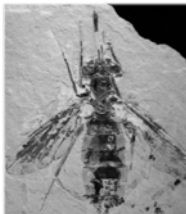
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### The Diversity of Insects

- Before diversity, there was evolution...  
...and insects are the most diverse organisms in the history of life!
- **Insects are unmatched in:**
  - Longevity
  - Diversity of adaptations
  - Biomass



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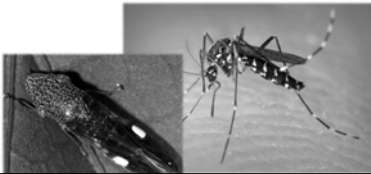
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### The Diversity of Insects

- Before diversity, there was evolution...
- ...and insects are the most diverse organisms in the history of life!
- Insects are unmatched in:
  - Longevity
  - Diversity of adaptations
  - Biomass
  - Ecological Impact



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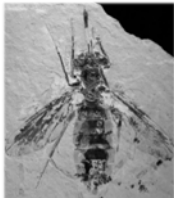
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### The Diversity of Insects

“In terms of biomass and their interactions with other terrestrial organisms, insects are the most important group of terrestrial animals.”



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### Common Insects: Dragonflies

Order: Odonata



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### Common Insects: Dragonflies

**Odonata**

- An ancient order of extant lineage
- Includes damselflies
- Incomplete metamorphosis
- Adults and larvae predaceous
- Indicators of moderate water quality



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### Common Insects: Dragonflies

**Odonata: Aeshnidae—Darners**

- Largest and most powerful group of dragonflies; up to 116 mm long;
- Green darner most common;
- Exhibit 'non-contact guarding' behavior



Common Green Darner

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### Common Insects: Dragonflies

**Odonata: Libellulidae—Skimmers**

- Largest and most powerful group of dragonflies; up to 116 mm long;
- Green darner most common;
- Exhibit 'non-contact guarding' behavior.



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### Common Insects: Dragonflies

**Odonata: Gomphidae—Clubtails**

- Robust group;
- 30-90mm in length;
- Yellowish/greenish markings;
- Distinguishable enlargement at terminal end of abdomen



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### Common Insects: Dragonflies

**Odonata: Calopterygidae**

- Relatively large group;
- *Calopteryx* and *Hetaerina* most common genera;



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### Common Insects: True Bugs

**Mantodea: Mantidae**

- Carolina Mantids
- Incomplete metamorphosis
- Usually a mottled gray/brown/green
- Adults are small ~2 inches



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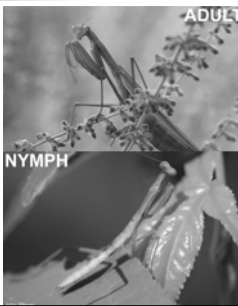
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### Common Insects: True Bugs

**Mantodea: Mantidae**

- Chinese Mantids
- Incomplete metamorphosis
- Wings extend back over abdomen
- Adults are much larger
  - Eat birds, insects, snakes, small mammals!



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### Common Insects: True Bugs

**Hemiptera: True Bugs**

- Incomplete metamorphosis
- Can be predaceous but are also pests
- Robust group!



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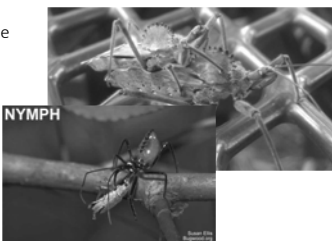
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### Common Insects: True Bugs

**Hemiptera: Reduviidae**

- Large group, ~160 spp.
- Beaks twice as thick as antennae
- Can appear spider-like
- Feed on:
  - Caterpillars
  - Other plant-feeding insects



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### Common Insects: True Bugs


**Hemiptera: Pentatomidae**

- Large group, ~200 spp.
- Spined soldier bugs
- Beaks twice as thick as antennae;
- Adults: orange-black coloration;
- Sharp 'spines' that stick out from bodies

**ADULT**



David J. Lombard  
Louisiana State Univ.  
Baton Rouge, LA  
UGA0014174



Mark Olson  
Univ. of Georgia  
Athens, GA  
UGA124209

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### Common Insects: True Bugs



Larry L. Hyatt  
Auburn University  
Baton Rouge, LA  
UGA1204049

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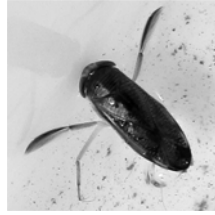
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### Common Insects: True Bugs

#### Hemiptera: Corixidae

- Water boatmen;
- Common in stream and pond edges; occasionally in brackish pools;
- Feed on algae and midge larvae.




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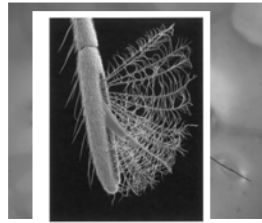
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### Common Insects: True Bugs

#### Hemiptera: Gerridae

- Water striders;
- "Skate" along the surface of the water;
- Predaceous of other insects that fall into the water




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### Common Insects: Beetles

#### Coleoptera

- The most diverse insect order
  - Over 300,000 species
- Complete metamorphosis
  - Larvae often referred to as "grubs"
  - Feed on plant roots
- Most species do not damage plants



Spotted Cucumber  
Beetle

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**Common Insects: Beetles**

**Coleoptera: Coccinellidae**

- Important predators
  - Aphids
  - Other insects
- Larvae also are predaceous




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**Common Insects: Beetles**




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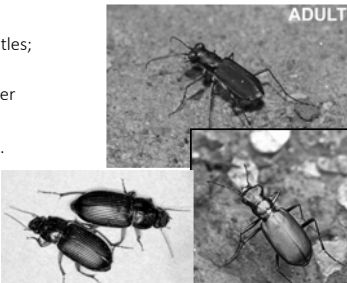
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**Common Insects: Beetles**

**Coleoptera: Carabidae**

- Ground beetles and tiger beetles; ~2,600 spp.
- Predators of weed seeds, other insects;
- Effective as biocontrol agents.




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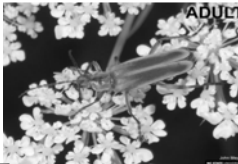
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**Common Insects: Beetles**

**Coleoptera: Cantharidae**

- Late summer/Early fall; 473 spp.
- Light colored margin around the wings
- Flattened body
- Larvae also are predaceous



ADULT



LARVA

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**Common Insects: Beetles**

**Coleoptera: Scarabaeidae**

- Scarab beetles; ~1,400 spp.
- Mostly dung-feeders; detritivores;
- Plant feeders;
- Worshipped in ancient Egyptian cultures


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**Common Insects: Beetles**

**Coleoptera: Staphylinidae**

- Rove beetles; 710 spp.
- Distinguished by shortened elytra/exposed abdomen;
- Active insects: fly and/or run;
- Mostly predaceous;




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### Common Insects: Beetles

#### Coleoptera: Passalidae

- Bess beetles;
- Detritivores, found primarily under logs and rotting wood;
- "Hiss" in order to escape predation




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### Common Insects: Flies and Mosquitoes

#### Order: Diptera

- Complete metamorphosis, larvae known as maggots;
- 2 wings; reduced hindwings (*halteres*);
- Important disease vectors (food and humans).




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### Common Insects: Flies and Mosquitoes

#### Diptera: Dolichopodidae

- Large group, ~1,300 species;
- Very long, thin legs;
- Metallic coloring;
- General predators as adults; larvae thought to be predaceous, but little known about their biology.




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**Common Insects: Flies and Mosquitoes**

**Diptera: Asilidae**

- Robber flies; ~1,000 spp.
- Very large, robust flies;
- Stubby antennae;
- "Bearded face"




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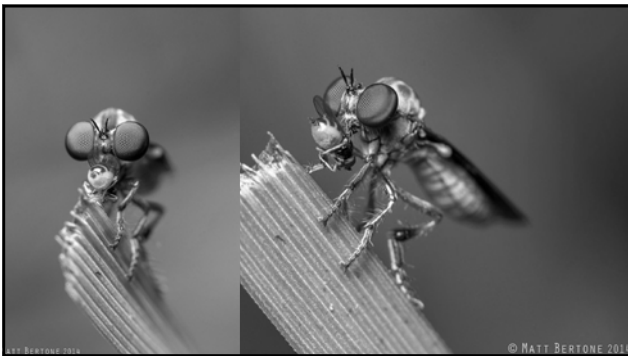
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**Common Insects: Flies and Mosquitoes**

**Diptera: Tachinidae**

- Tachinid flies; 2<sup>nd</sup> largest family, ~1,350 spp.
- Large, hairy abdomen;
- Parasites of many pests;
- May be confused with houseflies.




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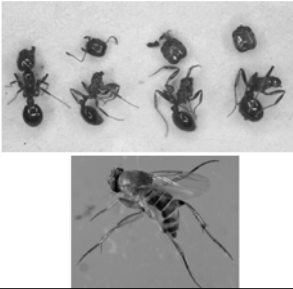
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**Common Insects: Flies and Mosquitoes**

**Diptera: Phoridae**

- Small group, ~370 spp.
- Mostly detritivores; some are parasites of other insects, or commensal




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**Common Insects: Flies and Mosquitoes**

**Diptera: Syrphidae**

- ~870 spp.
- Bee/wasp mimics;
- Pollinators as adults;
- Larvae feed on soft-bodied insects.




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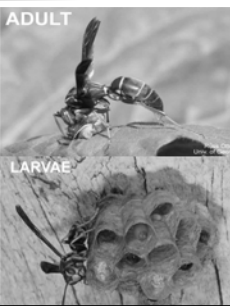
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### Common Insects: Wasps

**Hymenoptera: Vespidae**

- ~325 spp.
- Predators of caterpillars and other insect pests;
- Long gangly legs;
- Notched eyes;
- Bald or shiny appearance



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### Common Insects: Wasps

**Hymenoptera: Scoliidae**

- Robust, hairy body;
- Bright, iridescent blue;
- Orange abdomen;
- Wings have many wrinkles at the end;
- Parasites of june beetle grubs



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**Common Insects: Wasps**

**Hymenoptera: Scelionidae**

- Parasites of a large range of insect/arthropod eggs:
  - Orthoptera, Mantids, Hemiptera, Coleoptera, spiders, etc.
- Very successful as biological control agents;
- Some may be considered pests.




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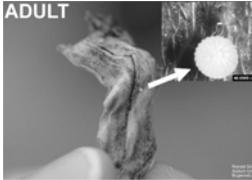
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**Common Insects: Wasps**

**Hymenoptera: Trichogrammatidae**

- Parasites of a large range of insect/arthropod eggs:
  - Orthoptera, Mantids, Hemiptera, Coleoptera, Lepidoptera.
- Most widely-used biocontrol agents; 10's of millions of acres per year




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**Common Insects: Wasps**

**Hymenoptera: Ichneumonidae**

- Largest family in all of Insecta, ~3,300 spp.
- Host range includes: flies, beetles, wasps, bees




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### Common Insects: Bees

**Hymenoptera: Apidae**

- Long-tongued bees; arguably most important in terms of angiosperm evolution and pollinator services;
- Includes honeybees, carpenter bees, cuckoo bees;
- Most exhibit eusociality.



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## BACKYARD BEES OF NORTH AMERICA









**Beyond Honeybees: Native Pollinators**

4,000+ native species

Generally more efficient at pollination; generalists

May have different preferences than honeybees

NOT Aggressive

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### Why Meadows?

#### Beyond Honeybees: Native Pollinators

Ground-dwellers—70%

Bare ground  
Abandoned nests




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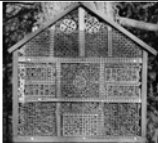
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### Why Meadows?

#### Beyond Honeybees: Native Pollinators

Cavity nesters—25-30%

Hollow/pithy stems—sumac, raspberries, milkweed  
Dead wood—holes created by borers, bee hotels




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### Common Insects: Butterflies and Moths

#### Lepidoptera: Noctuidae

- Largest family in Lepidoptera, ~2,900 species;
- Mostly nocturnal, heavy-bodied moths;
- Some fruit feeders, mostly plant feeders; some major economic pests.




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## Common Insects: Butterflies and Moths

### Lepidoptera: Saturniidae

- Largest moths in North America; up to 150mm wingspread;
- 68 North American species;
- Mostly nocturnal.




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**Common Insects: Butterflies and Moths**

**Lepidoptera: Hesperidae**

- Skippers, nearly 300 spp.;
- Feed inside sheltered cocoons as larvae;
- Many larvae overwinter and emerge in spring as adults.




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**Common Insects: Butterflies and Moths**

**Lepidoptera: Hesperidae**

- *Papilioninae*: Swallowtails
- Includes some of the largest, and most colorful species in this order.




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**Common Insects: Butterflies and Moths**

**Lepidoptera: Nymphalidae**

- ~210 spp.
- Brush-footed butterflies;
- Many beautiful and ornamental species, including:
  - Monarch butterfly
  - Great spangled fritillary
  - Red admirable
  - Zebra butterfly




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### Tying it All Together

**Diverse landscapes:**

- Add complexity to food webs
- Support higher species richness
- Afford more stability
- Prevent pest outbreaks
- Attracts and conserves wildlife species



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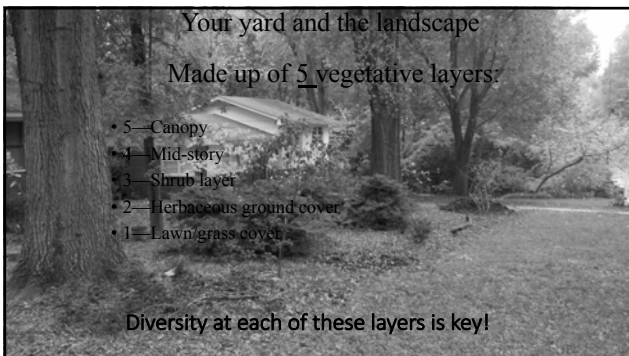
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### Native Groundcovers

**Bee Balm (*Monarda fistulosa*)**

- Perennial; 3'X4'
- Summer flowers
- Clay, dry soils
- Tolerates drought
- Full sun



2010 © Peter M. Cook

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### Native Groundcovers

**Bee Balm (*Monarda didyma*)**

- Perennial; 3'X4'
- Summer flowers
- Clay, dry soils
- Tolerates drought
- Full sun



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### Native Groundcovers

**Anise hyssop (*Agastache foeniculum*)**

- Perennial; 3'X3'
- Summer flowers
- Average, well-drained soils
- Tolerates drought
- Full sun; pt. shade
- Bees, bees, bees!



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### Native Groundcovers

**Mountain mint (*Pycnanthemum* sp.)**

- Several species available
- Summer flowers
- Drought tolerant (shade)

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### Native Groundcovers

**Goldenrod (*Solidago* sp.)**

- Perennial;
- Fall blooming;
- Wide range of conditions;
- Full sun;
- Look for colors throughout the fall:
  - *S. graminifolia*—late summer
  - *S. rugosa* 'Fireworks'—early fall
  - *S. speciosa*—Summer—fall
  - *S. gigantea*—late fall



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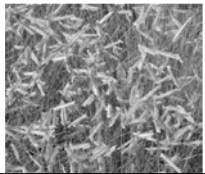

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### Native Groundcovers

**Blue grama grass (*Bouteloua gracilis*)**

- Clumping grass <8" tall; 1' seed heads
- Full sun/drought tolerant
- Can be mowed—low maintenance turf alternative

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### Native Groundcovers

**Joe Pye Weed (*Eutrochium* sp.)**

- Several species available
- Summer—early Fall flowers
- Fertile soils;
- Moisture;
- Pt. shade-sun



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### Native Groundcovers

**Indigo (*Baptisia alba* or *B. australis*)**

- Perennial shrub;
- Late spring—summer blooms; purple or white
- Full sun—shade
- Member of the 'bean' family—fixes nitrogen

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### Native Groundcovers

**Indian Pink (*Spigelia marilandica*)**

- Late spring;
- 1.5' X 1'
- Pt. —full shade;
- Rich, humusy soils (think forest understory)



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### Native Groundcovers

**Ferns (Various species)**

- Part-shade—shade
- Average soils; dry—moist
- Some evergreen

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**Your yard and the landscape**

Made up of 5 vegetative layers:

- 3 — Shrub Layer

**Remember: Diversity at each of these layers is key!**

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### Native Shrubs

**Buttonbush (*Cephalanthus occidentalis*)**

- Deciduous shrub
- Blooms June—August
- Moist soils; wet woods, marshes, pond edges
- Most soil types
- Supports bees and songbirds;



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### Native Shrubs

**Spicebush (*Lindera benzoin*)**

- Deciduous shrub—3-9' tall
- Strongly aromatic
- Spring flowers
- Red berries—early fall
- Stream margins
- Host plant for spicebush swallowtail



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### Native Shrubs

**Spicebush (*Lindera benzoin*)**

- Deciduous shrub—3-9' tall
- Strongly aromatic
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- Stream margins
- Host plant for spicebush swallowtail



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### Native Shrubs

**Virginia Sweetspire (*Itea virginica*)**

- Perennial shrub;
- Full sun-to part shade
- Low maintenance once established
- Most soil types



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### Native Shrubs

**Muhlenbergia capillaris (pink muhly grass)**

**Oakleaf Hydrangea (*Hydrangea quercifolia*)**

- Southeastern U.S. native
- Large shrub up to 6' tall
- Shady sites; well-drained to moist soils
- Beautiful fall color



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### Native Shrubs

**Muhlenbergia capillaris**  
(pink muhly grass)

**Oakleaf Hydrangea (*Hydrangea quercifolia*)**

- Southeastern U.S. native
- Large shrub up to 6' tall
- Shady sites; well-drained to moist soils
- Beautiful fall color



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### Native Shrubs

**Blue Star (*Amsonia* sp.)**

- Perennial
- Full sun-to part shade
- Low maintenance once established
- Most soil types
- Interesting foliage; many varieties!



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### Native Shrubs

**Switchgrass (*Panicum virgatum*)**

- Perennial; clumping/upright
- Full sun
- Dry conditions

Credit: Northcreek Nursery

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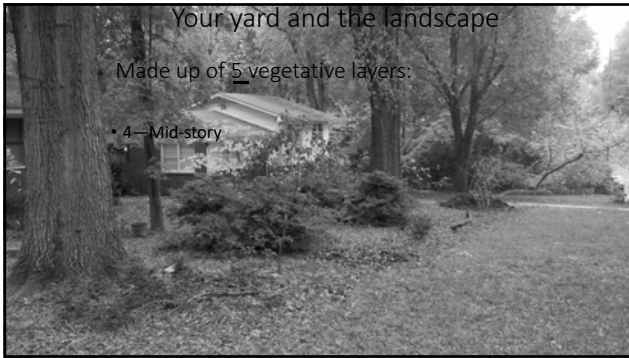
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### Mid-story Trees

**Fringe-tree (*Chionanthus virginicus*)**

- Tall shrub/small tree—20' tall
- March/April flowers—fragrant
- Full sun—part shade
- Dry woodlands/savannahs






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### Mid-story Trees

**Witch Hazel (*Hamamelis virginiana*)**

- Deciduous tree
- 10-20' tall
- Flowers in the fall
- Medium water; low maintenance
- Sun—part shade; moist to well-drained soils; rain gardens



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### Mid-story Trees

**Red buckeye (*Aesculus pavia*)**

- Deciduous tree
- 20' tall
- Red flowers in spring
- Sun—part shade
- Moist, well-drained soils



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Your yard and the landscape  
Made up of 5 vegetative layers:

- 5—Canopy

Diversity at each of these layers is key!

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### Canopy Trees

**Ironwood, American Hornbeam (*Carpinus caroliniana*)**

- Deciduous tree
- Up to 35'
- Moist, shady areas; well-drained
- Typically found with:
  - American beech
  - Chestnut Oak
  - Red maples
  - Ash
  - Hickory



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### Canopy Trees

**Black gum (*Nyssa sylvatica*)**

- Deciduous tree
- 80-100'
- Moist, well-drained soils
- Full sun—part shade

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### Your yard and the landscape

Made up of 5 vegetative layers

**The Shotgun Approach: Oak trees**

- Support over 300 species of lepidopterans
  - 4—Mid-story
- Insectivorous birds—350-570 caterpillars/day

each of these layers is key!

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