### Life Cycle of Woody Plants

- **Seedling**
  - Exponential growth rate, emphasis on root establishment and competition for sunlight
- **Youth**
  - Rapid growth, little flowering, immature morphology, few years to decades
- **Maturity**
  - Emphasis on seed production, more spreading habit, slower growth rate, few to thousands of years
- **Senescence**
  - Dieback, declining vigor, few to many years
- **Death**
  - Ceasing of life functions, collapse and decay

### Genetic Variation

- **Genotype × environment interaction**
  - Genotype sets potential for traits, environment modifies expression
  - Test by removing genotype from its ecological community
  - Relative competitiveness of given genotype may change with different environment
- **Sources of genetic variation**
  - Mutations, genetic segregation, & recombination
  - With environmental selection get evolution
  - Intervention by people results in cultivars
- **Intrinsic Variation** = within the species
- **Extrinsic Variation** = outside the species
**Example: Sequoia sempervivens**

Note the wide variation in growth habit, size, and foliage characteristics present within *S. sempervirens*

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**Intrinsic Variation With A Species**

- Ecophenic = Non-genetic
  - Phenotypic plasticity
    - Response to environment not under direct genetic control
    - Sun versus shade leaves
    - Smaller fruit on dry site
  - Not heritable
  - Reciprocal transplant studies
    - Is trait stable in different environments?
    - Ecotype versus Ecophene

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**Genetic Variation**

- **Heteroblastic Change**
  - Epigenetic changes
  - Juvenile to mature phase change
  - Seasonal heteromorphism

- **Mutations**
  - Alterations in genetic code

- **Chromosomal Variations**
  - Haploid, aneuploidy, polyploidy

- **Non-adaptive Variation**
  - Not associated with environmental factor

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**Genetic Variation**

- Ecotypic (adaptive) variation
  - Ecological Race
    - In response to environment, often discontinuous (Lost Pines)
  - Cline
    - Like ecotypic, but environmental gradient response (Red Maple)
  - Speciation
    - Result of ecotypic variation and/or isolation over time (Escarpment Live Oak)
Genetic Variation

• Reproductive variation
  – Outcrossing = xenogamy
  • Monoecious versus dioecious
  – Inbreeding = autogamy
  – Apomixis
    • Vegetative apomixis = vegetative reproduction
      – Example: Populus nigra ‘Italica’
    • Agamospermy = asexual seed formation

Genetic Variation

• Extrinsic Variation
  – Intergeneric and intrageneric hybrids
    • F₁ generation intermediate
    • F₂ segregates on wide continuum
  – Introgression
    • Repeated back-crossing to parental species
    • Hybrid swarms - gradient of characters
    • Transfers genes among species
  – Gene transfer (genetic engineering)

Questions / Comments?
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