EVOLUTION

Process that results in genetic change (gene frequencies) over time and space

- **gene frequencies in populations**
- **explains differences among**
  - **existing population (space)**
  - **lineages of populations (time)**

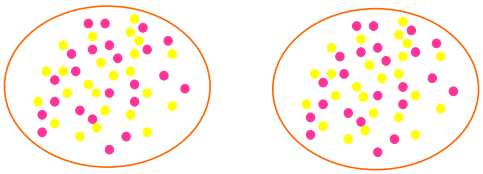
What are the mechanisms (processes) of evolution?

- **mutation**
- **migration**
- **chance**
- **natural selection**

But what about SEXUAL REPRODUCTION?

no change in time or space

SIGNIFICANCE?



Time 1 **Time 2**

within population variation

Evolutionary Mechanisms

- **Mutation**

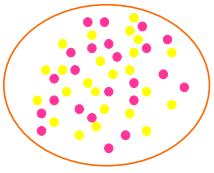
Mutations affecting tree form

Lombardy poplar:
Populus nigra var. italica

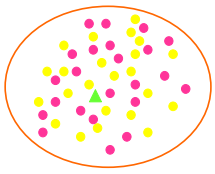
weeping willow:
Salix babylonica

MUTATION

SIGNIFICANCE?



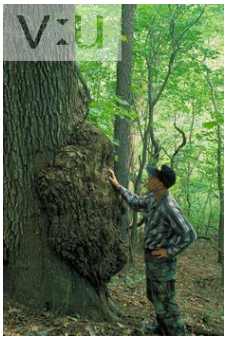
Time 1



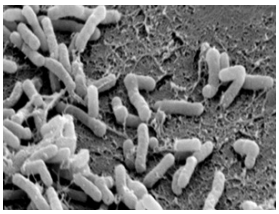
Time 2

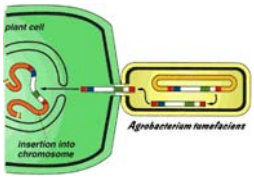
ultimate source of variation

How are poplars genetically modified?

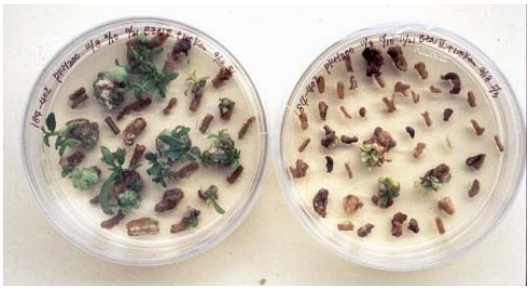


Agrobacterium tumefaciens





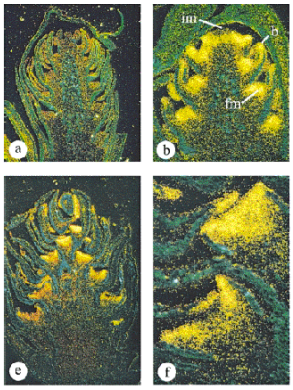
Transgenic manipulations



gene insertion through *Agrobacterium tumefaciens*

transgenic insertion: antiherbivory

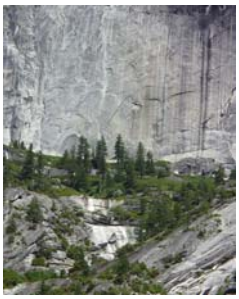
transgenic insertion: herbicide resistance



location of action of gene to prevent flowering

(goal: hybrid sterility will prevent spread of transgenic insertions)

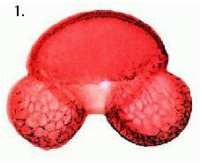
Evolutionary Mechanisms

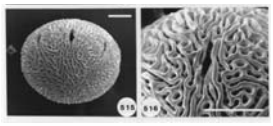


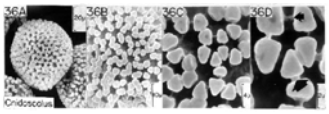
- Mutation
- **Migration**

SEEDS CARRY GENES

POLLEN GRAINS CARRY GENES

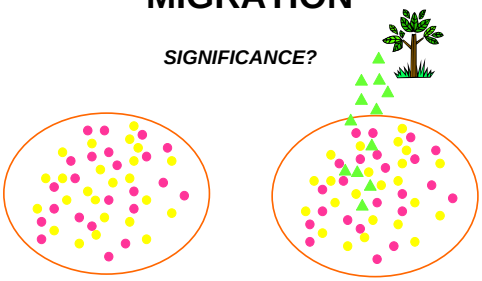






MIGRATION

SIGNIFICANCE?



Time 1 **Time 2**

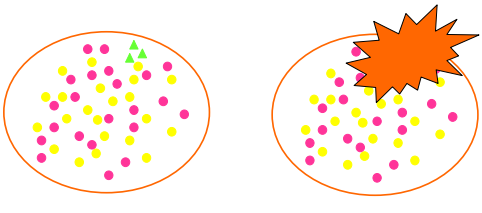
adds new genes (or source of stabilization)

Evolutionary Mechanisms

- Mutation
- Migration
- **Chance**

CHANCE EVENTS

SIGNIFICANCE?

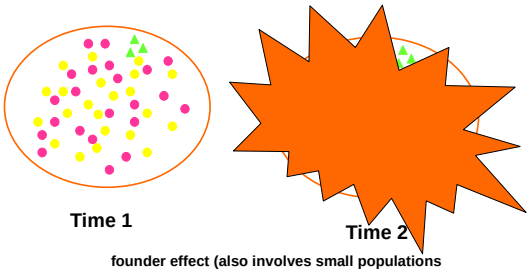


Time 1 **Time 2**

genetic drift (important in small populations)

CHANCE EVENTS

SIGNIFICANCE?



Time 1 **Time 2**

founder effect (also involves small populations

Evolutionary Mechanisms

- Mutation
- Migration
- Chance
- **Natural Selection (environment)**

SNOW

Chamaecyparis nootkatensis

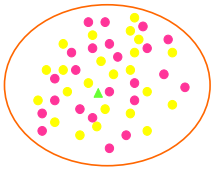
Abies lasiocarpa

Thick bark

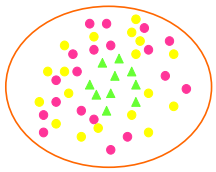
Serotinous cones

Root sprout

NATURAL SELECTION



Time 1



Time 2

SIGNIFICANCE?

ADAPTATION

genetically determined traits that convey advantage for survival and reproduction in a particular environment

SPECIATION (later)

Application of evolutionary mechanisms in restoration, conservation, preservation, forestry, agriculture:

Much debate, disagreement (but all are considered):

- **Mutation**: "transgenic engineering"
- **Founder effect, genetic drift**: size of seed-source population, local population sizes, crop "ancestors"
- **Gene migration:** "genetic swamping, genetic escapes"
- **Adaptation:** location, site conditions of seed sources
- **Natural selection:** selective breeding, screening, response to climate change, pollution, etc.