

## **SPECIATION-Origin of Species**

### **SPECIATION**

Origin of new species

### **SPECIES – BIOLOGICAL CONCEPT**

Population or groups of populations whose members have the potential to interbreed and produce fertile offspring

### **REPRODUCTIVE BARRIERS**

#### **PREZYGOTIC:**

Barriers that prevent fertilization

#### Habitat isolation

Populations can't get together

#### Behavior isolation

Different mating behavior

#### Temporal isolation

Breed or flower at different times

#### Mechanical isolation

Different anatomical structures

#### Gametic isolation

Gametes fail to fuse; don't recognize each other

#### **POSTZYGOTIC:**

Barriers that prevent the zygote from developing into fertile offspring

Reduced hybrid viability

Zygote fails to develop or reach sexual maturity

Reduced hybrid fertility

Hybrid sterile

Hybrid breakdown

Hybrid produces offspring but offspring not viable or not fertile

**MODES OF SPECIATION**

<b>ALLOPATRIC</b>	<b>SYMPATRIC</b>
<ul style="list-style-type: none"><li>○ Populations segregated by geographic barrier</li><li>○ Geographic barrier = ocean, mtn. Range, etc.</li><li>○ Conditions favoring<ul style="list-style-type: none"><li>▪ Small population at fringe</li><li>▪ Better chance gene pool already different</li><li>▪ Different selection factors</li></ul></li><li>○ Adaptive radiation - emergence of numerous species from common ancestor introduced into environment</li></ul>	<ul style="list-style-type: none"><li>• New species arise within range of parent species</li><li>• Reproductive isolation without geographic barrier</li><li>• How<ul style="list-style-type: none"><li>○ Plants - polyploidy (multiple sets of chromosomes)</li><li>○ Animals - group fixed on resources not used by parent population</li></ul></li></ul>

**GENETIC CHANGE**

1. Adaptive divergence

- 2 parts of population adapt to different environments
- Each accumulates different gene pools

2. Reproductive barriers develop

- Usually secondary to change in gene pool
- May be side effect of sexual selection

## TEMPO OF SPECIATION

GRADUALISM	PUNCTUATED EQUILIBRIUM
<ul style="list-style-type: none"><li>• 1 species gradually evolves into new species</li><li>• Represents microevolution</li><li>• Big changes occur through the accumulation of small changes</li></ul>	<ul style="list-style-type: none"><li>• Long periods of stasis (equilibrium) punctuated by episodes of speciation</li><li>• Species undergo most changes when first branch from parent; then change little</li><li>• Species develop in spurts of rapid change</li><li>• Not slow and gradual</li></ul>

## EVOLUTIONARY NOVELTIES

- Defines taxonomic groups
- Examples
  - Wings in birds
  - Amniotic egg in reptiles
  - Jaws in osteichthyes
- Evolve by gradual changes in existing structures
- Existing structures co-opted to perform different functions
- Genes that control development
  - Play major role in development of evolutionary novelty
  - Change rate or sequence of development
  - Change shape of adult form or basic body design
- Macroevolution
  - Development of taxonomic groups higher than species
  - Species selection (species that endure the longest and produce the greatest number of new species determined direction of evolutionary trend)

**QUESTIONS:**

1. What happens during the process of speciation?

\_\_\_\_\_

2. List the two patterns of speciation and describe each type.

<b>PATTERN</b>	<b>DESCRIPTION</b>

**24.1**

3. Use the biological species concept to define *species*.

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\_\_\_\_\_

4. What is required for the formation of new species?

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\_\_\_\_\_

5. What are *hybrids*?

\_\_\_\_\_

6. How are prezygotic reproductive barriers different from postzygotic barriers?

<b>Prezygotic Barriers</b>	<b>Postzygotic Barriers</b>

7. Use the key below to identify the type of reproductive barrier being described.
- A. Habitat isolation      B. Temporal isolation      C. Behavioral isolation  
 D. Mechanical isolation      E. Gametic isolation

- \_\_\_\_\_ Gametes fail to fuse  
 \_\_\_\_\_ Egg & sperm don't recognize each other  
 \_\_\_\_\_ Differences in sexual or anatomical structures  
 \_\_\_\_\_ Mating dance of a male not recognized by female  
 \_\_\_\_\_ Different mating seasons within the population  
 \_\_\_\_\_ Members of population separated by a mountain range  
 \_\_\_\_\_ Male flowers of some members of a plant species produce pollen before most of the female flowers are open  
 \_\_\_\_\_ Variation in mating ritual not recognized by female  
 \_\_\_\_\_ Male reproductive organs in insect populations vary enormously in size and shape, preventing the effective transfer of sperm to females of different species  
 \_\_\_\_\_ Structure of flower restricts access of insects without specific physical and behavioral adaptations

5. Match the type of postzygotic barrier with the correct description.

- A. Hybrid Breakdown      B. Hybrid Inviability      C. Hybrid Sterility

- \_\_\_\_\_ Zygote fails to develop; zygote fails to reach sexual maturity  
 \_\_\_\_\_ Hybrid fails to produce functional gametes  
 \_\_\_\_\_ Offspring not viable or infertile; offspring of hybrid have reduced viability or fertility

6. Identify the type of reproductive barrier illustrated by the following examples and indicate whether they are pre- or postzygotic barriers.

EXAMPLE	TYPE OF BARRIER	PRE- OR POST-
Two species of frogs are mated in the lab and produce viable, but sterile, offspring		
Two species of sea urchin release their gametes at the same time, but cross-specific fertilization does not occur		
Two species of orchid have different length nectar tubes and are pollinated by different species of moths		
Two species of mayflies emerge during different weeks in springtime		

EXAMPLE	TYPE OF BARRIER	PRE- OR POST-
Two species of salamanders will mate in the lab and produce viable, fertile offspring, but offspring of these hybrids are sterile		
Two similar species of birds have different mating rituals		
When two species of mice are bred in the lab, embryos usually abort		
Peepers breed in woodland ponds, whereas leopard frogs breed in swamps		

7. The result of a cross between a donkey and a horse is a mule. Mules are usually sterile.

a. What type of reproductive barrier does this represent? How do you know?

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b. Based on these results, would you say that the donkey and horse belong to the same species or to different species? Explain your answer.

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8. What are the limitations of the biological concept of a species?

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9. Match the species concept with the correct description.

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|------------------|-----------------|
| A. Biological    | B. Cohesion     |
| C. Ecological    | D. Evolutionary |
| E. Morphological | F. Recognition  |

\_\_\_\_\_ Defines species on the basis of the ecological role they play and the specific environment in which they live

- \_\_\_\_\_ Population or group of populations whose members have the potential to interbreed and produce fertile offspring
- \_\_\_\_\_ Focuses on adaptations that maximize successful mating within a species that enable individuals to recognize a mate and that can be acted on by natural selection
- \_\_\_\_\_ Based on measurable physical features; used by taxonomists
- \_\_\_\_\_ Emphasizes adaptations that maintain a species identity despite occasional hybridization with another species
- \_\_\_\_\_ Defines species in terms of evolutionary lineage and ecological role; populations making up a species are subject to and united by a unique set of selection pressures

**24.2**

10. Two groups of a population are isolated reproductively. What will probably happen over time provided these groups remain isolated from each other?

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11. Match the term with the correct definition.

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|-----------------------|--------------------------|
| A. Adaptive radiation | B. Allopatric speciation |
| C. Endemic species    | D. Sympatric speciation  |

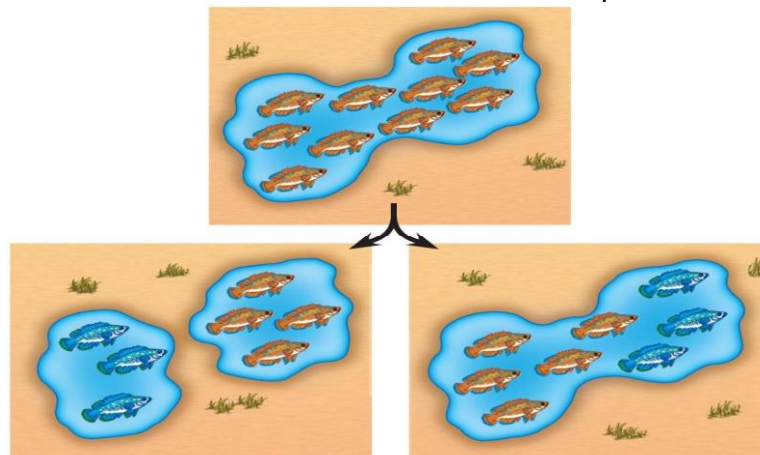
- \_\_\_\_\_ New species arise when a population is segregated by geographic barrier
- \_\_\_\_\_ Emergence of numerous species from a common ancestor that spreads into a new environment
- \_\_\_\_\_ New species arise within the range of the parent population
- \_\_\_\_\_ Species found nowhere else on Earth

12. Why is the most favorable condition for allopatric speciation a small population at the fringe of the parent population?

\_\_\_\_\_

\_\_\_\_\_

13. Gene flow can be interrupted in two main ways. Explain and give an example of each by labeling and annotating this figure, which shows an ancestral species of fish and then the two modes of speciation.



14. What type of speciation is caused by a barrier such as the Grand Canyon?

\_\_\_\_\_.

15. Explain how polyploidy could result in sympatric speciation.

\_\_\_\_\_  
\_\_\_\_\_

16. Explain how balanced polymorphism could result in sympatric speciation.

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\_\_\_\_\_

17. What factors have contributed to the adaptive radiation of the thousands of endemic species on the Hawaiian Archipelago?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

18. How is autopolyploidy different from allopolyploidy?

<b>AUTOPOLYPLOIDY</b>	<b>ALLOPOLYPLOIDY</b>

19. A new plant species B forms by autopolyploidy from species A which had a chromosome number of  $2n = 10$ . How many chromosomes would species B have?

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20. If species A ( $2n = 10$ ) were to hybridize by allopolyploidy with species C ( $2n = 14$ ) and produce a new, fertile species, D, how many chromosomes would species D have?

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21. Why might sexual selection lead indirectly to reproductive isolation?

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22. Why is reproductive isolation so important in the process of speciation?

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23. What could happen if two related populations that have been allopatric for some time come back together?

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**24.3**

24. What is a hybrid zone?

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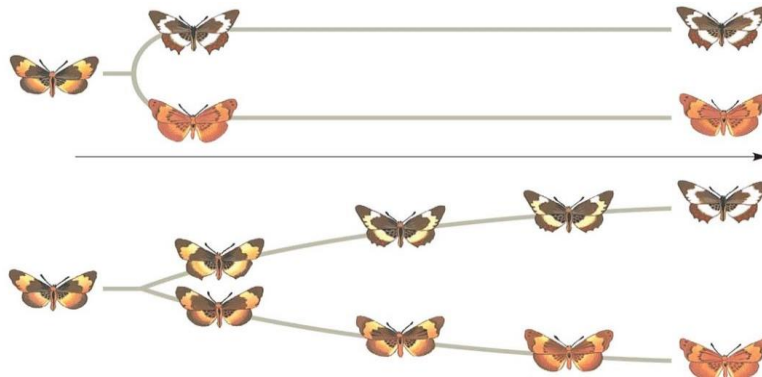
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**24.4**

25. Indicate if each of the following statements is true of **G**radualism or **P**unctuated Equilibrium.

- \_\_\_\_\_ Gradual divergence of a species from the ancestral form
- \_\_\_\_\_ Most change occurred when species branched from ancestral form
- \_\_\_\_\_ Long periods of stasis punctuated by episodes of speciation
- \_\_\_\_\_ Darwinism
- \_\_\_\_\_ Evolution occurred in spurts of rapid change
- \_\_\_\_\_ Big changes occur from the accumulation of many small ones

17. This figure shows 2 different views of speciation. Label this figure, and explain how each of the pictures explains speciation.



26. Describe what happens during species selection.

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**End of Chapter Synthesis and Evaluation Problems**

1. Answer questions 1-7, 11. Then check and correct your answers to 1-7 in the back of text.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_

\*\*\*Question #11 should be typed out, then answered in no more and no less than 100 to 150 words. Turn in separately to the tray. This is worth **20 points!** Do not plagiarize. Use your own words and thoughts...but, use vocabulary terms and ideas taught in this chapter!

**Study Guide/ISN (20 points)**

In your study guide book, review pages 159 to 161. In your ISN, title a page as follows: **Chapter 24 The Origin of Species Must Know!** In one color, copy down must know items listed below leaving space underneath to include in a different color a brief description, diagram, model, or mnemonic device that will help you study for the unit test and more importantly the AP Test in May.

**Bozeman Science/ AP Biology/ISN (See Syllabus for format) (20 points each)**

- 1. Speciation and extinction (Big Idea 1)
- 2. Speciation (Big Idea 1)
- 3. Analysis and evaluation of evidence (AP Biology Practices)