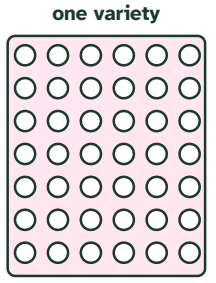
AP BIOLOGY | UNIT 8 | TOPICS 8.6 AND 8.7 | REVISION ON TWO PAGES

Diversity, and what *disrupts* it

What to know, what to draw and what to say. Nothing else.

THE ONE IDEA

An ecosystem with more parts, and more variety among them, keeps its structure through change. Mutation, invaders, people and the planet keep changing it.



every plant alike: **all lost**

some varieties resist: **three strips survive**

Same disease, two fields. Near clones share one weakness; a mix of varieties does not.

8.6.A START HERE

Fewer parts, less *resilience*

- An ecosystem's **parts** are its species, the variety within each species, and its abiotic factors.
- **Resilience**: keeping its structure through a change in the environment, or returning to it afterward. It does not mean nothing changes.
- Ecosystems, natural or artificial, with **fewer parts and little diversity among them** are **often** less resilient: one change can hit every part the same way.
- **Example:** Irish potatoes in 1845 were mostly one variety, grown from tubers, so blight ruined the crop year after year; about a million people died.

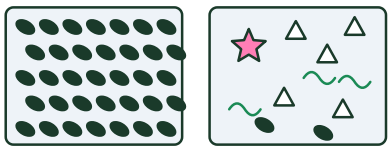
WHAT MAINTAINS DIVERSITY — *Plants And Bees Keep*

P Producers the food, often the habitat	**A** Abiotic water, light, nutrients	**B** Biotic pollinators, decomposers	**K** Keystone far beyond its numbers

8.6.A 8.6.B RARE BUT VITAL

Keystone species

- A **keystone species** has an effect on its ecosystem **far out of proportion to its abundance**. Remove it and the ecosystem often collapses.
- **Paine, from 1963:** he kept the sea star *Pisaster* off one strip of shore. Mussels, the strongest competitors for space, took over.
- **Sea otters** too: where they were hunted out, urchins grazed the kelp forests to bare rock.
- It can be a predator, a herbivore, a plant or a habitat builder.



sea star removed — control

8.6.B FOLLOW THE CHAIN

Add or remove a *part*

- Any part added or removed **changes the structure** of the ecosystem.
- **Short term:** what it ate and what ate it change first. **Long term:** species further along the web, and the habitat itself.
- **Predict as a chain:** the direct effect, then each knock-on effect, every link with a "because".

WHEN	BEAVERS RETURN
Months	Willows and aspens are cut for dams.
A year	The stream backs up into a pond.
Years	Still-water animals move in; ground becomes wetland.

8.7.A THEN SELECTION

The variety comes *first*

- **Mutations are random**: not directed by what the environment needs. The environment then **selects** among the variants already there.
- An **adaptation** is a genetic variation favored by selection, shown as a trait that helps **in a particular environment**.
- **Heterozygote advantage**: the heterozygote has a higher relative fitness than either homozygote, so both alleles stay.

0.90	**1.00**	**0.20**
two normal alleles	one of each	two sickle cell alleles

Relative fitness where malaria is common: each survival count ÷ the highest (invented numbers).

8.7.A HETEROZYGOTE ADVANTAGE

Sickle cell and *malaria*, an example to reason with

- One sickle cell allele and one normal allele protect against **severe malaria**. Two sickle cell alleles cause **sickle cell disease**.
- So where malaria is common the heterozygote leaves the most offspring.

With malaria the heterozygote is fittest
Selection keeps both alleles in the population.

Malaria gone no advantage left
The allele slowly falls: most copies sit in healthy heterozygotes, out of selection's reach.

Invaders, people and a *moving planet*

8.7.B TWO ROUTES

Invasive species

- An **invasive species**, introduced by people, spreads and changes its new ecosystem; most introduced species never do. Either way it goes, **diversity often falls**.

ROUTE 1
A niche free of enemies
Kudzu, a vine from East Asia, left its insects and fungi at home; it now covers trees in the Southeast.

ROUTE 2
Outcompetes the natives
Zebra mussels, carried from Europe in ballast water, filter out the plankton native mussels need.

8.7.B REJECT, OR FAIL TO REJECT

Testing a *claim*

- A decline after an arrival is not proof: compare plots **with and without** the invader.
- **Null hypothesis:** the vine makes no difference. 60 snails: 21 in vine plots, 39 in the others; 30 and 30 expected.
- $\chi^2 = 81 \div 30 + 81 \div 30 = \mathbf{5.4}$, above the critical value of 3.84 (1 degree of freedom, p = 0.05): **reject the null**. It is unlikely to be chance, but it does not prove the vine is the cause.

8.7.C EUTROPHICATION, THEN BIOMAGNIFICATION

People: *too much food*, and a poison that climbs

- Human impact **accelerates change**, locally and globally, and drives extinctions. Both processes start with something people add.

1 **Nutrients in** Nitrate, phosphate from fertilizer.

2 **Bloom** The algae multiply.

3 **Shade** Plants below die.

4 **Death** Algae die and sink.

5 **Decomposers** Respire the oxygen away.

6 **Fish die** Too little oxygen.

- A substance **not broken down or excreted**, stored in fat, becomes **more concentrated at each trophic level**: each eater keeps what was in all its prey.
- DDT thinned eagles' eggshells; the United States banned it for general use in 1972.



water 0.00005 ppm · plankton · small fish · larger fish · cormorant 26.4 ppm

8.7.D THEY CHANGE HABITATS AND WHERE ECOSYSTEMS ARE FOUND

A planet that *moves*: geological and meteorological events

EVENT	TIME SCALE	WHAT IT DOES TO HABITATS
Continental drift	Tens of millions of years	Carries whole ecosystems: the same land fossils lie on continents now apart.
Climate change	Decades	Ranges move toward the poles and uphill.
El Niño	Months	Trade winds weaken; upwelling off Peru fails; plankton, anchovies and seabirds fall.
Meteor impact	A day	Chicxulub, about 66 million years ago, left an iridium layer worldwide.

Biogeography, where species live and lived, is the evidence.

Slowest first: *Drifting Climates Even Meteors*

WATCH OUT

Six mistakes that *cost points*

- ✕ **Mutations are not made to order.** Selection acts on them.
- ✕ **Keystone is not "top predator".** It is an effect beyond its numbers.
- ✕ **The sickle cell allele is not harmless.** Two copies cause the disease.
- ✕ **Decomposers use up the oxygen.** Living algae make it.
- ✕ **Introduced is not invasive.** Most never spread.
- ✕ **Resilient is not unchanged.** It keeps, or gets back, its structure.

COVER THE SHEET

Can you *answer these?*

1. Describe what makes an ecosystem resilient.
2. Explain why a rare sea star can be a keystone species.
3. Predict the effects of removing a predator.
4. Calculate relative fitness for 450, 500 and 100 survivors.
5. Explain why fish die in a eutrophic lake.
6. Explain why a top predator holds the most DDT.
7. Identify the two routes by which an invader spreads.
8. Justify drift from fossils of one land animal.

IN THE EXAM

Name the cause, then the chain: nutrients, bloom, death, decomposers, low oxygen. With data, state the null, compare χ^2 with the critical value, then reject or fail to reject.

GO FURTHER

Animated figures, a dry lab and a marked Check are in the full guide online.