

::: FIELD ASSIGNMENT • DETECTIVE WORK

The Casebook

Apply the criteria. Analyze the evidence. Make the call.

AGENT (STUDENT)

PERIOD

CASE DATE

:::PART A Make the Call — Theory, Law, or Hypothesis?

For each Field Log case below, use what the tutorial taught about natural selection, extinction, and the limits on adaptation to make the call, then briefly justify it.

:: CASE FILE 001

"On a sandy beach, a population of mice varies in coat color. A new predatory bird arrives. Over several generations the population becomes mostly light-colored. Which statement best explains how this happened by natural selection?"

THE DARK MICE SENSED THE DANGER AND CHANGED THEIR FUR TO LIGHT SO THEY WOULD SURVIVE

✓ VARIATION IN COAT COLOR ALREADY EXISTED; THE BIRD CAUGHT MORE DARK MICE, SO LIGHT MICE SURVIVED AND REPRODUCED AND PASSED ON THE TRAIT, AND THE POPULATION EVOLVED

ALL THE MICE MUTATED TO LIGHT FUR AT THE SAME TIME ONCE THE BIRD APPEARED

THE MICE DECIDED AS A GROUP TO ADAPT TO THE NEW PREDATOR

ANSWER KEY Natural selection acts on variation that is already present. Dark mice stood out against the sand and were caught more often, so light mice had better survival, reproduced, and passed coat color to their offspring - shifting the population toward light coats over generations. The population did not decide to change and the mice did not mutate on demand; it evolved because some traits survived better than others.

:: CASE FILE 002

"Hawaiian honeycreepers went extinct when a strain of bird malaria arrived and every individual was equally susceptible - no bird carried a resistance trait. Which limit on adaptation does this show?"

NOT ENOUGH TIME - THE DISEASE SPREAD FASTER THAN THEY COULD ADAPT

THE TRAIT WAS NOT POSSIBLE - BIRDS CANNOT EVOLVE DISEASE RESISTANCE AT ALL

✓ NOT ENOUGH VARIATION - WITH NO DIFFERENCES IN RESISTANCE, NATURAL SELECTION HAD NOTHING TO ACT ON

TOO MUCH VARIATION - THE BIRDS WERE TOO DIFFERENT FROM ONE ANOTHER

ANSWER KEY Natural selection can only work when individuals differ in a trait. Because every honeycreeper was equally susceptible to the malaria, there was no resistant variant for selection to favor, so the population could not adapt and went extinct. This is the 'not enough variation' limit, distinct from 'not enough time' and from a trait being physically impossible to build.

:: CASE FILE 003

"Many cacti have a tough outer layer that holds water. Which statement describes how cacti most likely evolved that feature via natural selection in response to a drier climate?"

CACTI WERE STRESSED BY DRYNESS, SO EACH PLANT GREW A TOUGHER LAYER DURING ITS LIFE AND PASSED THAT EFFORT ON

✓ SOME CACTI HAD TOUGHER OUTER LAYERS THAN OTHERS; THOSE HELD MORE WATER AND SURVIVED AND REPRODUCED BETTER IN DRY CONDITIONS, AND THEIR OFFSPRING INHERITED TOUGHER LAYERS, SO THE POPULATION GRADUALLY EVOLVED TOUGH SKINS

ANIMALS ATE THE CACTI, SO ALL CACTI SUDDENLY MUTATED TOUGH LAYERS TO STOP THEM

CACTI WITH THICK STEMS BECAME COMMON PURELY BY CHANCE, WITH NO EFFECT ON SURVIVAL

ANSWER KEY Natural selection starts from existing variation: some cacti had tougher layers than others. In a drying climate those plants held more water, survived, and reproduced more, and their offspring inherited the tougher layers, so the trait became common over many generations. The plants did not toughen up by effort during their lives, did not

mutate on demand, and the change was not just random chance - it was selection favoring an existing advantageous variant.

::PART B Build the Case: Adapt or Go Extinct

Walk a population through a changing environment to one of the two outcomes. For each step, name what is happening, then finish with the big conclusion about adapt or die.

STEP 1 - THE ENVIRONMENT CHANGES	Earth's climate, atmosphere, or food web shifts (e.g., a drying climate, a new predator, or the loss of a partner species), changing the conditions a population depends on.
STEP 2 - CHECK FOR VARIATION	Natural selection can only act if individuals differ in a useful trait. If the population has variation in a trait that fits the new conditions, adaptation is possible; if not (like the honeycreepers' uniform susceptibility), it is blocked.
STEP 3 - SELECTION ACTS (IF THERE IS TIME AND THE TRAIT IS POSSIBLE)	Individuals with better-suited traits survive and reproduce more; their offspring inherit those traits. This needs enough time and a trait the body can actually build (a pig can't evolve wings).
STEP 4A - OUTCOME: ADAPT	Over generations the population changes and becomes well-suited to the new environment - like cacti evolving tough, water-storing bodies for a drier climate, so they thrive.
STEP 4B - OUTCOME: DIE	If there is not enough time, the trait is not possible, or there is not enough variation, the population cannot keep up and goes extinct - like the Florida torrey, stuck and unable to adapt to its lost seed-disperser and new diseases.
CONCLUSION	Adapt or die is not a choice a species makes. When a changing world meets a population, natural selection works on whatever variation exists - and that is what decides whether the species adapts and survives or fails and goes extinct. Over 99% of species have met the second outcome.