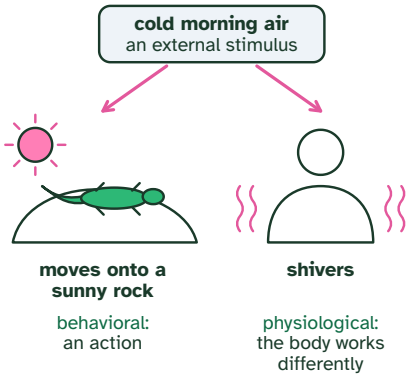
A change, then a *response*

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

THE ONE IDEA

Organisms detect changes and respond to them. Responses that raise survival and reproductive success are favored by natural selection.



Sort by what happens, not by speed: an action is behavioral, a change in the body's workings is physiological.

8.1.A START HERE

Every response answers a *change*

- A **stimulus** is a change an organism can detect: **outside** it (light, cold, a predator) or **inside** it (falling blood sugar, rising body temperature). The **response** is what it does about it.
- A **behavioral response** is an action: the organism moves, calls, hides or feeds. A **physiological response** changes how its body works: it shivers, sweats or releases a hormone.
- Many responses are both: a hot dog pants and lies in the shade. Either way, responding keeps an organism alive and able to reproduce as conditions change.

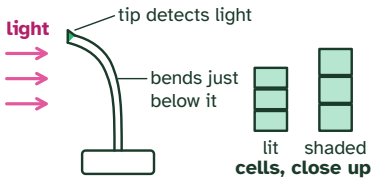
TWO KINDS OF RESPONSE — *Does, or Works*

B Behavioral — what the organism does	**P** Physiological — how its body works

8.1.A PLANTS GROW

Phototropism

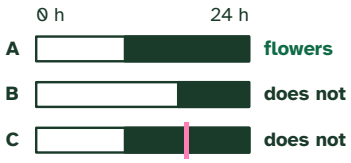
- A shoot lit from one side grows **toward the light**: cells on its **shaded side grow longer** than cells on its lit side.
- It is **growth, not movement**. The tip detects the light and the region below it bends, so a **signal** must pass between them (Darwin and his son, 1880).
- Turned to the light, the leaves catch more for photosynthesis.



8.1.A PLANTS TIME IT

Photoperiodism

- Many plants flower at one season, cued by day and night length. They flower together, when pollinators are about.
- The cue is the **longest unbroken night**. A minute of light in the middle of a long night stops plant C flowering.
- A **"short-day" plant** flowers when nights are longer than its **critical night length**: really a long-night plant.

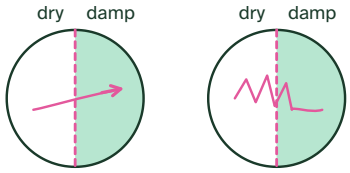


C: a minute of light at night

8.1.A ANIMALS MOVE

Taxis or *kinesis*

- **Taxis**: movement directly toward or away from a stimulus. Its track points.
- **Kinesis**: a change in **speed or turning** with no direction. Pill bugs walk fast and turn often in dry air and slow down where it is damp, so they gather there.
- Both gather animals; only the track tells them apart. Nocturnal and diurnal animals time activity to light and dark.



8.1.A SCIENCE PRACTICE 3.C

Testing a *response*

- **Choice chamber:** pill bugs are released between a damp and a dry dish and counted at the end.

CHANGE	MEASURE
Independent variable Damp or dry paper.	**Dependent variable** The count on each side.
HOLD **Controlled** Light, temperature, number released.	**COMPARE** **Control** Both sides damp.

Release at the join, use fresh animals each trial, then a chi-square test on the counts.

8.1.A INTERNAL CHANGES, EXTERNAL CUES

Changes inside, and *news* between organisms

- A stimulus can be **internal**: thirst sends an animal to drink. Organisms also **exchange information**: one bird calls at a hawk and the flock dives.

Fight or flight physiological, for a behavior
A threat is seen: **epinephrine** raises heart rate and blood sugar. Then the animal runs or hides.

A chewed plant chemicals on the air
Damaged leaves release airborne chemicals; a neighbor downwind **detects them** and raises its defenses.

Signals, learning and *cooperation*

8.1.B EACH SUITS A PLACE

Five kinds of *signal*

- **Communication**: a sender makes a signal, a receiver detects it, and **the receiver's behavior changes**. No change, no communication.

SIGNAL	SUITS	EXAMPLE
V Visual	Light and a clear line of sight	Fireflies flash in their own pattern.
A Audible	The dark, and around obstacles	A songbird sings at its territory edge.
T Tactile	Close up only	Bees in a dark hive follow a dancer.
E Electrical	Water too muddy to see in	Electric fish signal with pulses.
C Chemical	Lasts after the sender leaves	Ants lay a scent trail to food.

In order: *Very Active Toads Eat Crickets*

8.1.B FOUR USES

What signals are *for*

- A signal changes who survives and who leaves offspring: **differential reproductive success**.

1 **Dominance**
A contest settled without a fight.

2 **Food**
Others are led to it.

3 **Territory**
Held by song or scent at its edges.

4 **A mate**
Found and won by a display.

Vervet monkeys give different alarm calls for a leopard, an eagle and a snake, and each sends the troop a different way.

8.1.B TWO SOURCES

Innate or learned

- **Innate** behavior needs no experience: a spider's first web. **Learned** behavior changes with it.
- Most is both, and either is **favored by natural selection** when it raises survival and reproduction.
- **Test it:** raise young apart from adults. White-crowned sparrows raised so sing abnormally: they must hear their species at about 10 to 50 days old.

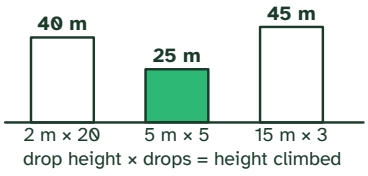
Innate works first time
Best where a mistake kills.

Learned fits a changing world
Best where conditions vary.

8.1.B FITNESS

Cost and *payoff*

- A behavior costs **energy, time and risk** and pays in food, mates or safety. Those it pays best leave more offspring, so its alleles spread.
- **Foraging:** crows drop whelks onto rocks. Height × drops is the cost, least near 5 m, where the crows drop from.
- **Courtship:** a long tail costs risk but wins mates. **Parents** feed the chicks that beg hardest.



8.1.B WHY HELP

Cooperation

- Hunting in a pack, moving as a herd, flock or school, living in a colony and warning others **raise the fitness of the individual** and the **survival of the population**.
- A wolf pack brings down prey no single wolf could; in a school, each fish is less likely to be taken.
- **Alarm calls** risk the caller. Female Belding's ground squirrels, living among relatives, call most: relatives share its alleles (**kin selection**).

102
predator encounters watched

4
summers, in the 1970s

WATCH OUT

Five mistakes that *cost points*

- ✕ **A response need not be quick, or by an animal.** A shoot bending and a plant flowering are responses too.
- ✕ **Kinesis is not random movement.** Its speed and turning depend on the stimulus, which is why the animals gather.
- ✕ **A plant "measuring day length" is measuring the night.** The names give no season.
- ✕ **Innate does not mean fixed, and learned does not mean free of genes.** The ability to learn is inherited.
- ✕ **Never "for the good of the species".** A behavior spreads when those doing it, or their relatives, leave more offspring.

COVER THE SHEET

Can you *answer these?*

1. Describe two kinds of response to cold.
2. Explain how a shoot grows toward light.
3. Explain what a "short-day" plant measures.
4. Describe how a track shows taxis rather than kinesis.
5. Identify the control in a choice chamber test.
6. Justify a sound signal for animals in a dark forest.
7. Describe how to test whether a song is learned.
8. Explain how a risky alarm call can be favored.

IN THE EXAM

Stimulus, response, payoff: name the change, say what the organism does, then how that raises survival or reproduction. In a design question, name the independent and dependent variables and justify the control.

GO FURTHER

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