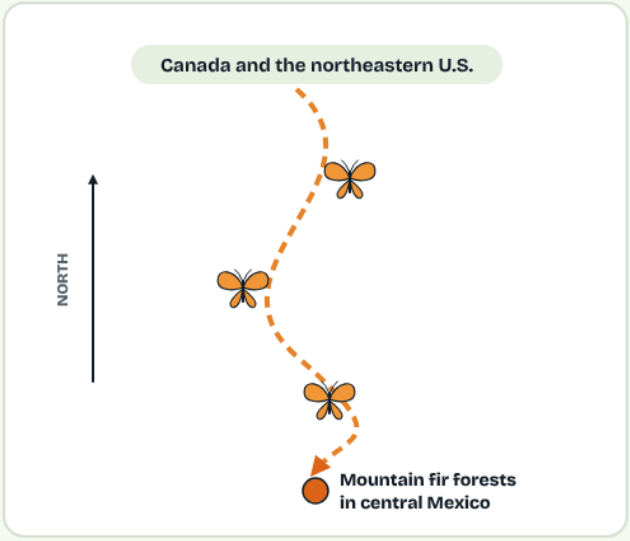
That is why

How do monarch butterflies find Mexico?

Their eyes track the sun, a clock in their antennae corrects for the time of day, and a magnetic compass backs it up.

A The journey

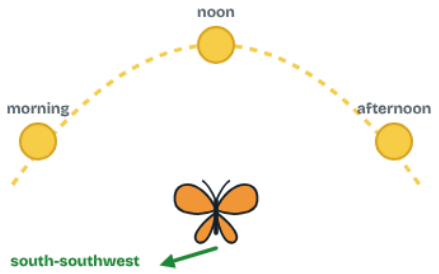


Upwards of 3,000 miles each fall.

A "super generation" that can live up to 8 months flies south. The trip back north takes 4 to 5 generations, so no butterfly has made the fall flight before.

B A sun compass with a clock

The sun moves, so the angle to it must change through the day.



1 Eyes
watch where the sun is

2 Antennae
hold a clock that keeps the time

3 Brain
combines both to hold its course

C Proof, and a backup

The antenna tests

- **Antennae removed** — could not head the right way
- **Antennae painted black** — flew a fixed, wrong direction
- **Antennae painted clear** — headed south correctly

Merlin, Gegear and Reppert, Science, 2009

Magnetic backup

When the sun is hidden, monarchs can steer by the tilt of Earth's magnetic field.

It only works in ultraviolet to blue light (380 to 420 nm), and the sensors appear to sit in the antennae. Flipping the tilt in a flight simulator sent them north.

Guerra and colleagues, Nature Communications, 2014

Sun position plus time of day equals south, even on a first-ever flight.

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Diagram: https://thatiswhy.com/diagrams/why-monarchs-navigate/ · Full guide: https://thatiswhy.com/why-monarch-butterflies-can-navigate-3000-miles-using-the-sun/