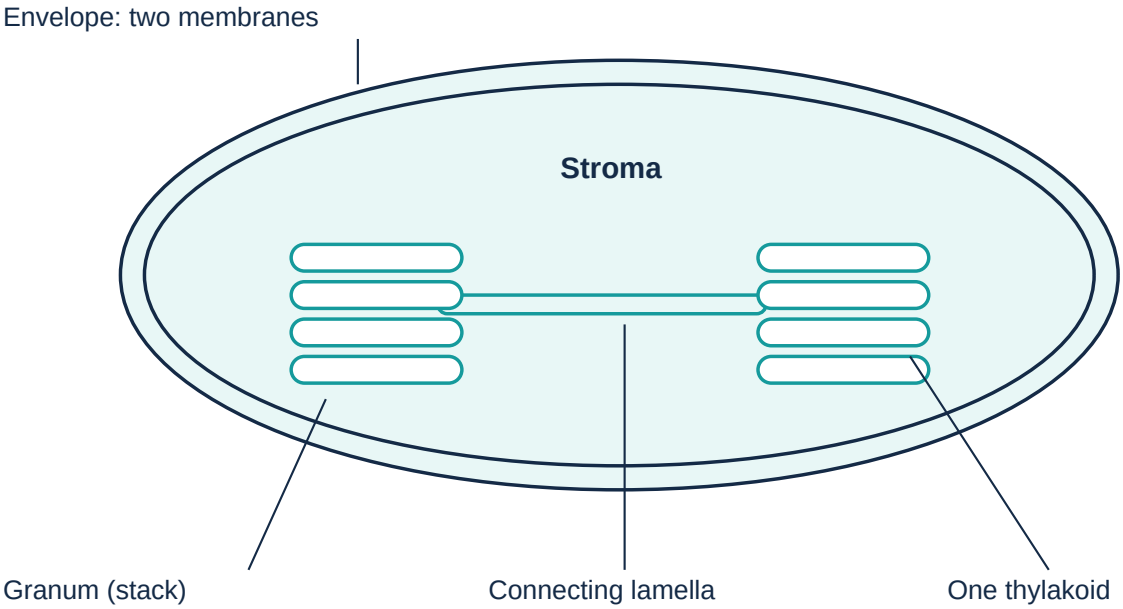
A chloroplast is compartmentalised

Chloroplasts and photosynthetic pigments: the structures that capture light energy and support its transfer into organic molecules.

1. LOCATE THE STRUCTURES



Simplified section; not to scale. The thylakoid lumen is the space inside each sac.

2. MEMBRANES CAPTURE AND TRANSFER ENERGY

Thylakoid membranes provide a large surface for pigments, electron carriers and ATP synthase. The enclosed lumen allows a proton gradient to form across the membrane during the light-dependent stage.

3. THE STROMA SUPPORTS CARBON FIXATION

The stroma surrounds the thylakoids and contains enzymes, including rubisco, for the Calvin cycle. ATP and reduced NADP from the light-dependent stage support production of organic molecules. Chloroplast DNA and ribosomes enable synthesis of some chloroplast proteins.

Micrograph clue: repeated dark membrane profiles indicate grana; the surrounding region is stroma, not a thylakoid space.

Chloroplast compartments and stages: OpenStax, Biology 2e 8.1.
Membranes, proteins and energy transfer: Alberts et al., Chloroplasts.

Scope: Cambridge Biology 9700, section 13.1, outcomes 1-6, p. 35.

Different pigments capture different light

A pigment absorbs selected wavelengths rather than all visible light equally. Chlorophylls absorb strongly in blue and red regions; green light is less strongly absorbed.

1. THE MAIN CHLOROPLAST PIGMENTS

Pigment	Appearance	Contribution
Chlorophyll a	Blue-green	Reaction-centre pigment; also present in antenna complexes.
Chlorophyll b	Yellow-green	Accessory pigment with a different absorption pattern.
Carotene	Orange	Accessory carotenoid; absorbs mainly blue-region light.
Xanthophyll	Yellow	Accessory carotenoid; contributes to capture and photoprotection.

2. A PHOTOSYSTEM COLLECTS LIGHT ENERGY

Pigments bound to proteins form antenna complexes. Absorbed excitation energy is passed between pigments to reaction-centre chlorophyll a. An excited electron is then transferred to an acceptor. Accessory pigments broaden the useful wavelength range.

3. DO NOT CONFUSE THE TWO SPECTRA

Absorption spectrum: how much light a pigment absorbs at each wavelength.

Action spectrum: how effective each wavelength is at driving photosynthesis, measured by a rate such as oxygen production.

Both use wavelength on the x-axis. Action spectra reflect all the pigments working together, so they need not match chlorophyll a alone.

Pigments and absorption: OpenStax, Biology 2e 8.2.
Antenna energy transfer and reaction centres: Alberts et al., Chloroplasts.

Scope: Cambridge Biology 9700, section 13.1, outcomes 1-6, p. 35.

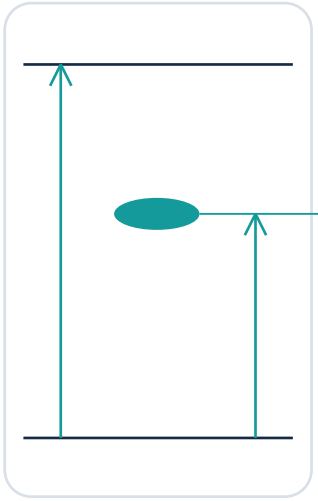
Separate pigments and identify them

Chromatography separates a leaf extract because pigments differ in solubility in the moving solvent and attraction to the stationary phase.

1. DEVELOP A CHROMATOGRAM

Apply a small, concentrated extract spot to a pencil baseline. Keep the baseline above the solvent level. Let solvent rise, then remove the strip and mark the solvent front immediately. Handle volatile, flammable solvents with appropriate lab supervision.

2. MEASURE FROM THE SAME BASELINE



Illustrative distances:
pigment = 3.0 cm
solvent front = 5.0 cm

R_f = distance moved by pigment / distance moved by solvent front

$R_f = 3.0 / 5.0 = 0.60$ (no units)

3. USE Rf AS EVIDENCE, NOT A FIXED LABEL

Compare band colour and R_f with known pigments run under the same conditions. Solvent and stationary phase affect migration, so there is no single universal R_f for a pigment. Measure to the band centre, not from the bottom edge of the paper.

Pigment separation and Rf measurements: Texas Tech, Plant Pigment Chromatography.
Pigment identity and light absorption: OpenStax, Biology 2e 8.2.

Scope: Cambridge Biology 9700, section 13.1, outcomes 1-6, p. 35.