

Pigments and spectra

60 minutes • C1.3.4 and C1.3.6 • Chapters 3, 5

Separating leaf pigments by chromatography, working out R_f , and comparing absorption and action spectra

BY THE END, STUDENTS CAN

- ☐ Separate leaf pigments by chromatography, work out R_f values and identify each pigment by colour and R_f C1.3.4
- ☐ Compare absorption and action spectra, and plot an action spectrum from oxygen or carbon dioxide data C1.3.6

TIMING

0–5	5 min	Do now: one green or several?	
5–35	30 min	Separate the greens	
35–43	8 min	Measure and identify	
43–55	12 min	Engelmann's bacteria	
55–60	5 min	Exit	
	60 min	One lesson	

STARTER

5 min Do now: one green or several?

"Is the green of a leaf one pigment or several? Which would travel furthest in a solvent, and why?"
Students write a sentence each. Do not correct yet.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

03 More than one green

CHAPTER 03 IN THE SLIDES

Slide the figure through Time 0 and Time 100, and have the class say what will change before each.

Step through the figure (3 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

- Grind a leaf with a little sand and a few drops of propanone. Spot the extract on a pencil line 2 cm from the bottom of the strip, then stand the strip in propanone, below the line, with the lid on.
- Take the strip out before the solvent reaches the top and mark the front in pencil at once. The pigments have separated into bands. The table beside it lists known values for this solvent.
- Measure from the origin line to the middle of each band and to the front. Work out R_f for each band, then name each pigment from its colour and its R_f .

Predict box: The solvent front has moved 8.0 cm from the origin and a yellow band 5.7 cm. What is the band's R_f ?
Hands up or mini whiteboards first.

Answer B: 0.71

05 Absorbed is not the same as used

CHAPTER 05 IN THE SLIDES

Show the figure: Seven wavelengths of light, the oxygen a sprig gave off in 10 minutes in each, and empty axes. Rate = volume of oxygen ÷ time.

Play the animation, Engelmann's bacteria. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. A strand of green alga, and bacteria that swim towards **oxygen**.
2. In white light the whole strand gives off oxygen. The bacteria gather evenly.
3. Engelmann put a **prism** under the slide. What will the bacteria do?
4. The bacteria crowd where **red** and **blue** light fall. Counted, they draw an **action spectrum**.

Predict box: Engelmann shone a spectrum along a strand of alga and added bacteria that swim towards oxygen. Where did the bacteria gather? Hands up or mini whiteboards first.

Answer A: Under the red and the blue light

THE LESSON

30

min

Separate the greens

The practical below: grind, spot, run. While the solvent climbs, [chapter 3's](#) figure is on the board (slide the time), then the Rf predict.

8

min

Measure and identify

Measure the strip, work out each Rf and identify the pigments from the table. Pairs answer the four Chromatography questions (below). No lab: use the chromatography bench instead, in pairs.

12

min

Engelmann's bacteria

[Chapter 5:](#) the predict (Engelmann), then Engelmann's experiment: split the light, count, compare. Then Plot it, done as a class on the board.

ACTIVITIES

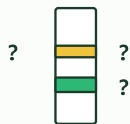


PRACTICAL

Separate the greens

Paper chromatography of spinach ([chapter 3](#)). Grind 4 or 5 leaves with a little sand and 1 cm³ of propanone to a paste. Draw a pencil origin 2 cm from the bottom of a strip of chromatography paper. Spot the extract with a fine pipette, drying between spots, until there is a small dark spot (under 2 mm). Stand the strip in solvent below the origin in a stoppered boiling tube. Take it out before the front reaches the top and mark the front at once. Measure and work out each Rf, and identify from the table for that solvent. Safety: propanone is highly flammable and an irritant: no flames, good ventilation, eye protection.

Needs: spinach, sand, mortar and pestle, propanone, chromatography paper or TLC strips, boiling tubes with bungs, fine pipettes, pencils, rulers, eye protection.



DISCUSS

Chromatography questions

Four questions. A pigment that clings to the paper: does it move faster or slower? One that dissolves well in the solvent? What makes one pigment outrun another? How do you identify one? Pairs answer in one sentence each, then the class agrees model answers.

Needs: the questions on the board.

PLENARY

5

min

Exit

Work out an Rf from two distances, and give one similarity and one difference between the absorption and action spectra.

WHAT STUDENTS GET WRONG

R_f can be more than 1, or is measured from the bottom of the paper. It is measured from the origin, and is always under 1.

The action spectrum is the same as the absorption spectrum. It is the rate at each wavelength: it follows absorption but is not identical.

STRETCH AND SUPPORT

Support: chapter captions as cut-up cards to put in order; the dotted key terms as a glossary; a writing frame for "explain the effect of light intensity" (rise, why, plateau, why).

Stretch: why might a red seaweed's pigments not show up at all in this solvent? (Its main extra pigments dissolve in water, not propanone.)

Stretch: compare chlorophyll with haemoglobin and melanin: what does each absorb, and what is it for?

IN THE GUIDE

- 3** [More than one green](#)
- 5** [Absorbed is not the same as used](#)
- A11** [The whole guide, with the figures that play](#)
- PPTX** [This lesson's slides, in the order of this plan](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on C1.3 at standard level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=C1.3&level=SL&paper=quiz&marks=15&src=ep



PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- [Tarsia puzzle, dominoes and picture reveal](#) on C1.3, built from its key terms and ready to print
- A [pub quiz](#) with rounds on C1.3, to present or run with no projector
- An [escape room built from the question bank](#) on C1.3

ALREADY ON THE SITE FOR C1.3

- Quiz: [Photosynthesis](#)
- Quiz: [Photosynthesis \(HL\)](#)
- Revision map: [C1.3 Photosynthesis](#), to fill in
- Exam questions: [C1.3 in the exam maker](#), a paper with its markscheme

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- [C1.3 Photosynthesis \(SL\)](#)
- [C1.3 Photosynthesis \(HL\)](#)

How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.