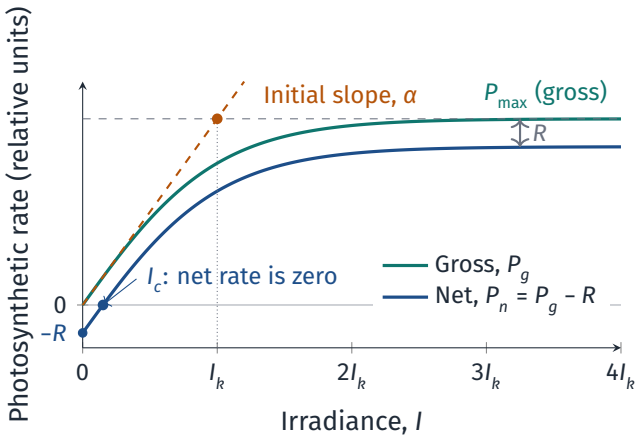
Reading a photosynthesis–irradiance curve



- In darkness, net photosynthesis is negative because respiration continues
- At I_c, gross photosynthesis equals respiration
- I_k is the saturation irradiance parameter: $I_k = P_{max}/\alpha$

$P_g = P_n + R$

Illustrative tanh model with constant respiration: $P_g = P_{max} \tanh(\alpha I / P_{max})$. Photoinhibition is shown on slide 4.

What do the P–I parameters mean?

Symbol	Meaning
α	Initial slope: change in photosynthetic rate per unit irradiance at low light.
P_{max}	Maximum gross rate in this model. The net plateau is $P_{max} - R$.
R	Respiration rate. Here it is constant; in darkness, $P_n = -R$.
I_c	Compensation irradiance: $P_g = R$ and $P_n = 0$.
I_k	Saturation parameter: $I_k = P_{max}/\alpha$. Defined by the initial tangent's intersection with P_{max}.

At I_k, the actual gross curve reaches about 76% of P_{max} in the tanh model.

I_c and I_k are irradiances, usually expressed in μmol photons m^{-2} s^{-1}.

The curve approaches its maximum gradually. Model: Jassby and Platt (1976).

Why do P–I curves change?

- **Temperature:** photosynthetic capacity often rises to an optimum, then falls as heat stress increases
- **Nutrients and inorganic carbon:** limited supplies can restrict P_{max}
- **Light history:** acclimation changes pigments and photosystems, affecting α and P_{max}

Temperature, nutrients and inorganic carbon

↓

Metabolic capacity

↓

P_{max}

Light history

↓

Pigments and photosystems

↓

α and P_{max}

I_k changes when P_{max}/α changes. I_c also depends on respiration.

A fall in P_{max} can indicate stress; check the species, light history and measurement conditions.

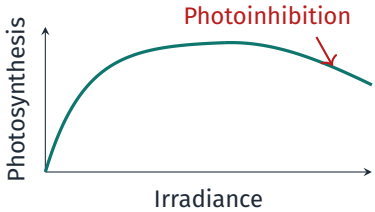
Light requirements differ among habitats

Indicative values for seaweeds

I_c: about 2–11 in shallow water; it may be lower in deeper water.

Habitat	I_k
Intertidal	400–600
Upper to mid-sublittoral	150–250
Deep water	< 100

All irradiances in μmol photons m^{-2} s^{-1}.



Excess light can reduce photosynthesis, especially when heat or drying adds stress.

Ice-diatom example: saturation near 5; photoinhibition near 25 (same units).

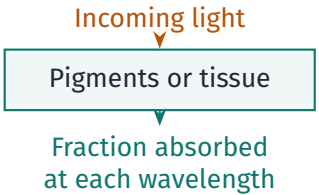
Indicative examples from the original course notes, not universal thresholds. The curve is schematic.

Absorption spectra and action spectra

Absorption spectrum

How much light is absorbed?

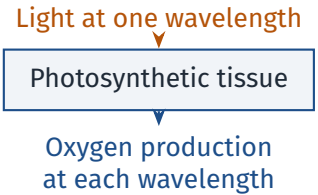
At each wavelength, measure the light absorbed by pigments or tissue.



Action spectrum

How much photosynthesis is driven?

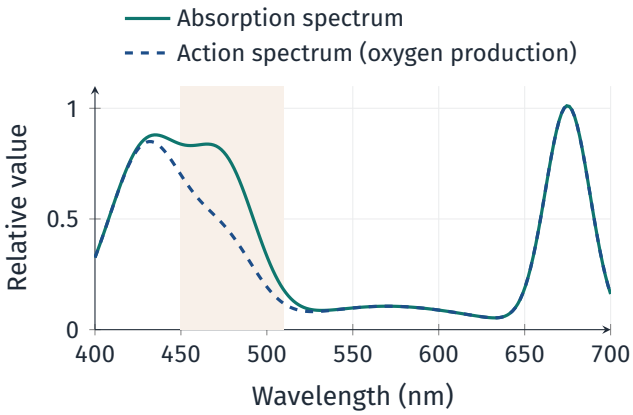
At each wavelength, measure a response such as oxygen production.



Compare action at equal incident photon flux and at light levels below saturation.

Use matched tissue and conditions. Example: Haxo and Blinks (1950), marine algal action spectra.

Comparing absorption and action spectra



- Similar peaks show where absorbed light drives photosynthesis
- In the shaded region, action is lower than absorption
- Some carotenoid excitation energy is dissipated before it reaches chlorophyll

Transfer efficiency differs among pigments and organisms; this pattern is an example.

Schematic curves scaled to their maxima, not measurements. Related reading: Haxo and Blinks (1950).