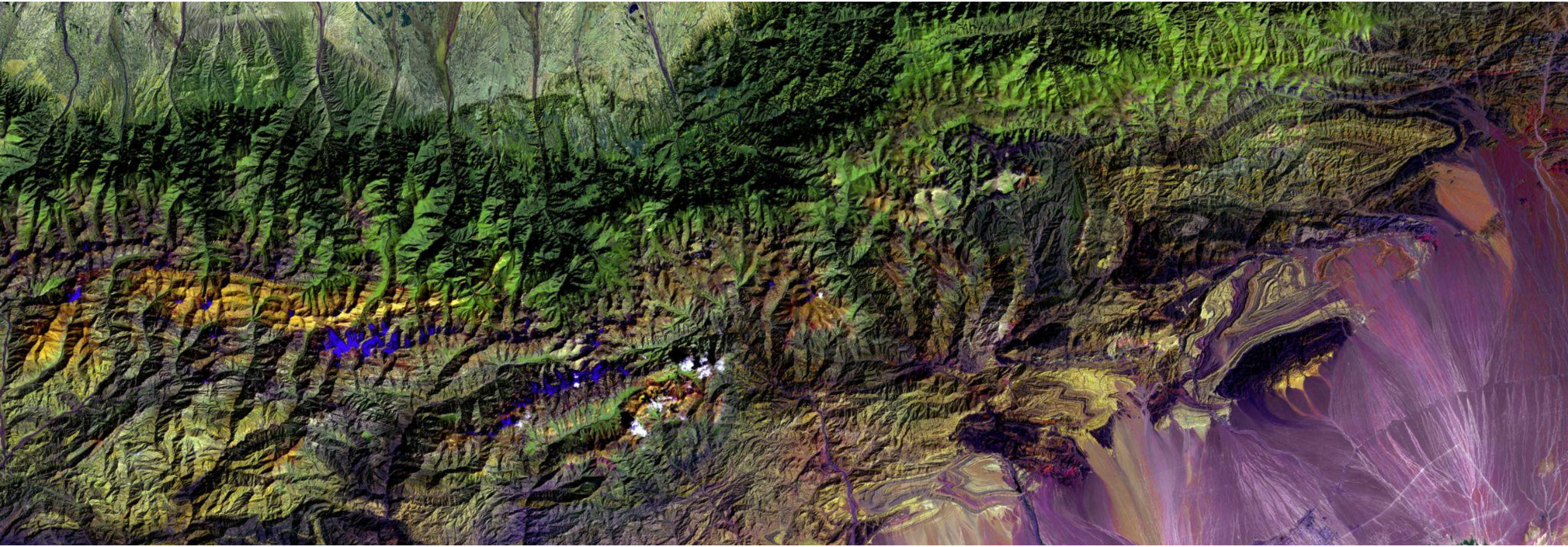
EDS 223: Geospatial Analysis & Remote Sensing
Week 8



USGS via Unsplash

Welcome!

- **Reminders**
  - Assignment 4 is posted! Due December 9
  - Portfolio is due December 15
- **Assessment**
  - Due tomorrow by midnight

Why do leaves change colors?

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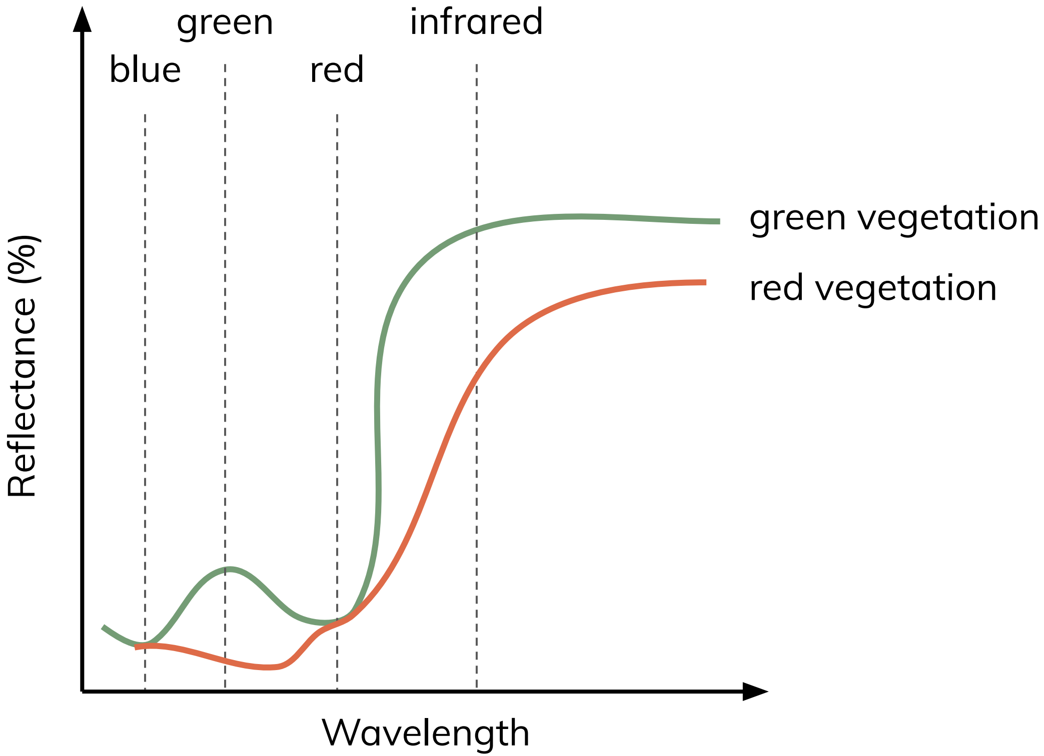
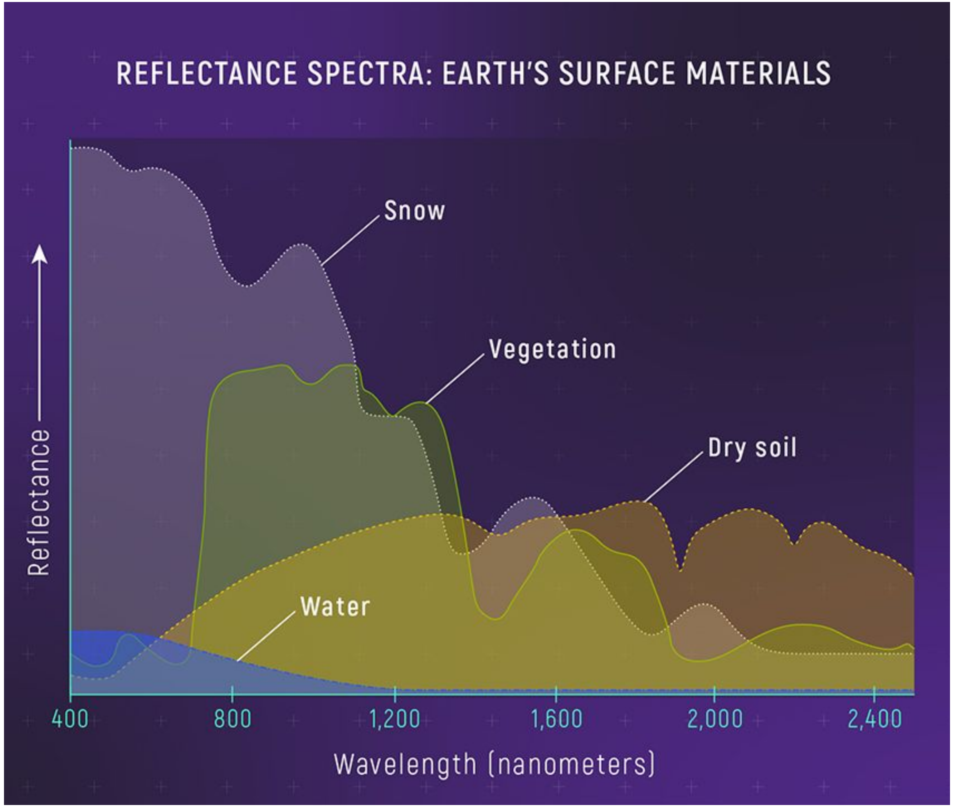


Welcome!

- **Remote sensing of vegetation**
    - Leaf
    - Canopy
    - Landscape
        - Vegetation indices
- **Investigating plant phenology in Southern CA**

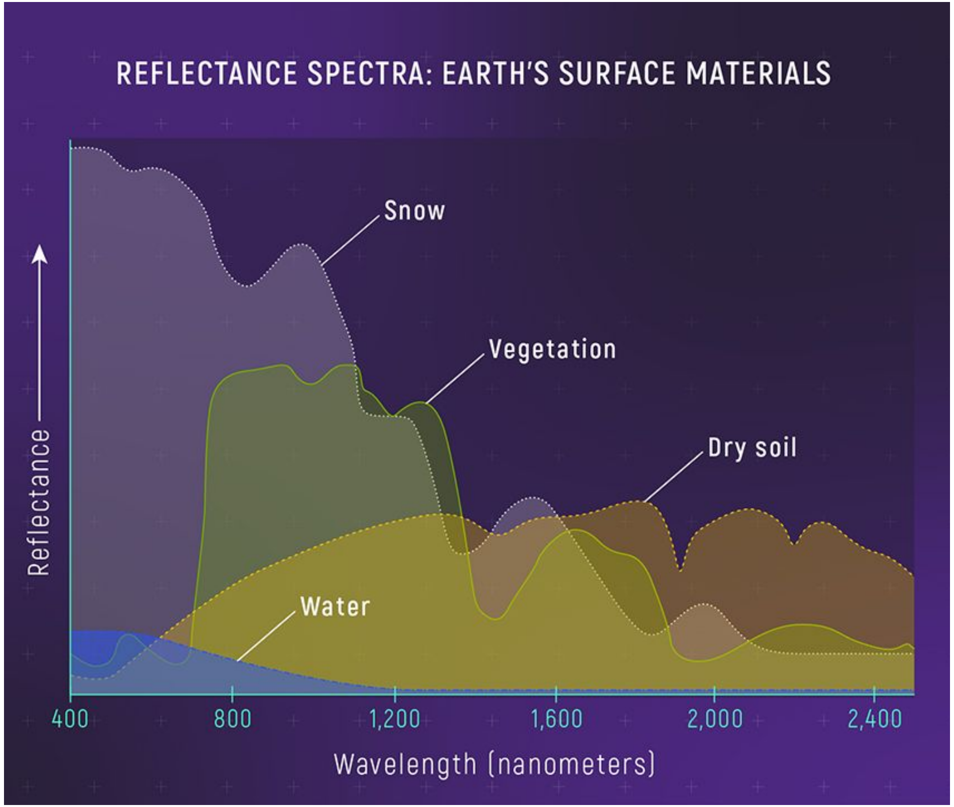
Remote sensing of vegetation



Source: NASA, Leah Hustak

Remote sensing of vegetation

Why does the reflectance spectra for vegetation look like this?



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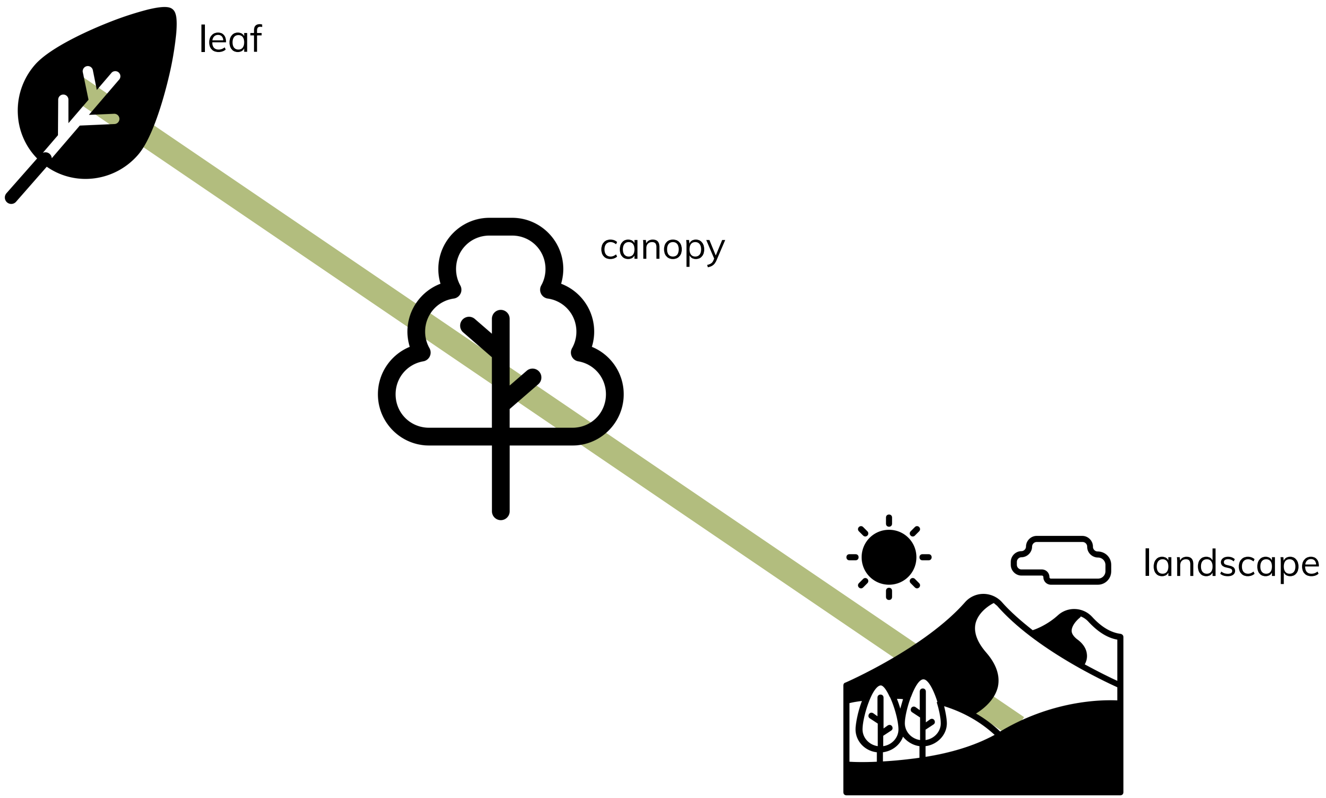

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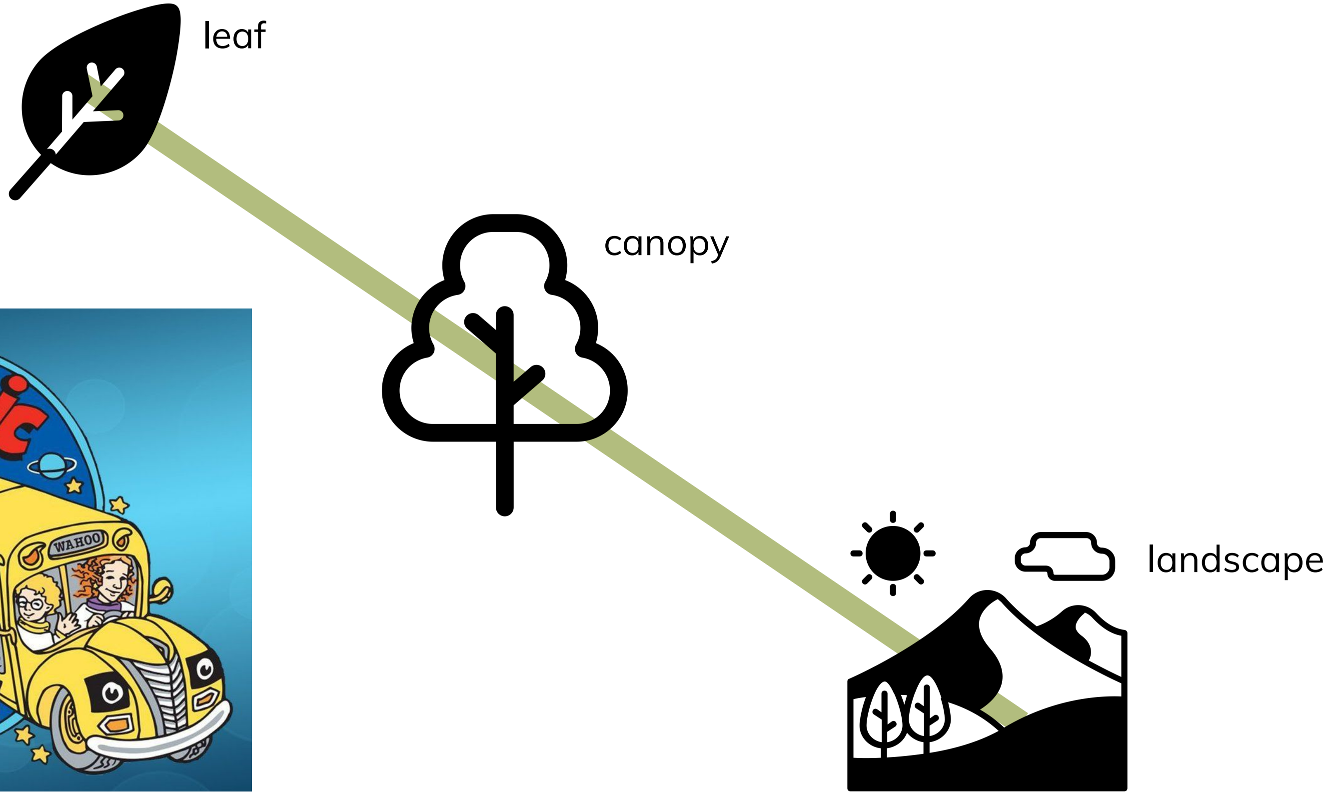

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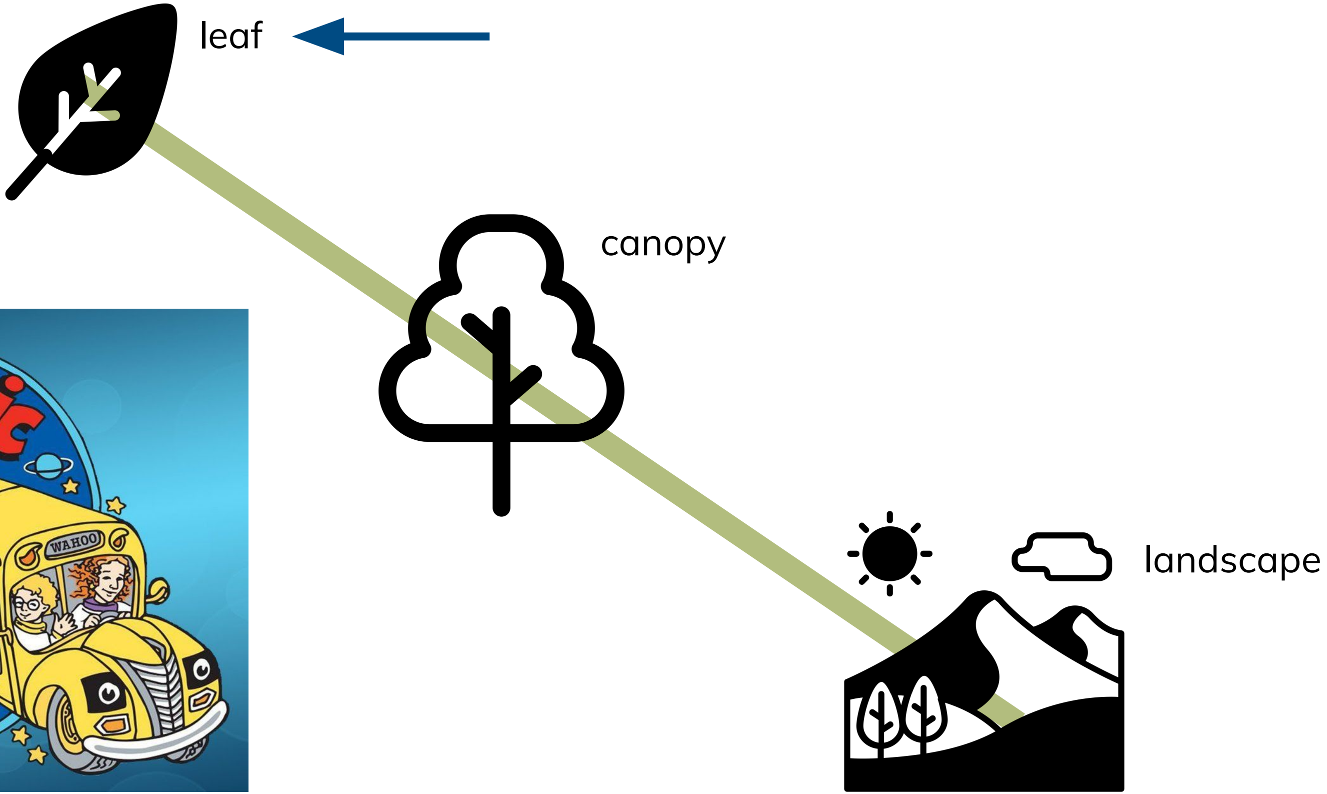
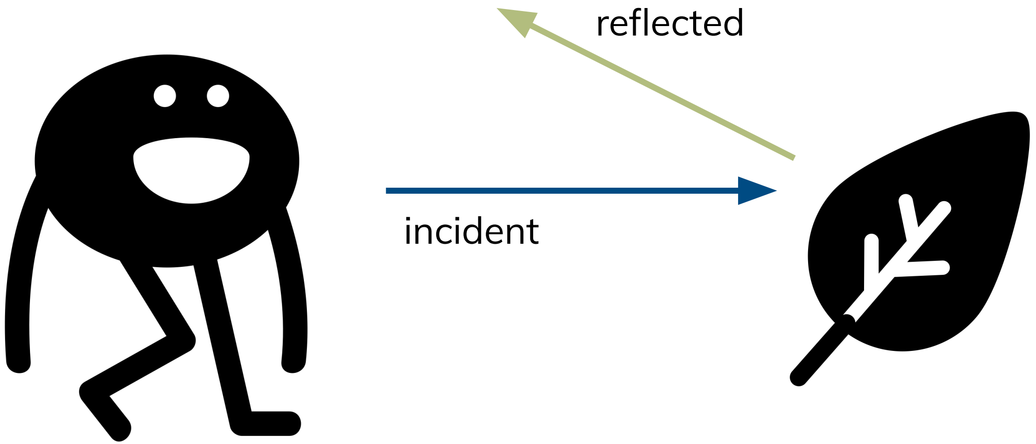


A photon's journey

A photon’s journey



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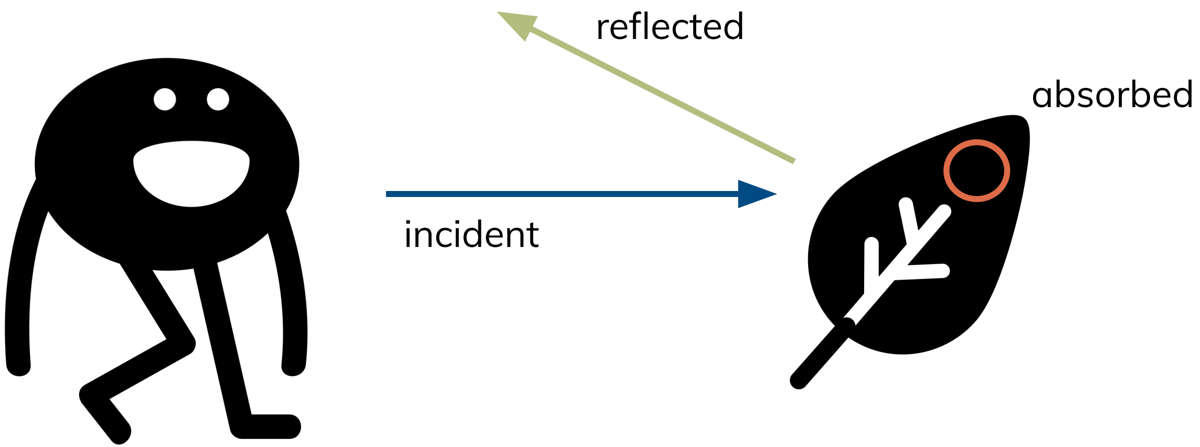

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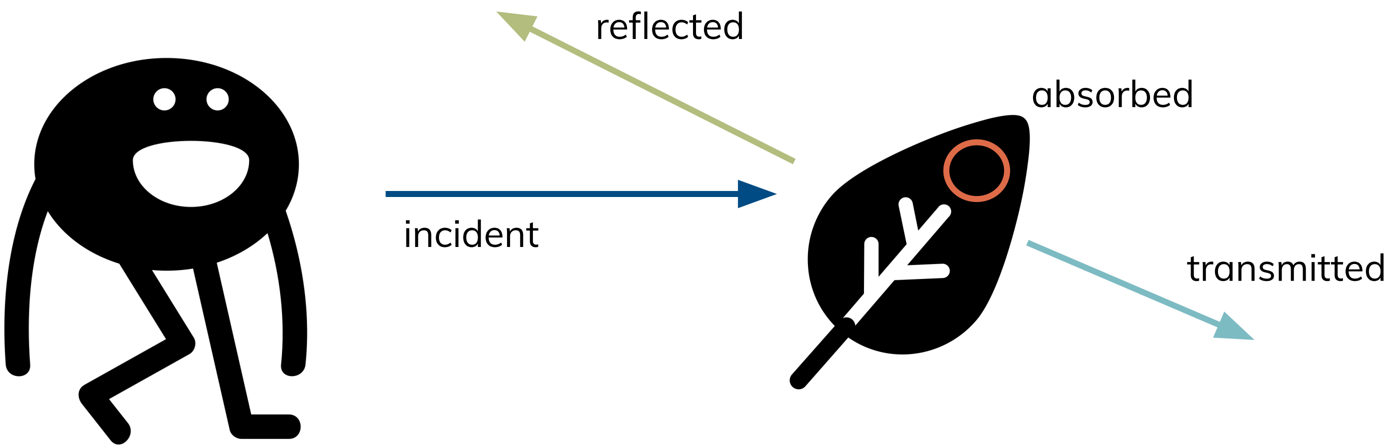
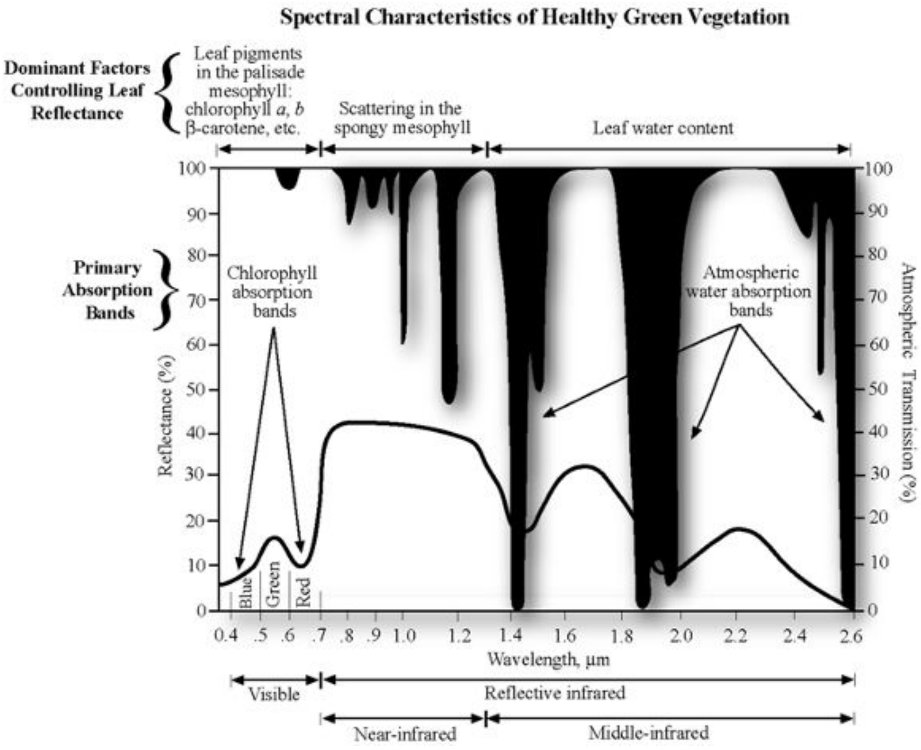


Factors controlling leaf reflectance



Source: Jensen 2007

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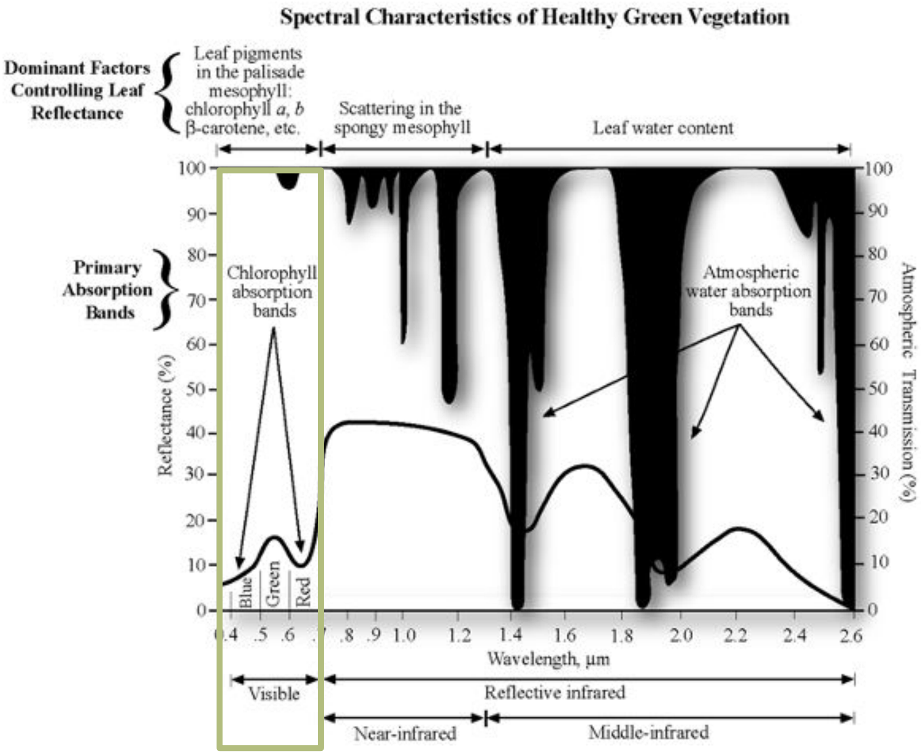

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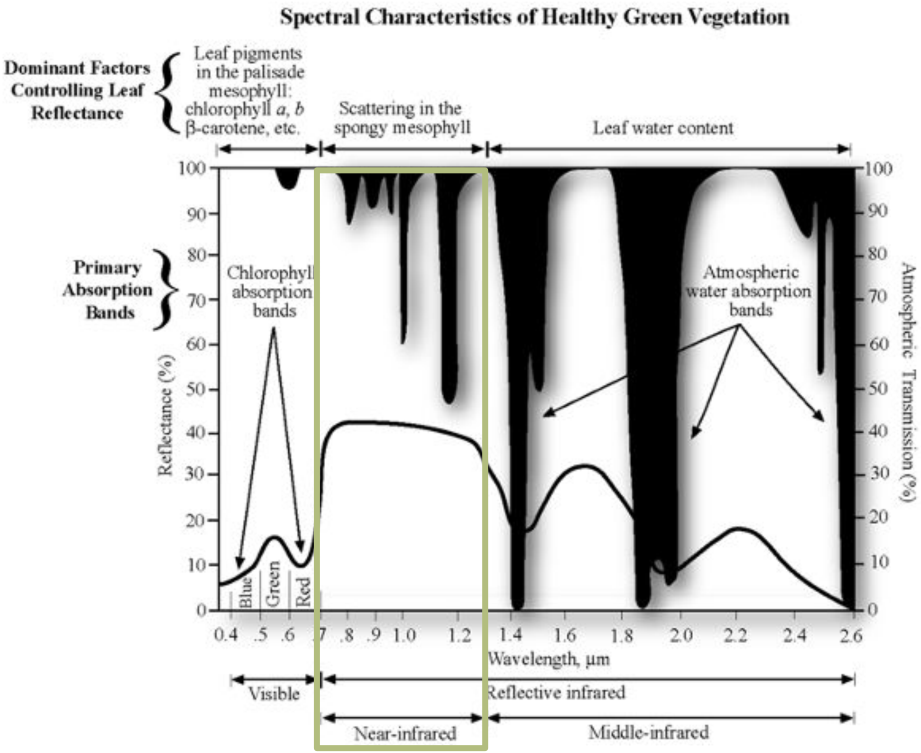

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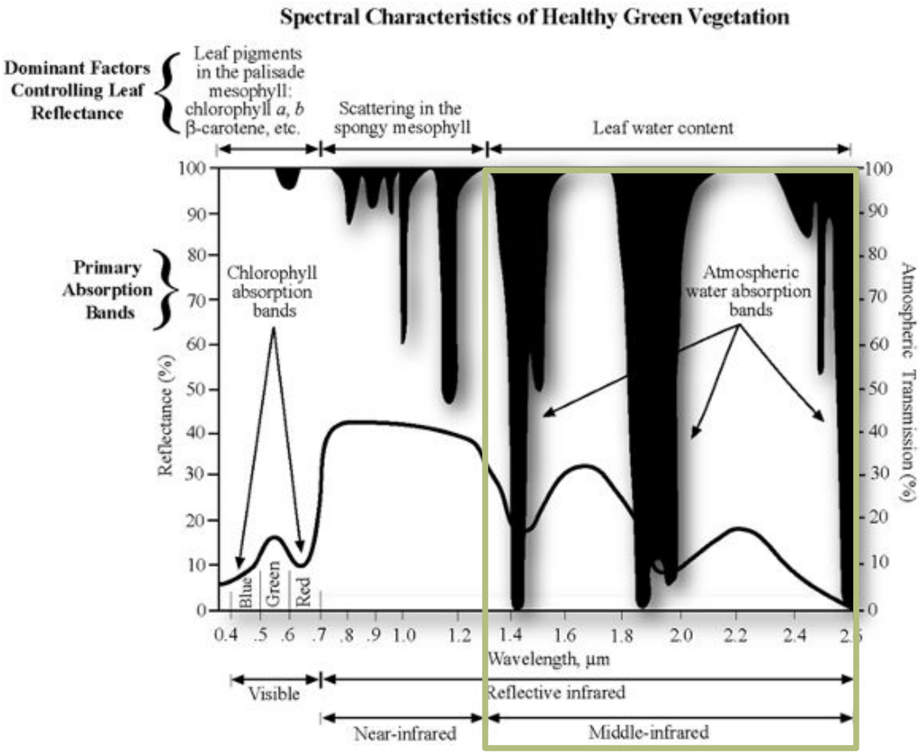

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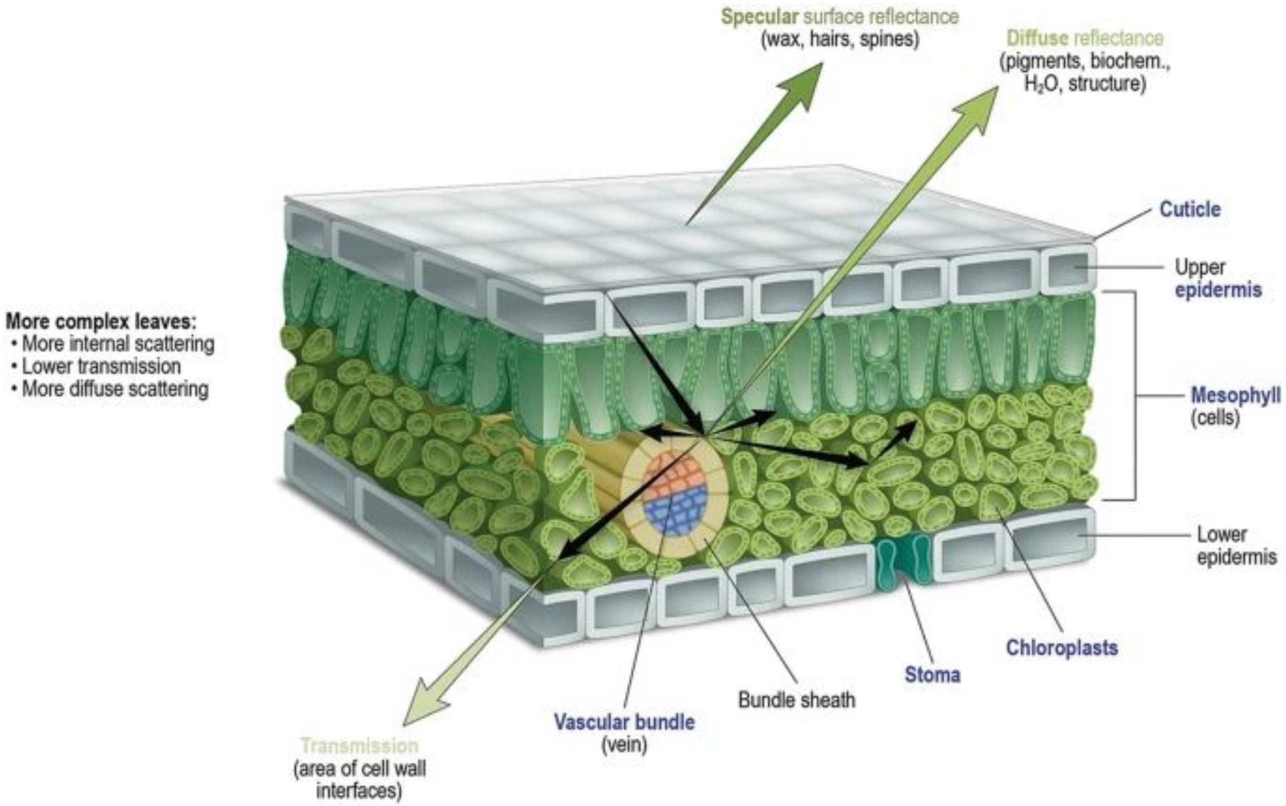
Interaction of light with leaf structure



Source: Serbin and Townsend 2020

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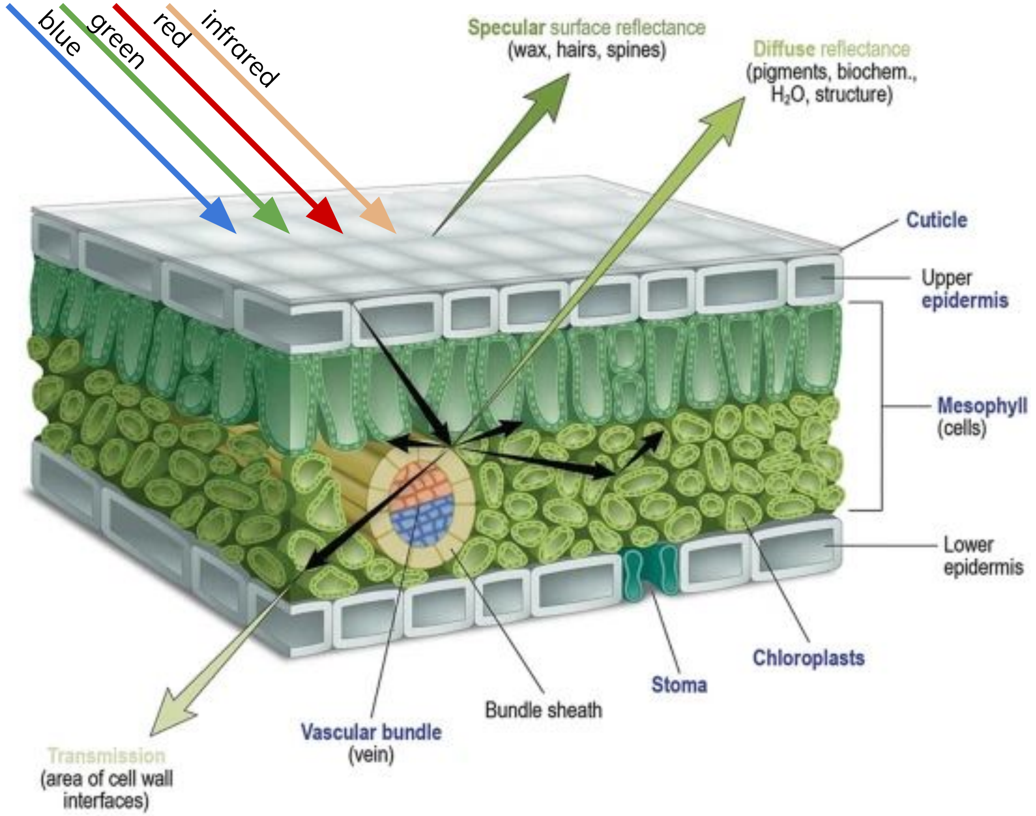

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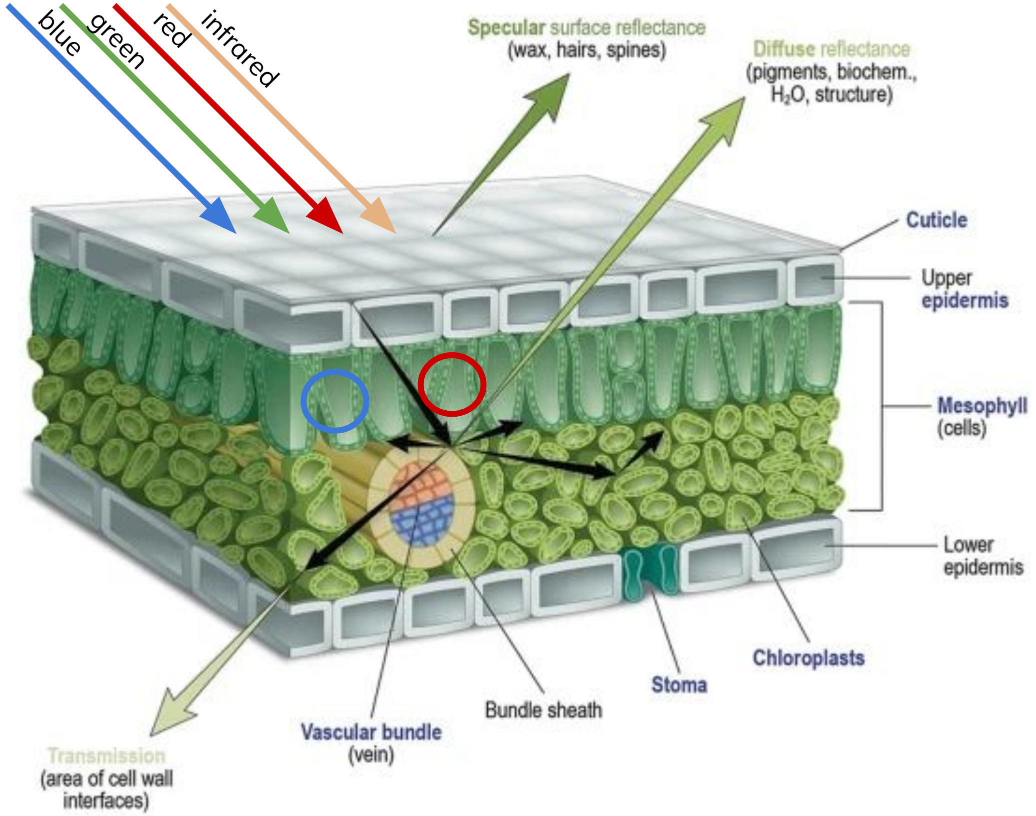

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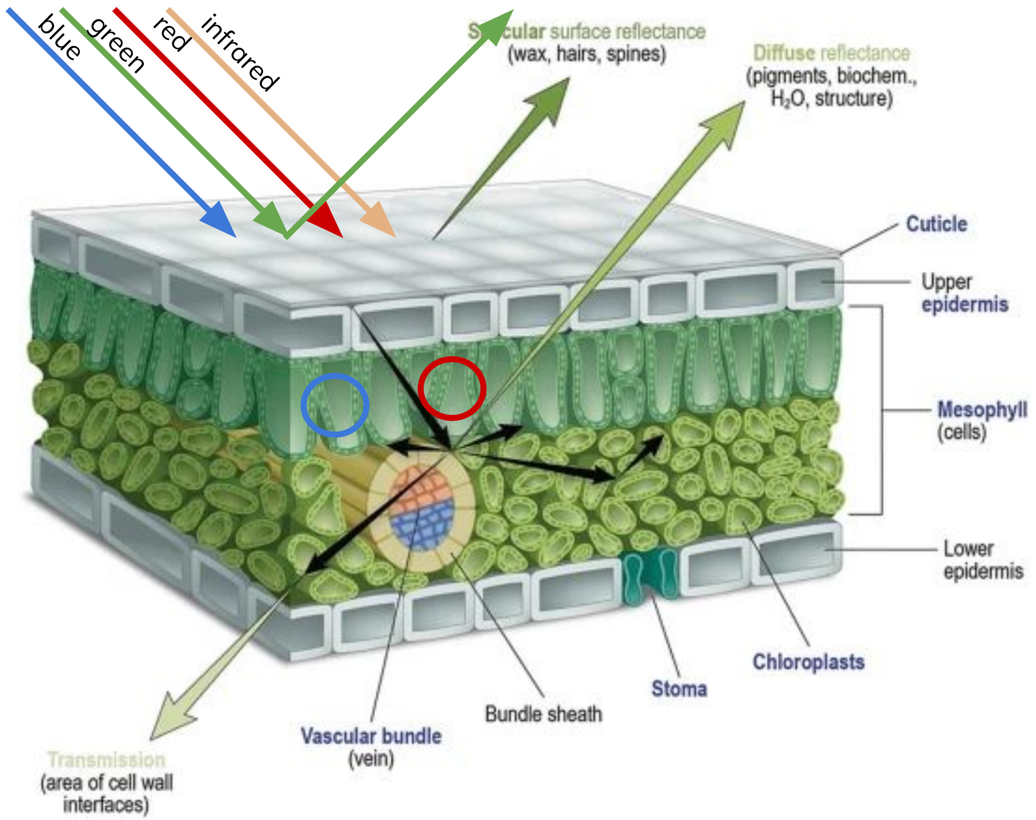

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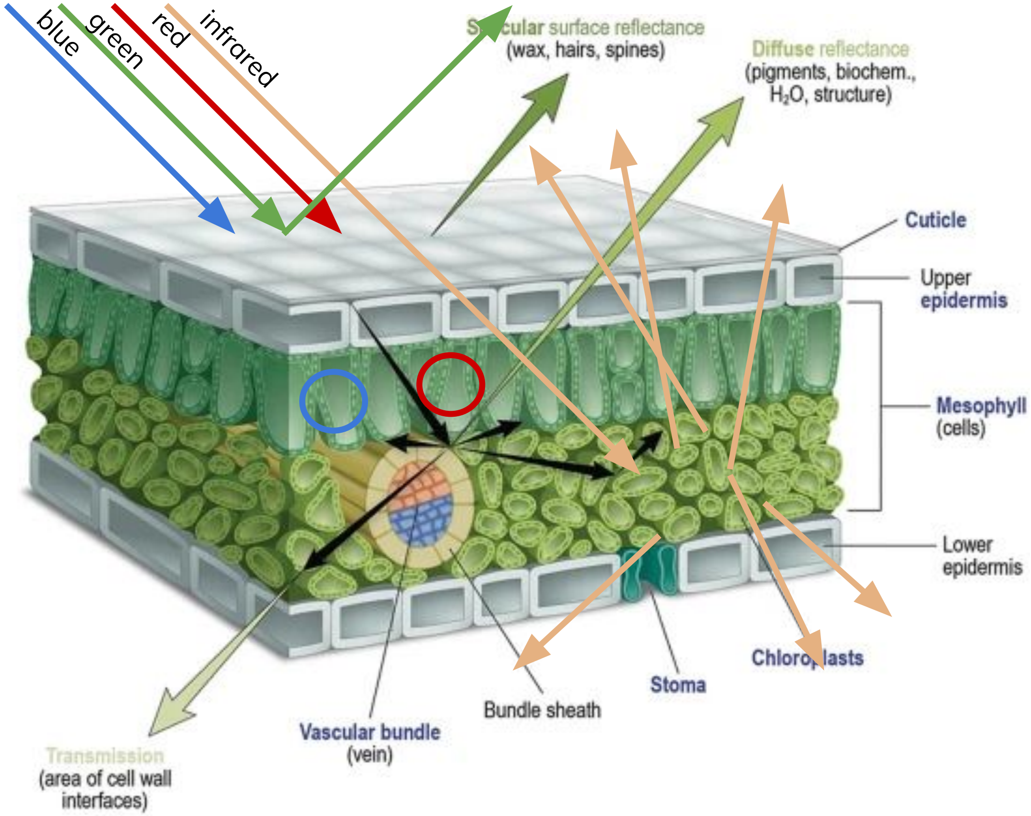

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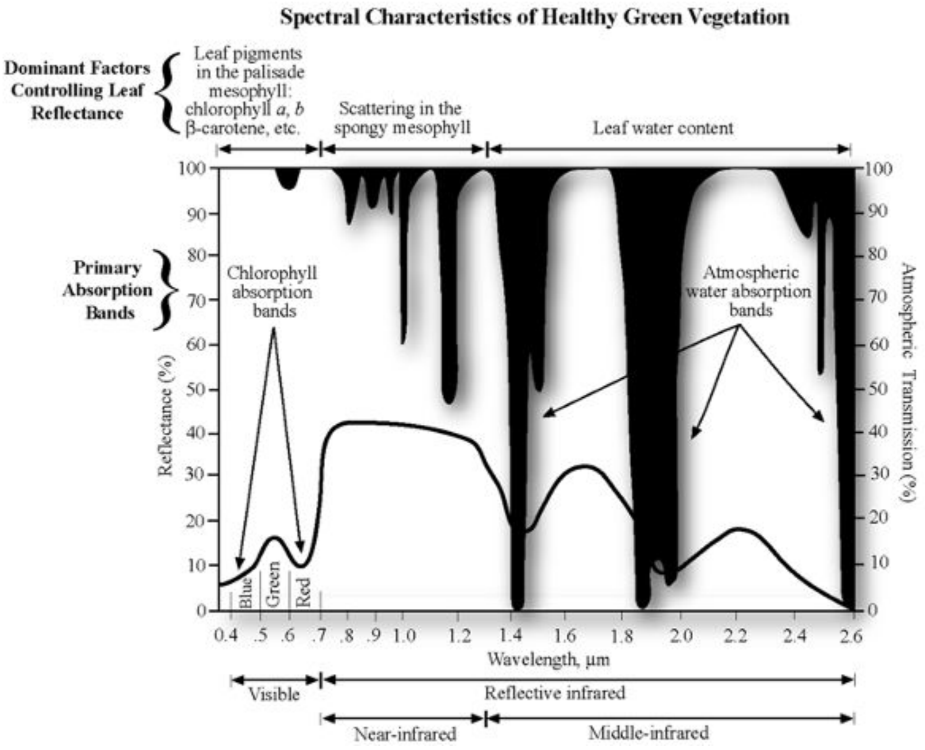

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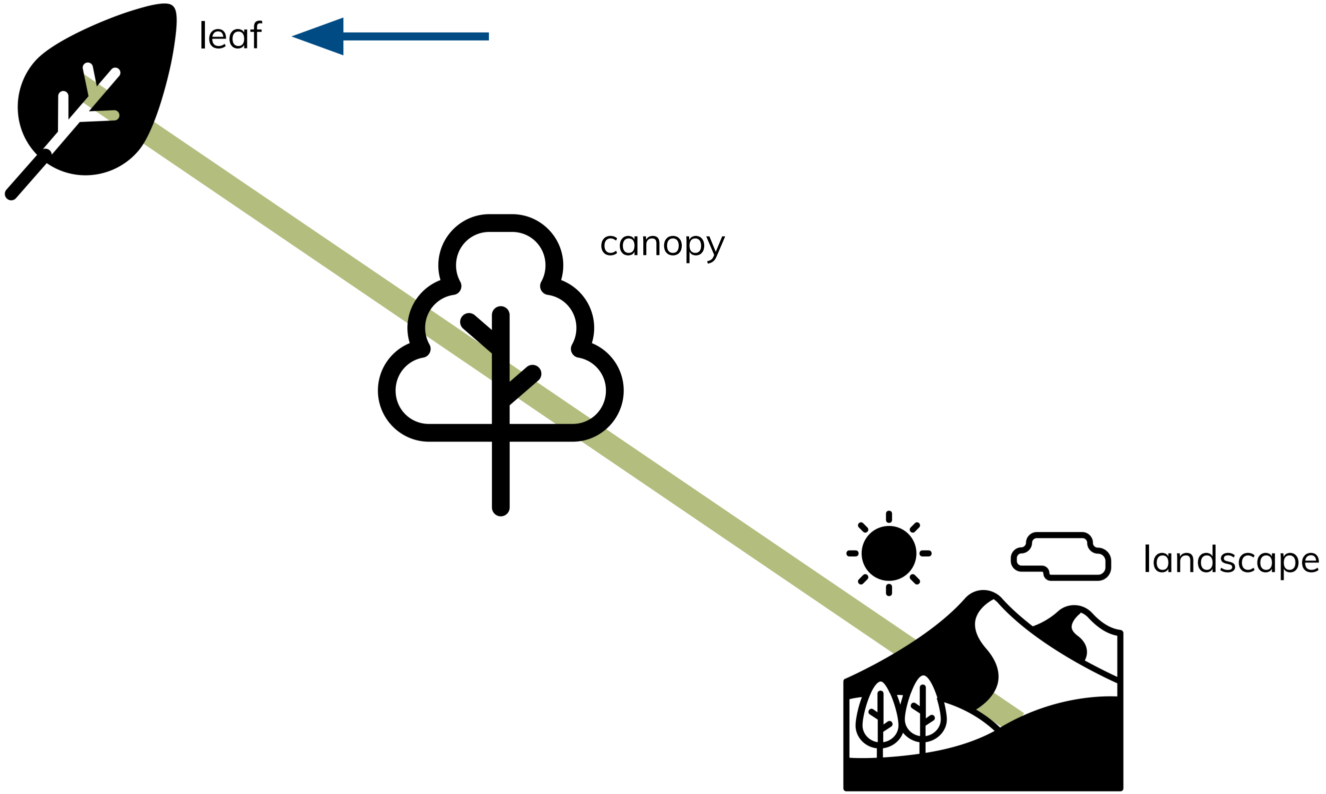

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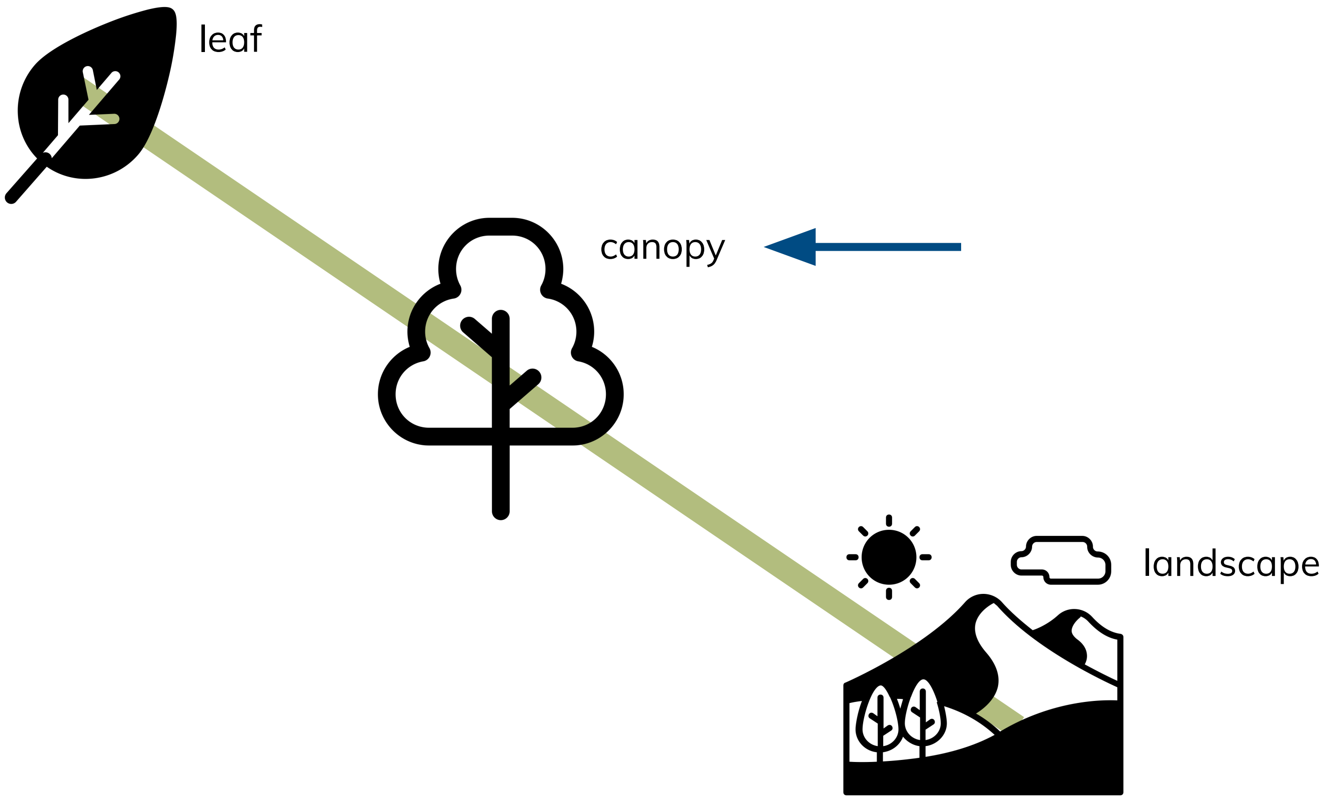

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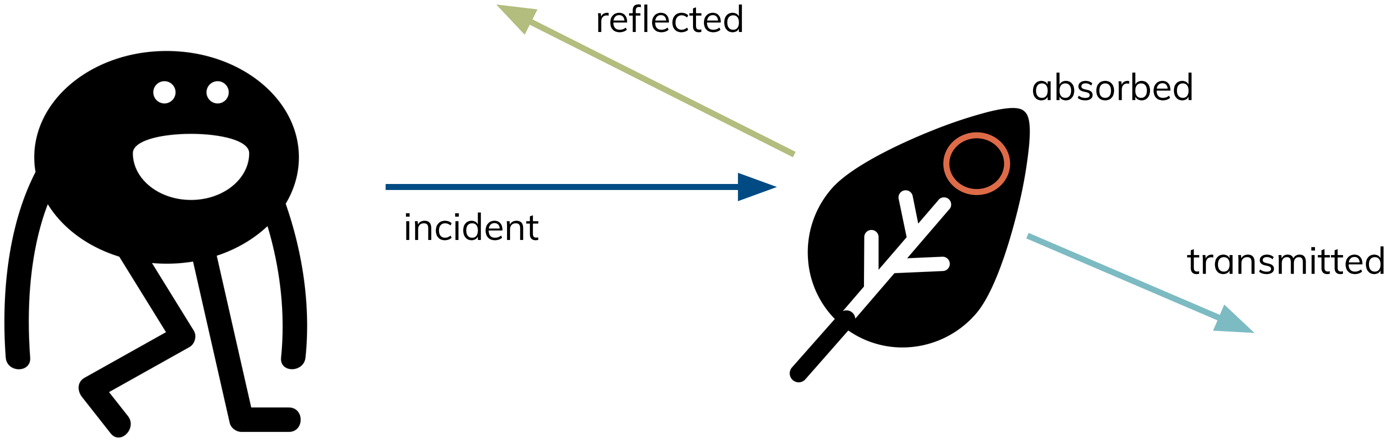
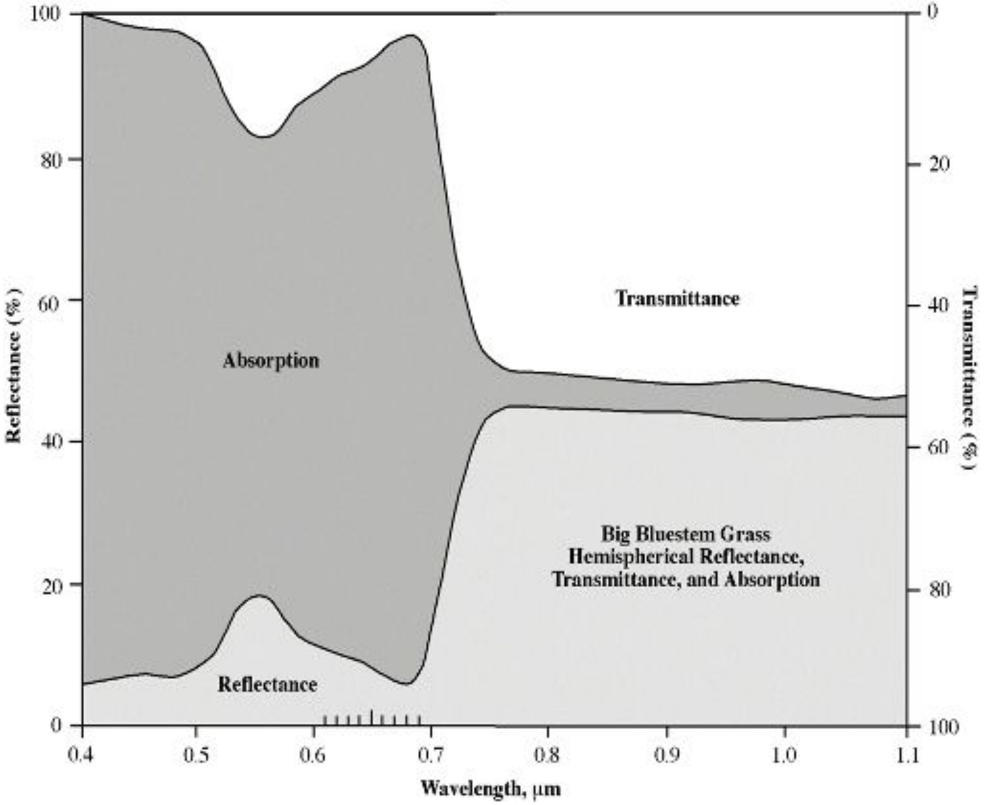


Spectral properties of vegetation



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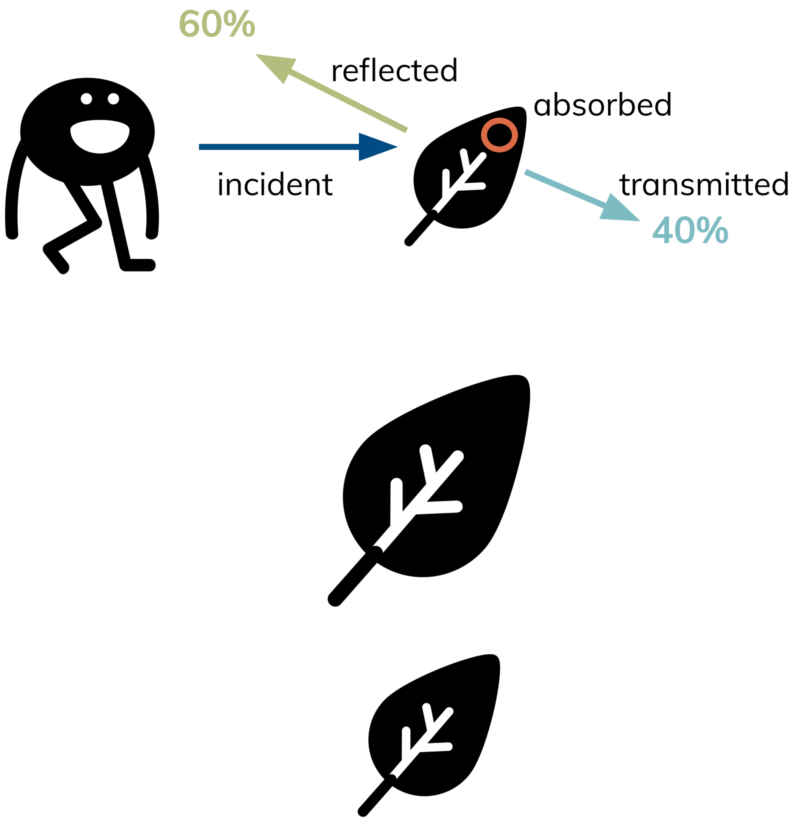

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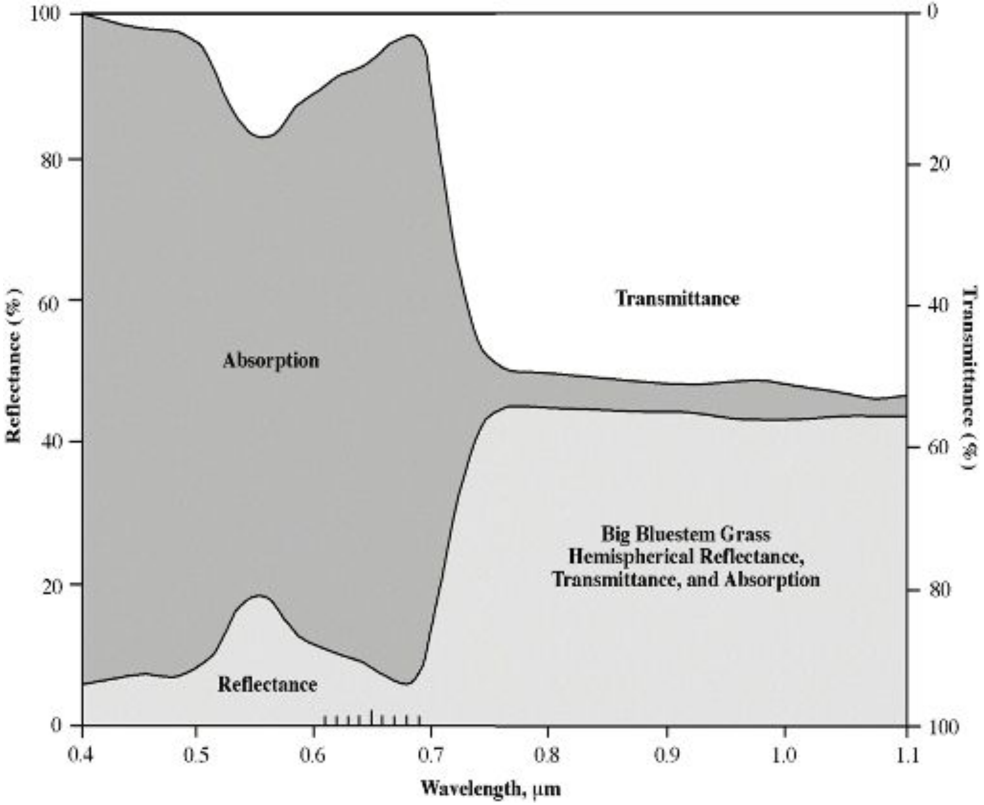

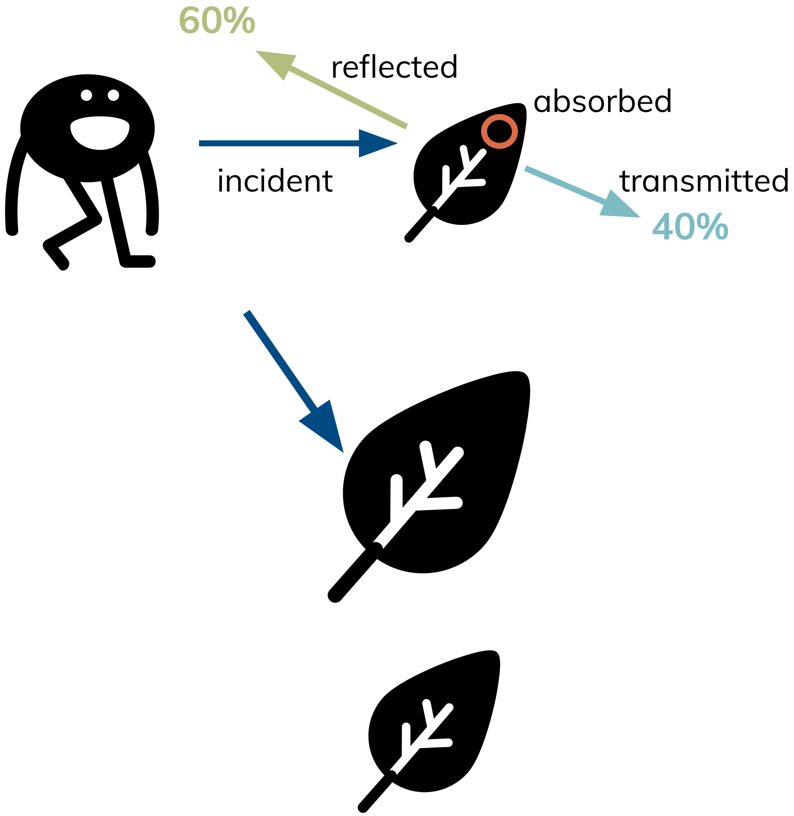

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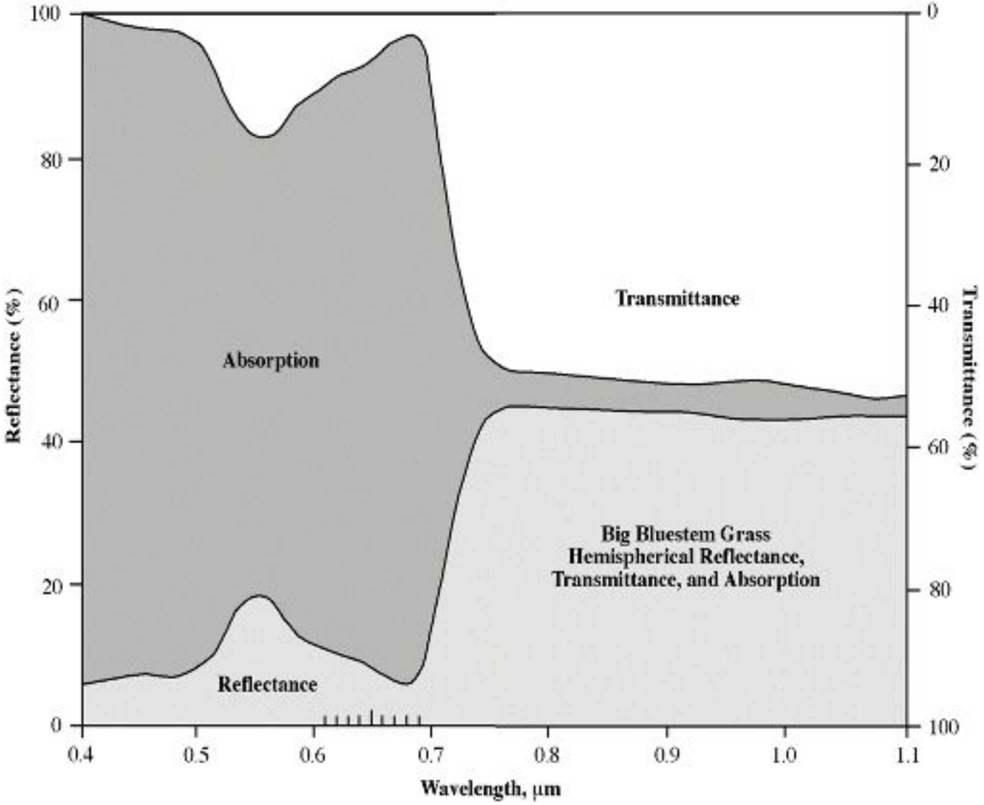

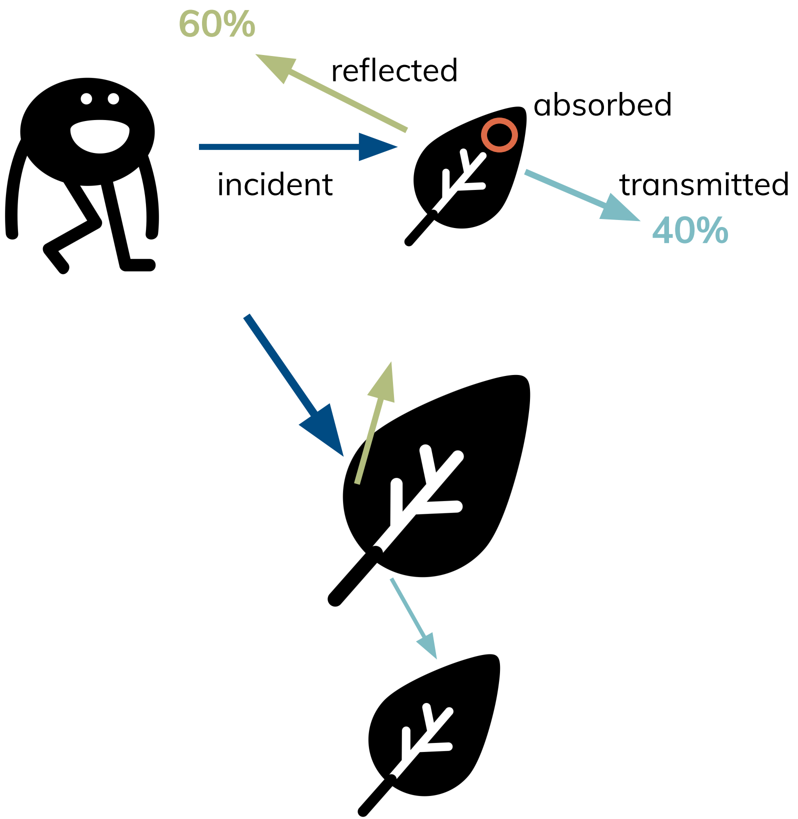

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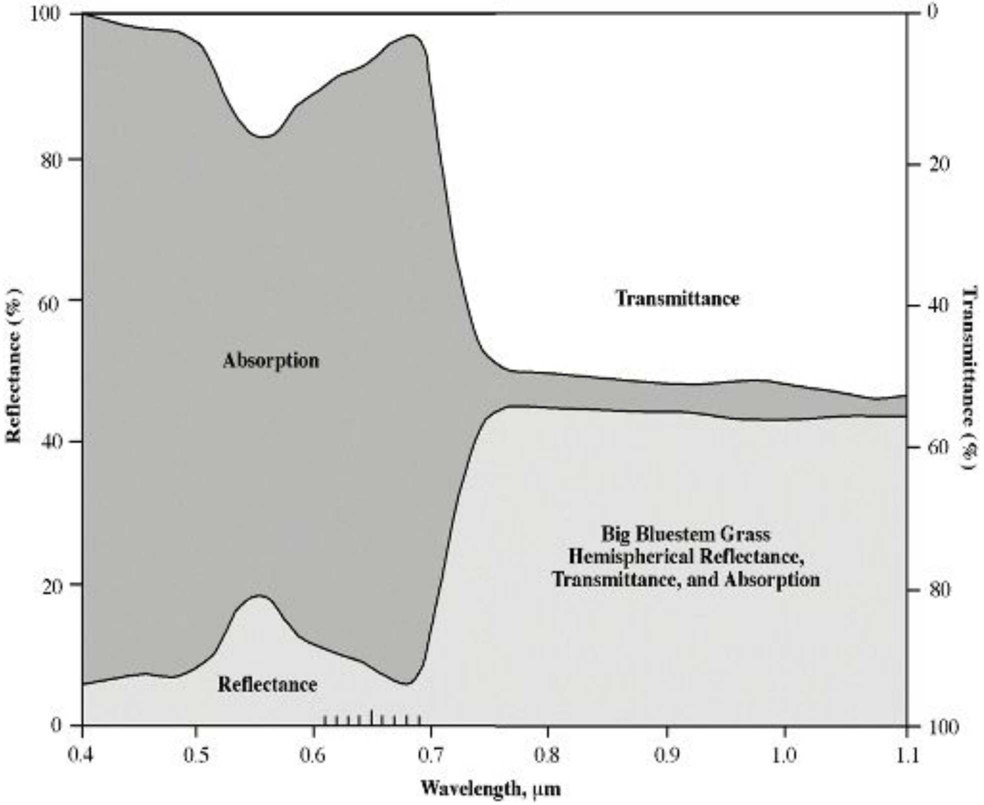

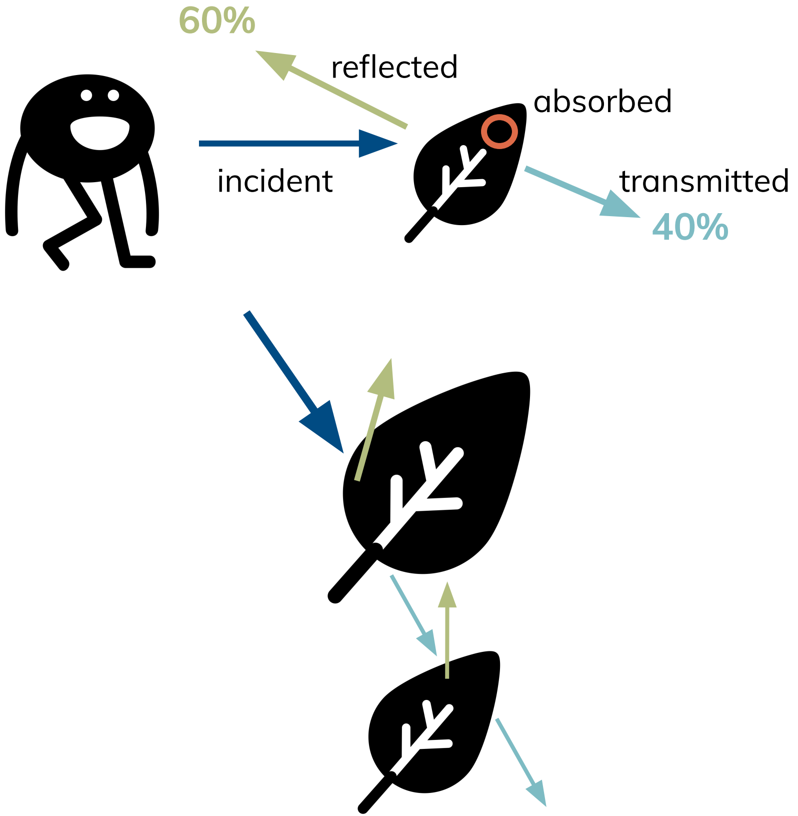

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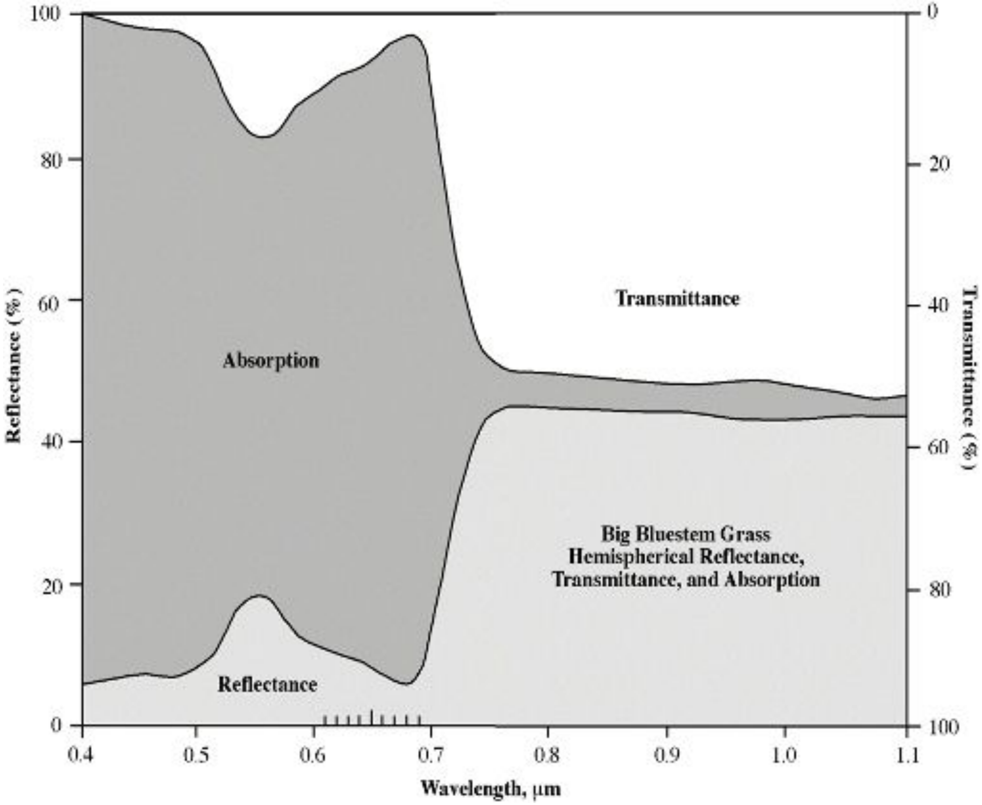

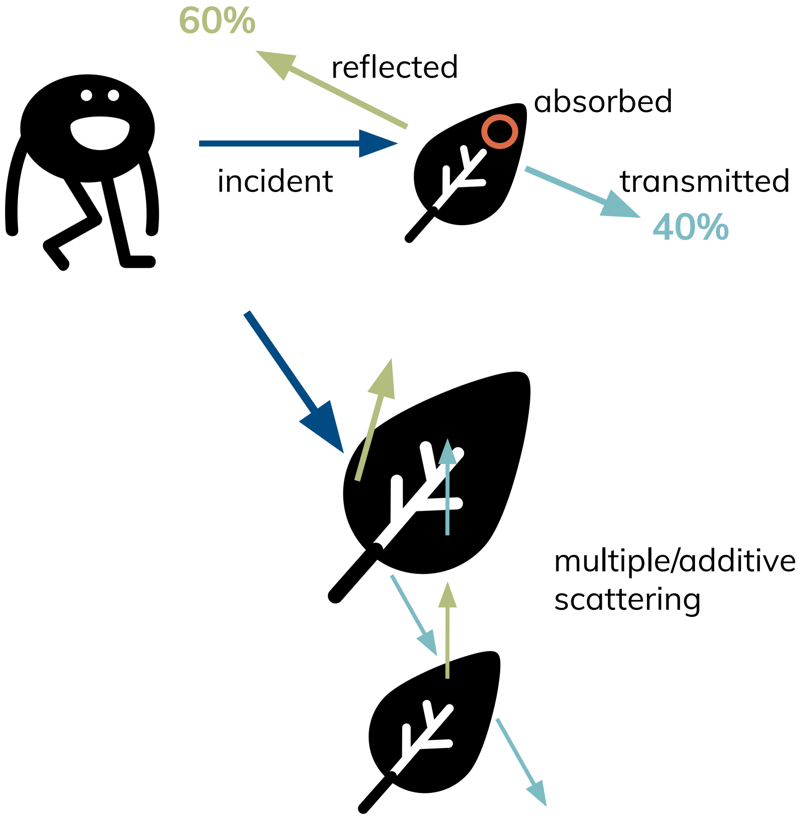

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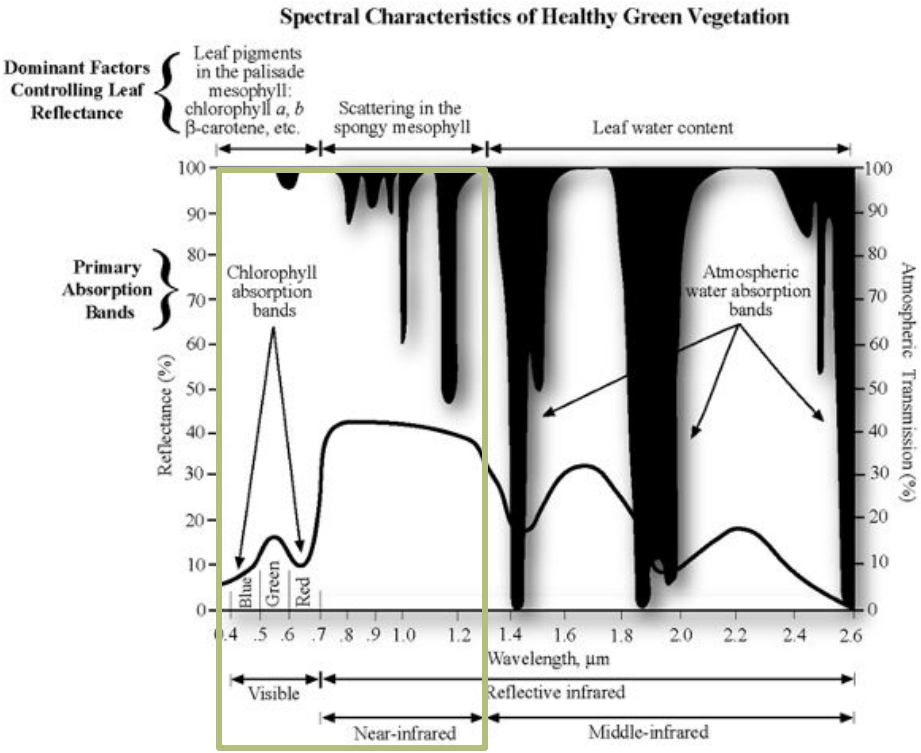
Factors controlling leaf reflectance



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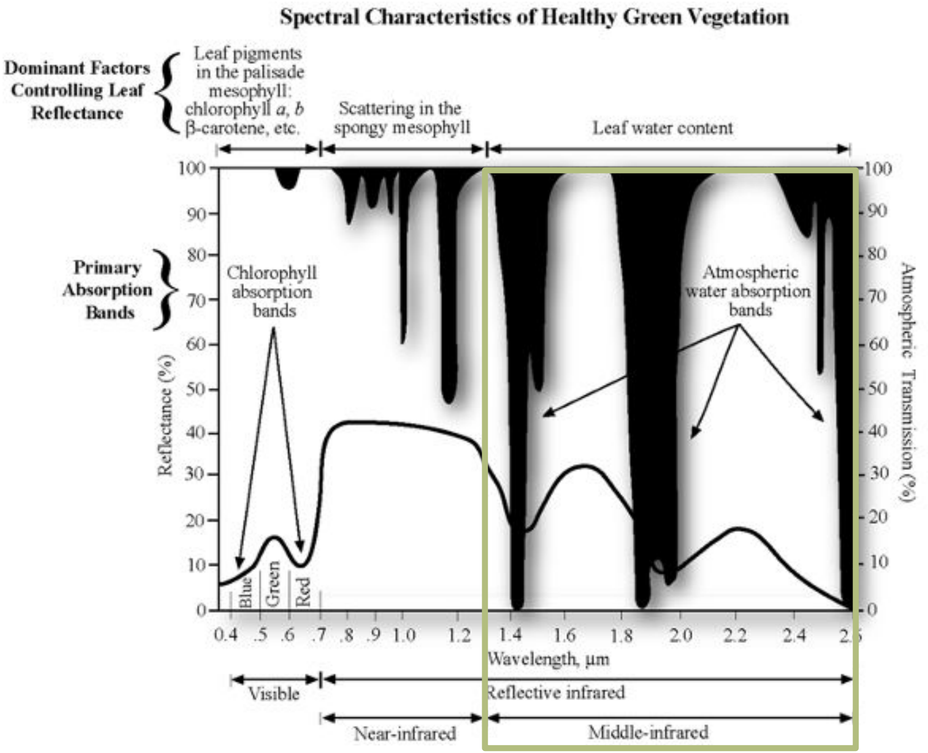
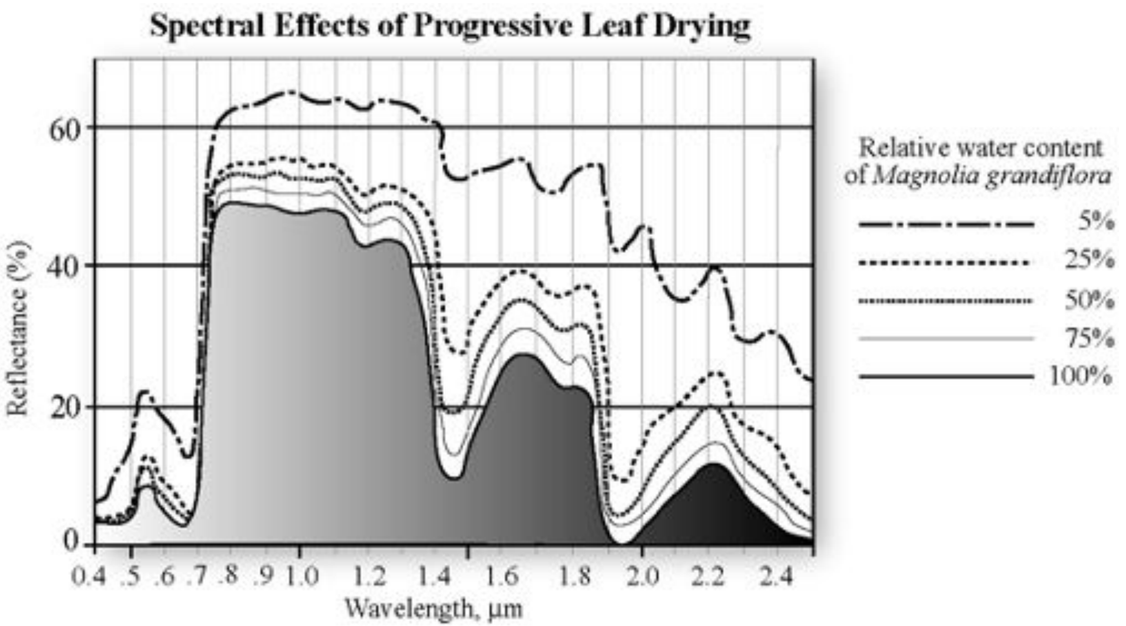


Source: Jensen 2007

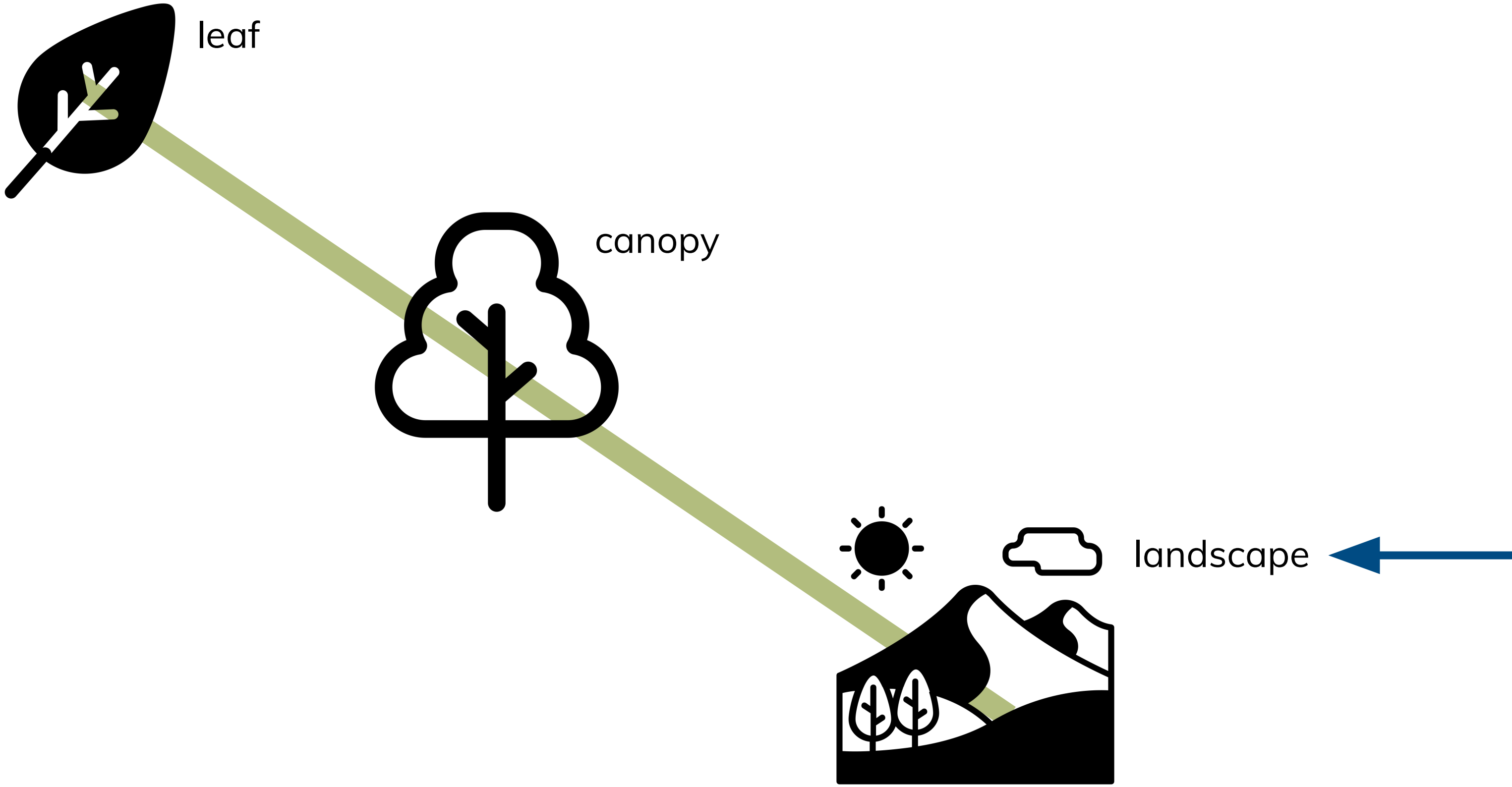
Remotely sensing leaf moisture content



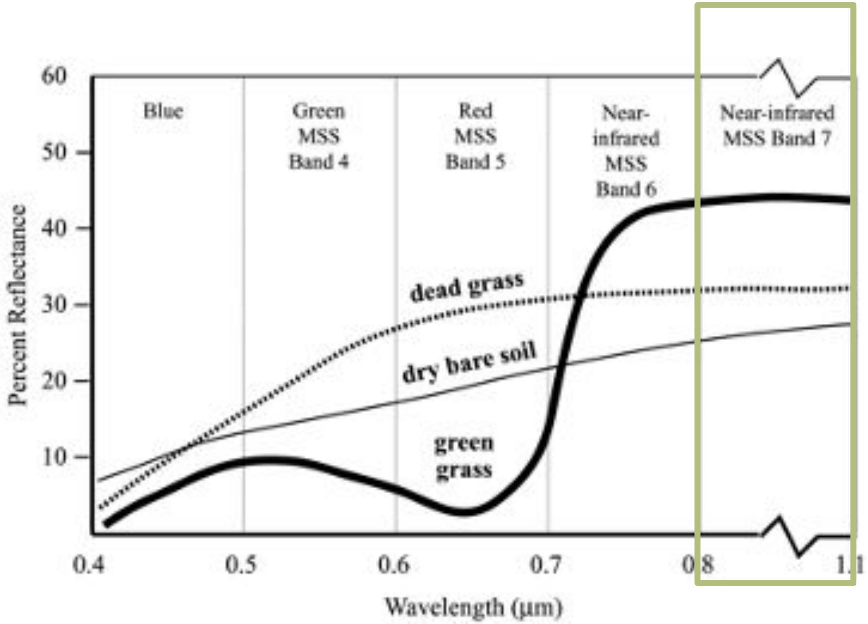
↓ moisture content

↑ shortwave infrared reflectance

Remote sensing of vegetation

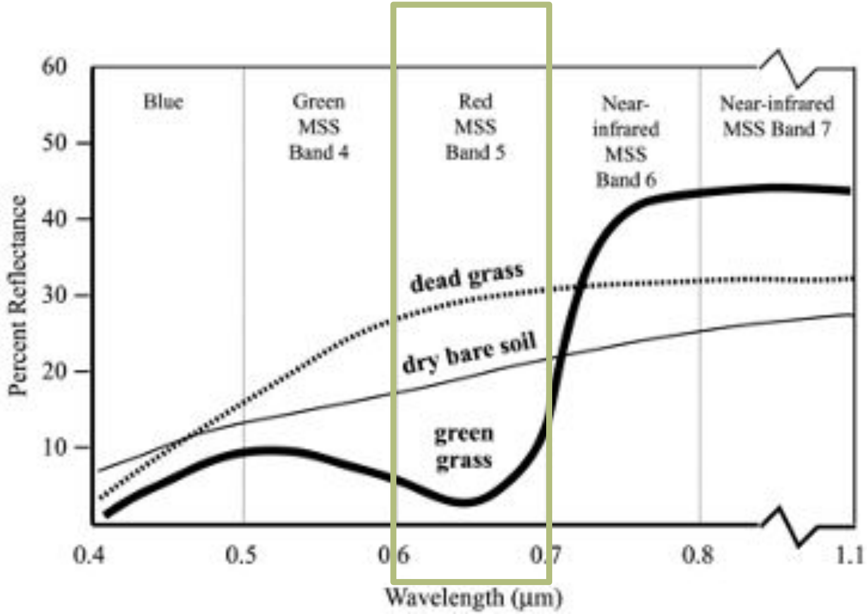


Soil reflectance



soil and vegetation both strongly reflect near infrared

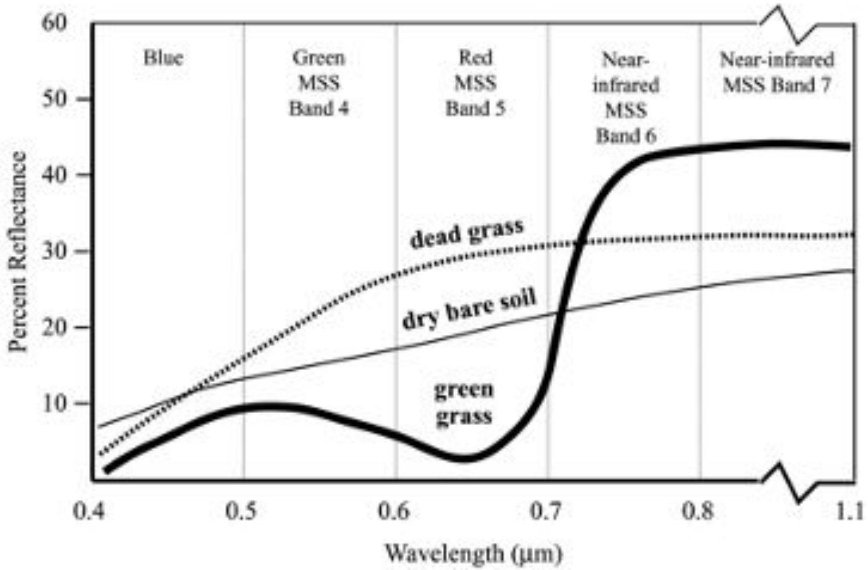
Soil reflectance

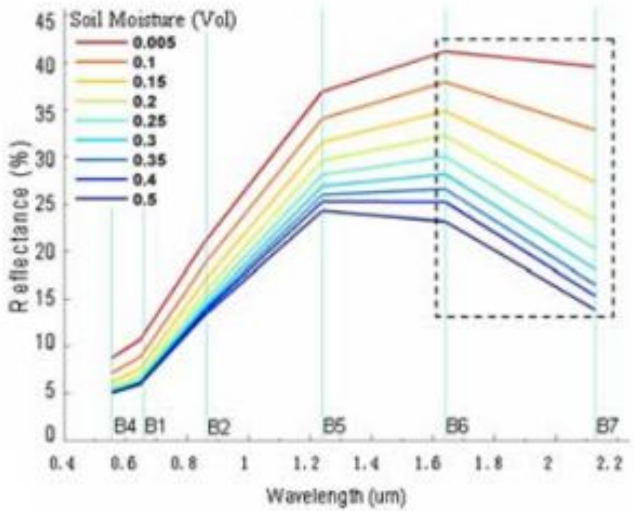


soil and vegetation both strongly reflect near infrared

healthy vegetation absorbs more red

Soil reflectance





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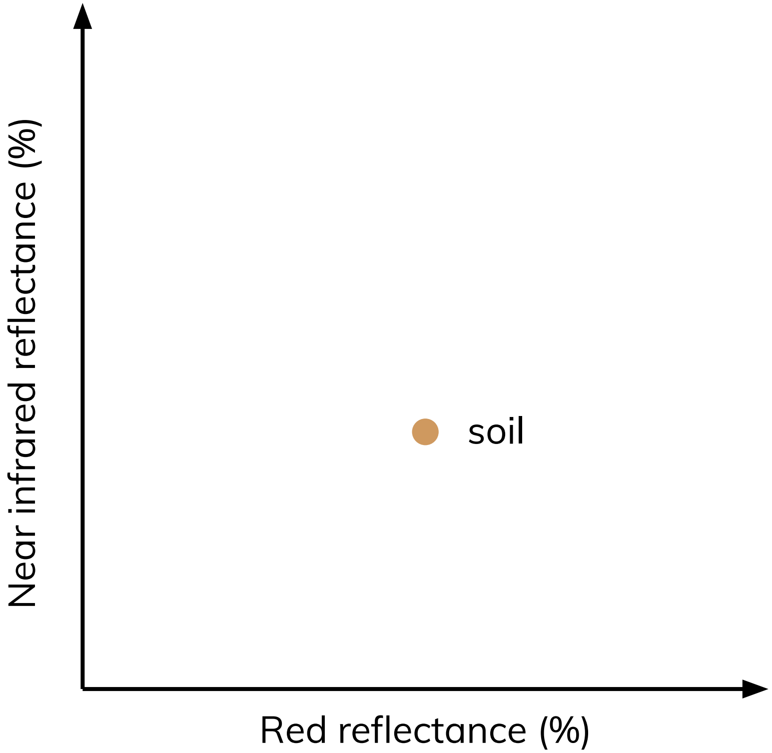
↓ moisture content

↑ near infrared reflectance

Distinguishing soil and vegetation



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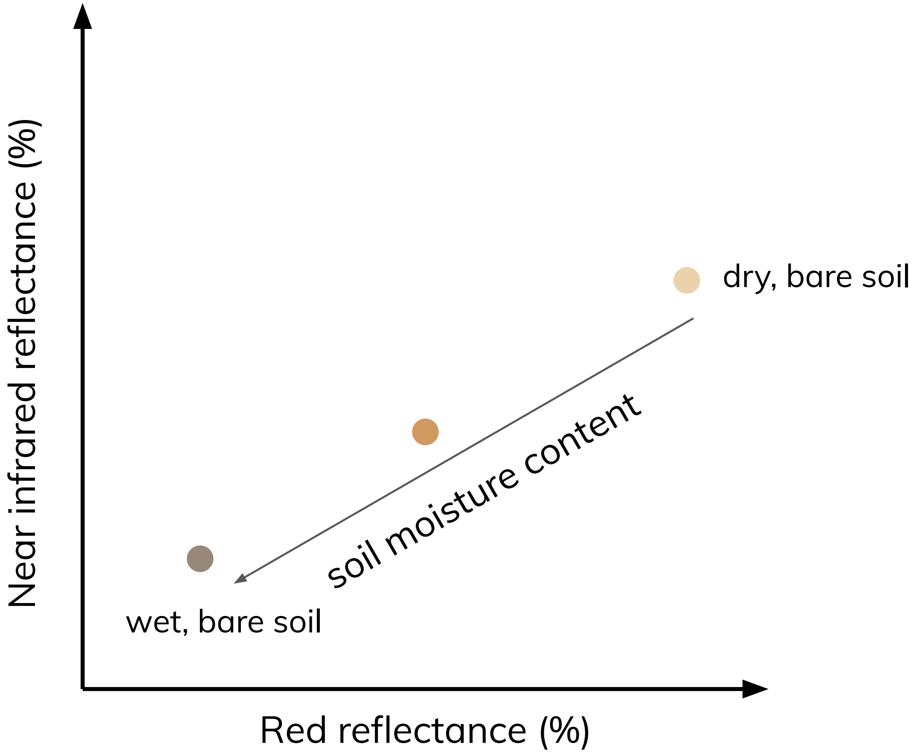

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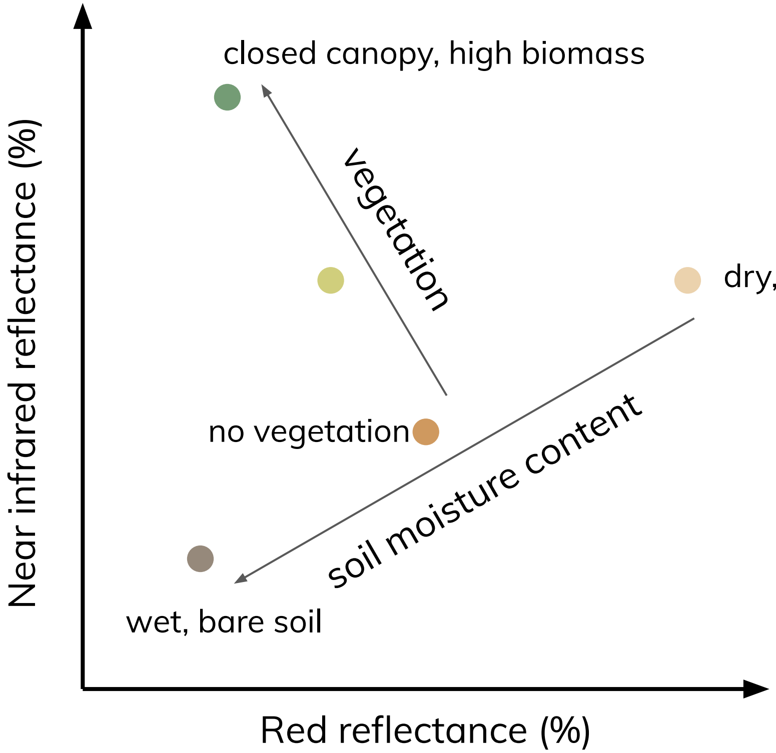

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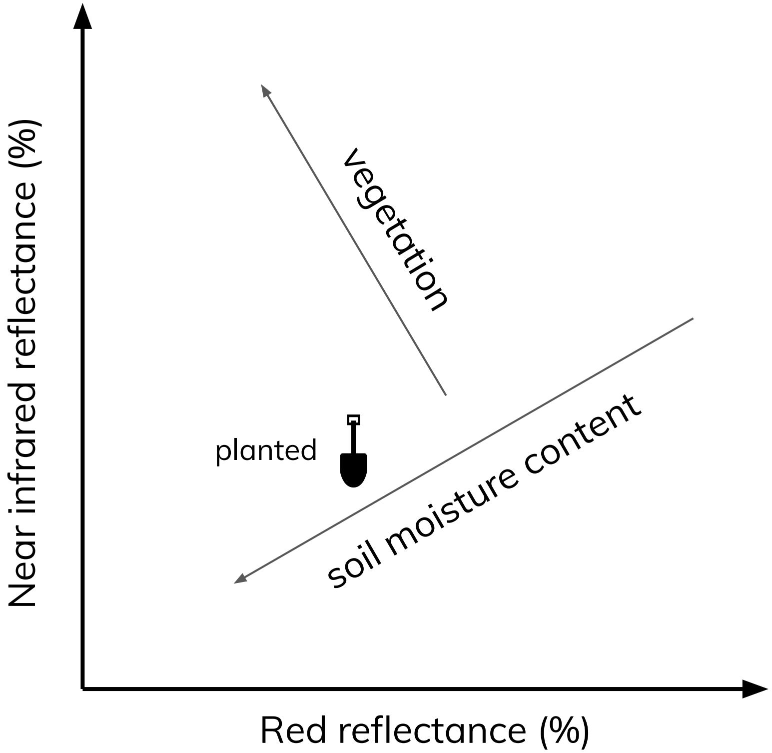

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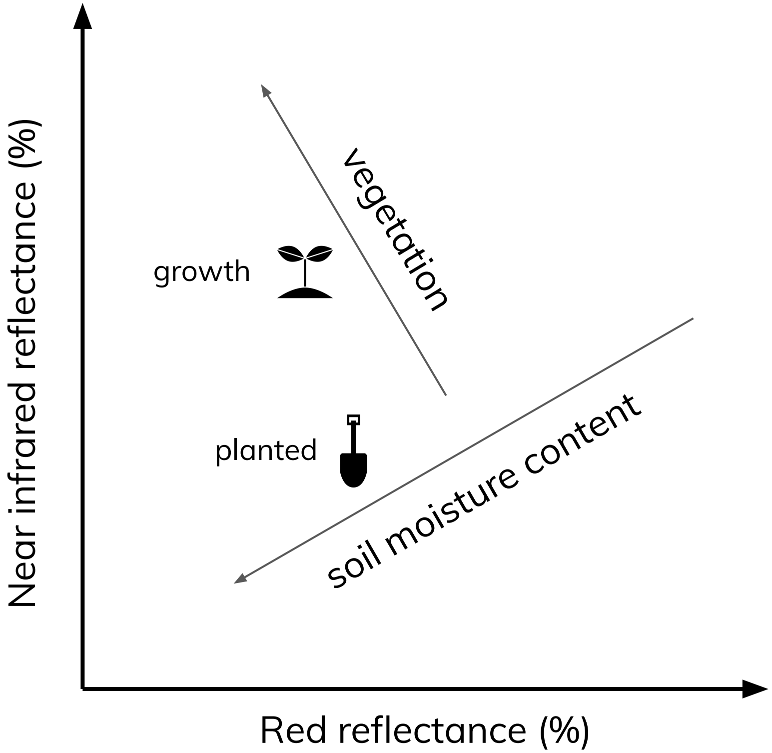

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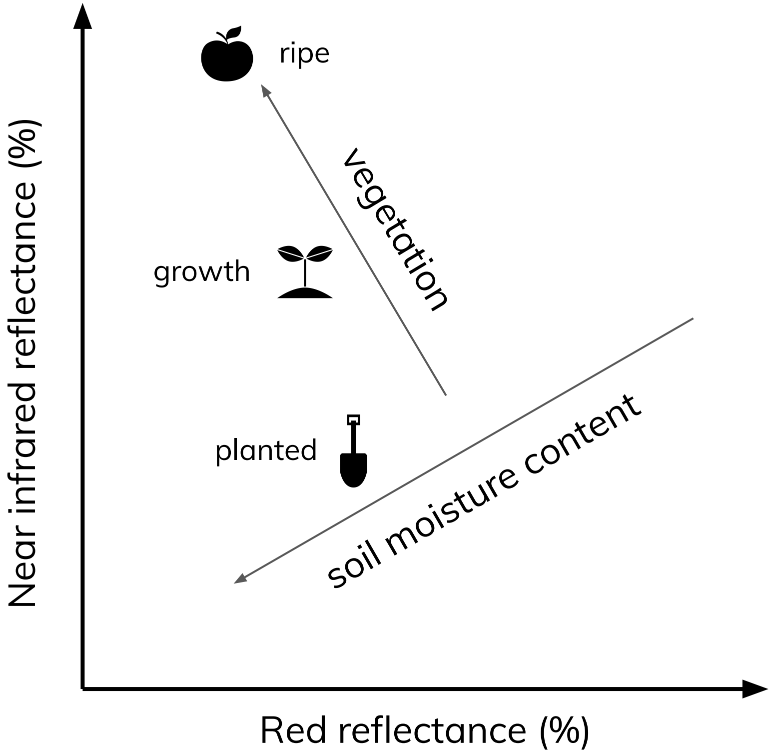

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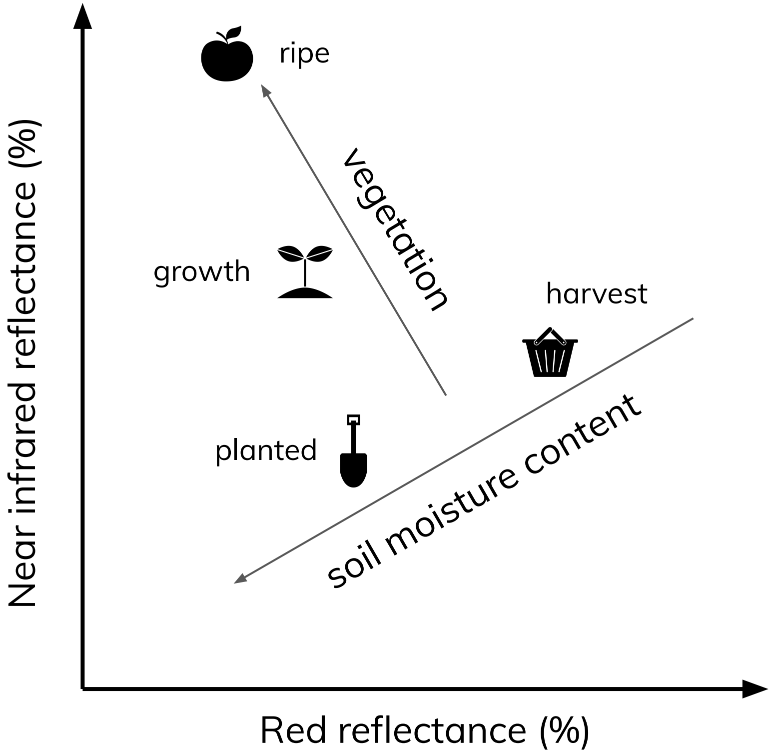
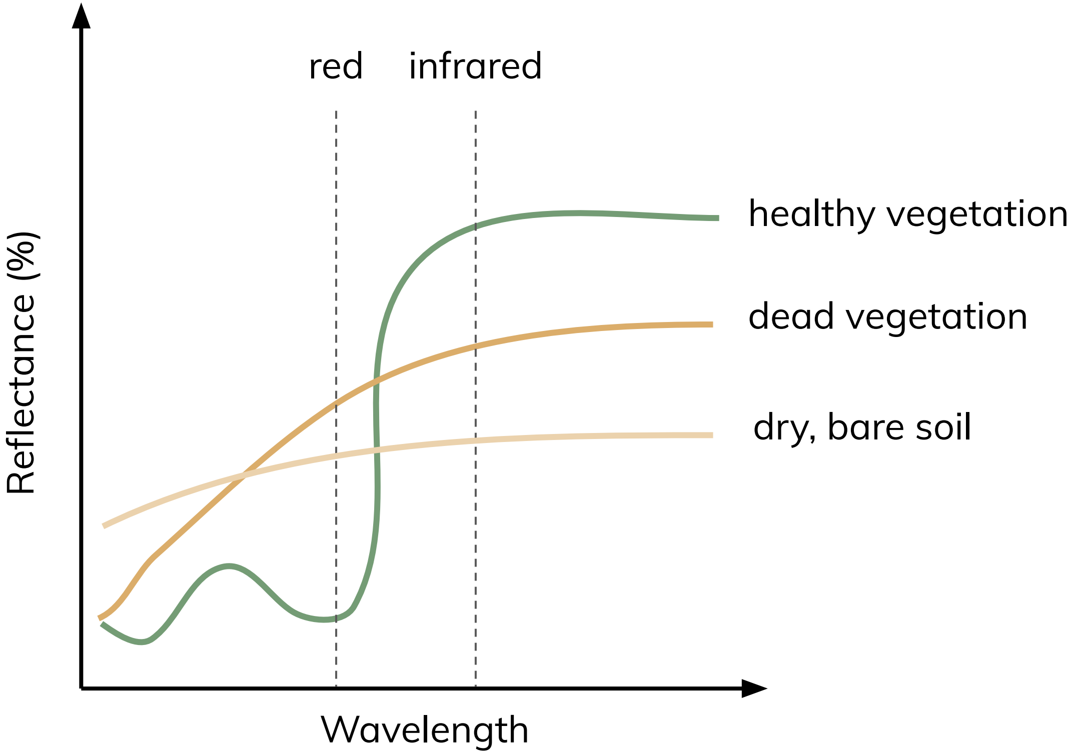


Vegetation indices



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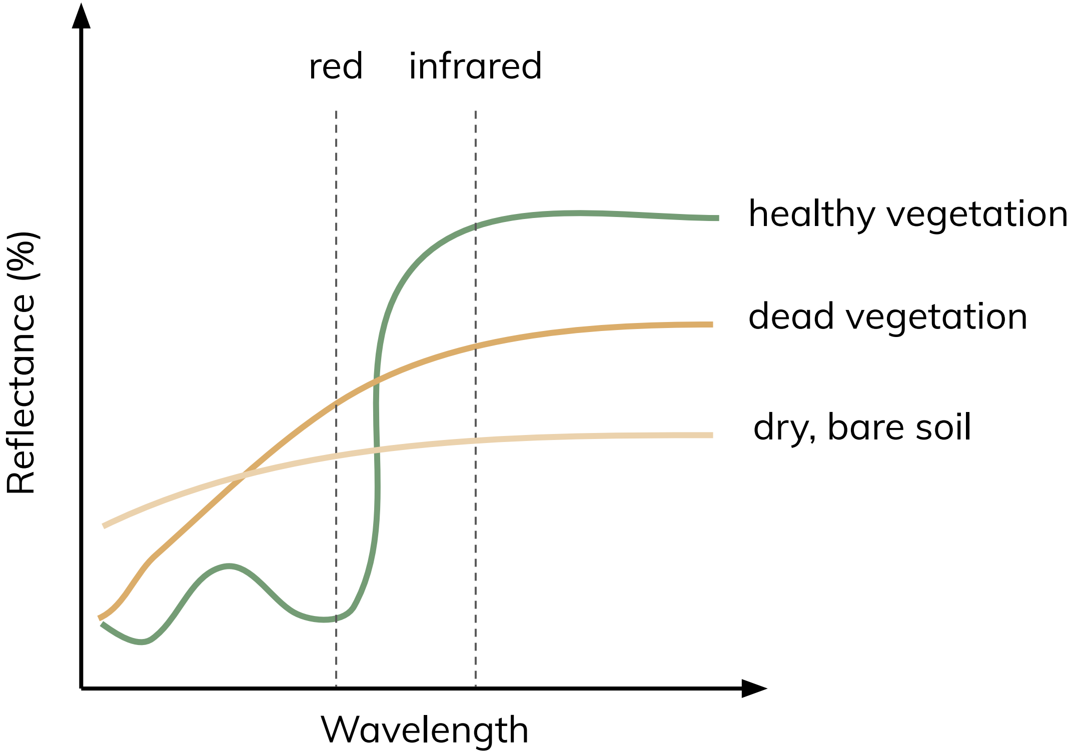
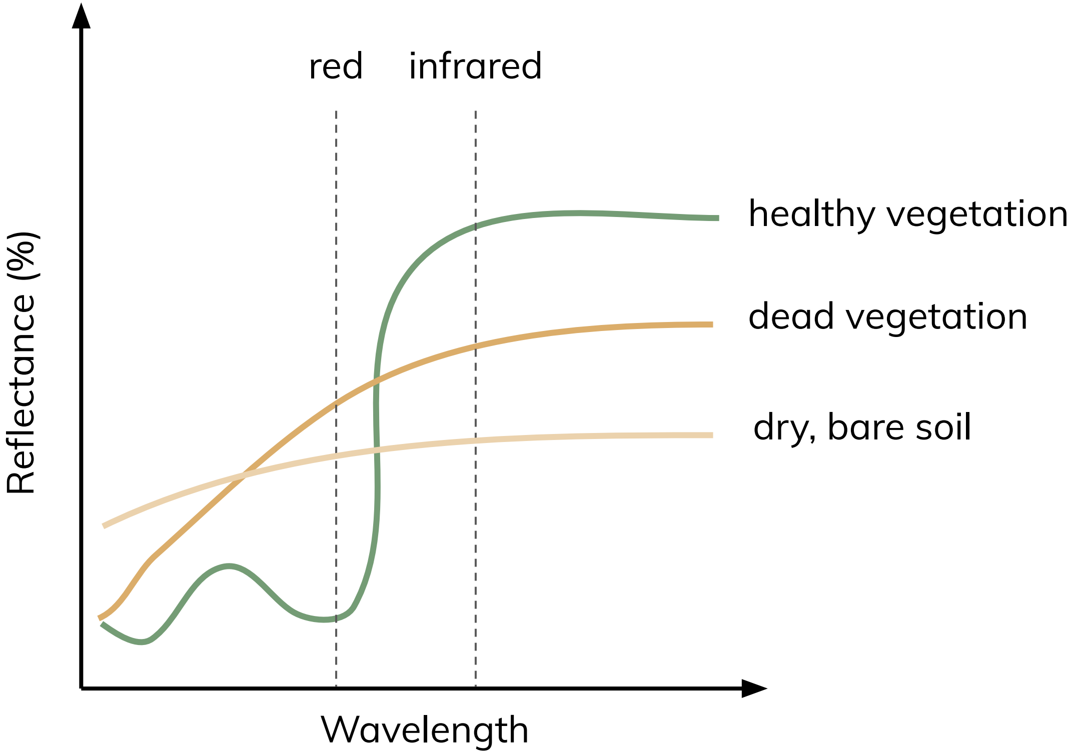


Goals:

- Distinguish (un)healthy vegetat and soil
- Stay constant across images

Vegetation indices



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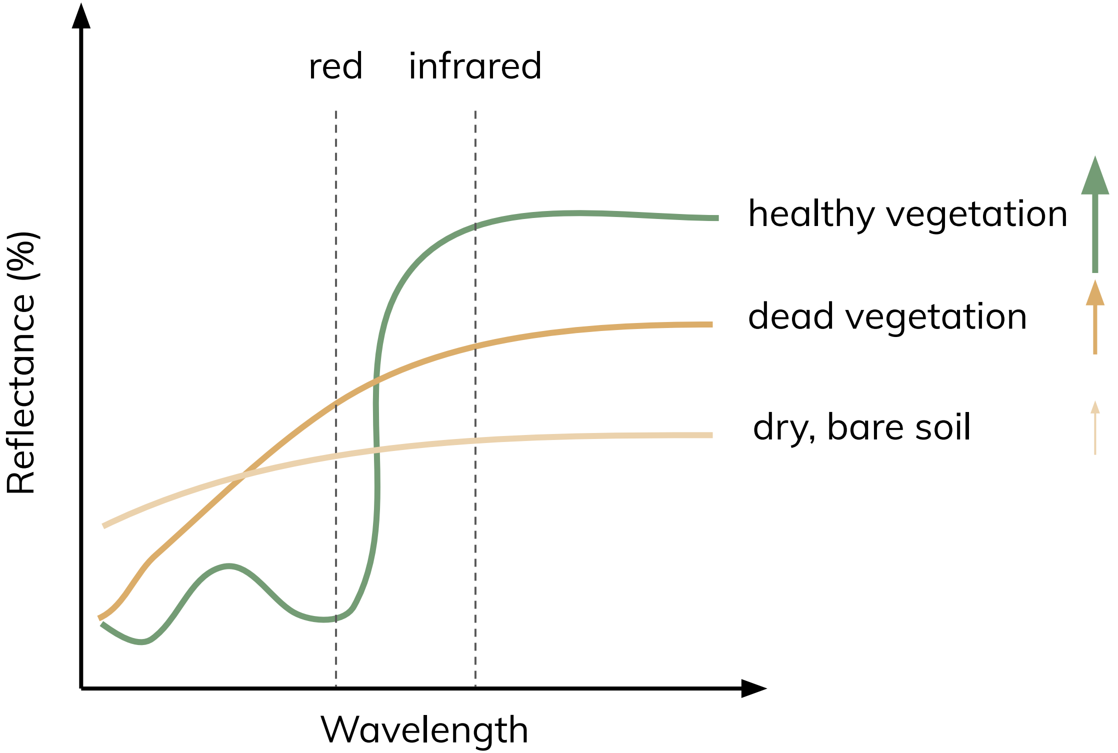
Difference Vegetation Index

DVI = Near infrared - Red

Vegetation indices



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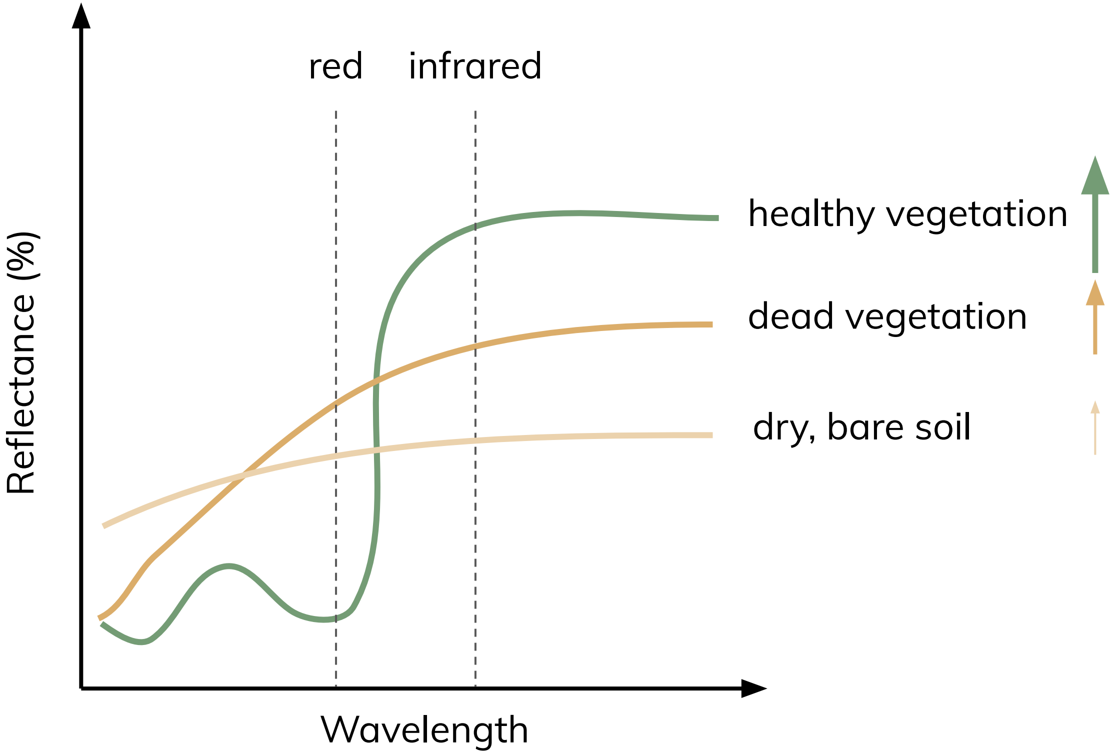

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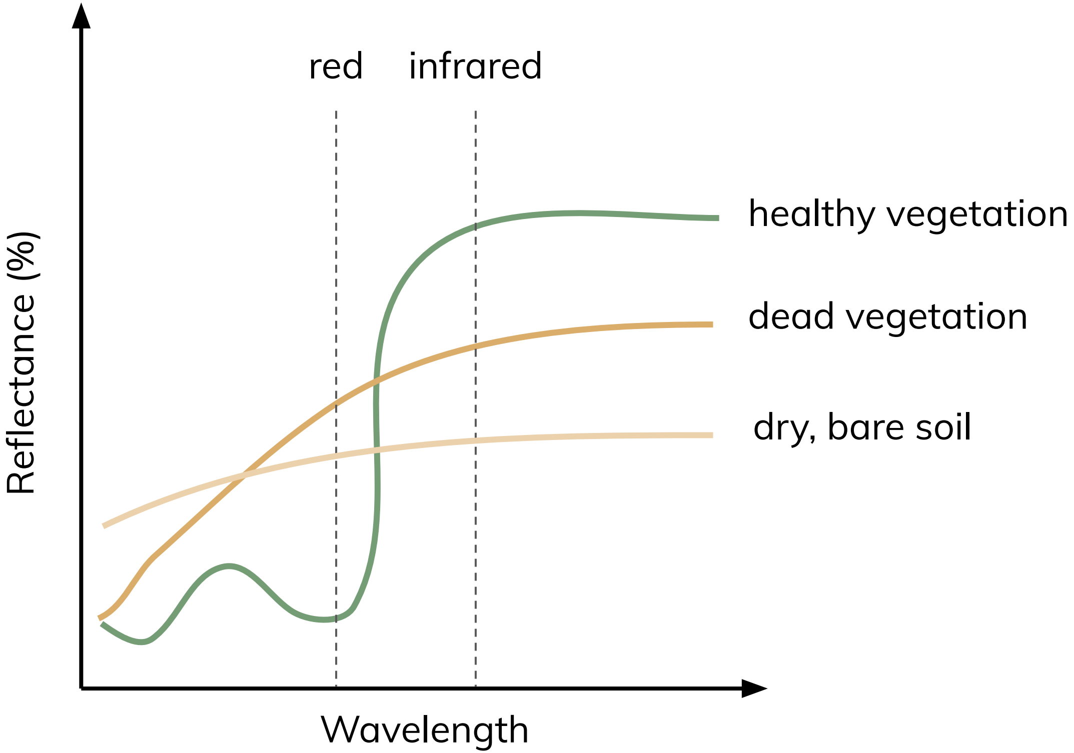

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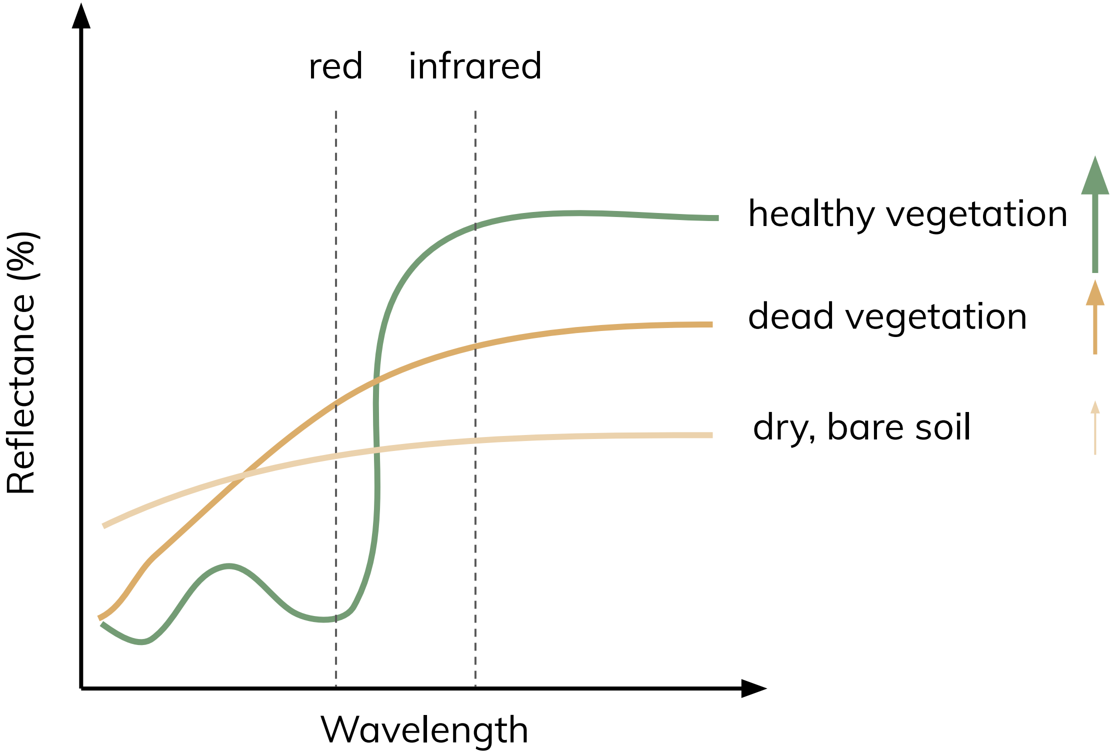
Ratio Vegetation Index

RVI = Near infrared ÷ Red

Vegetation indices



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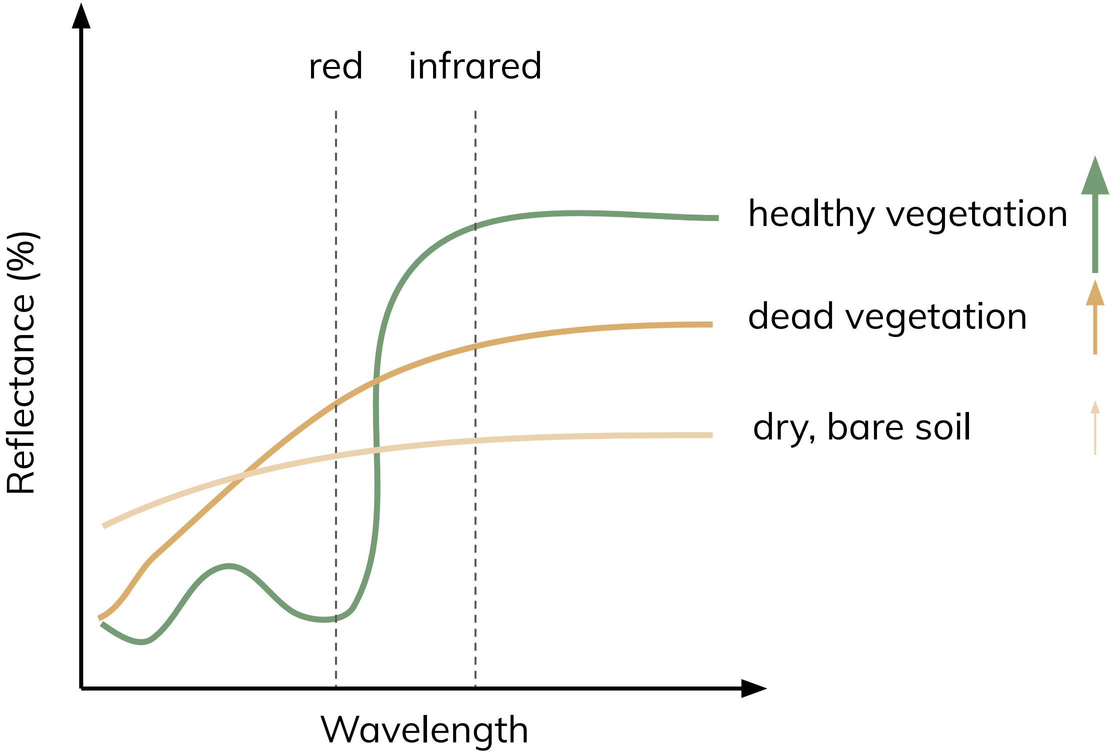

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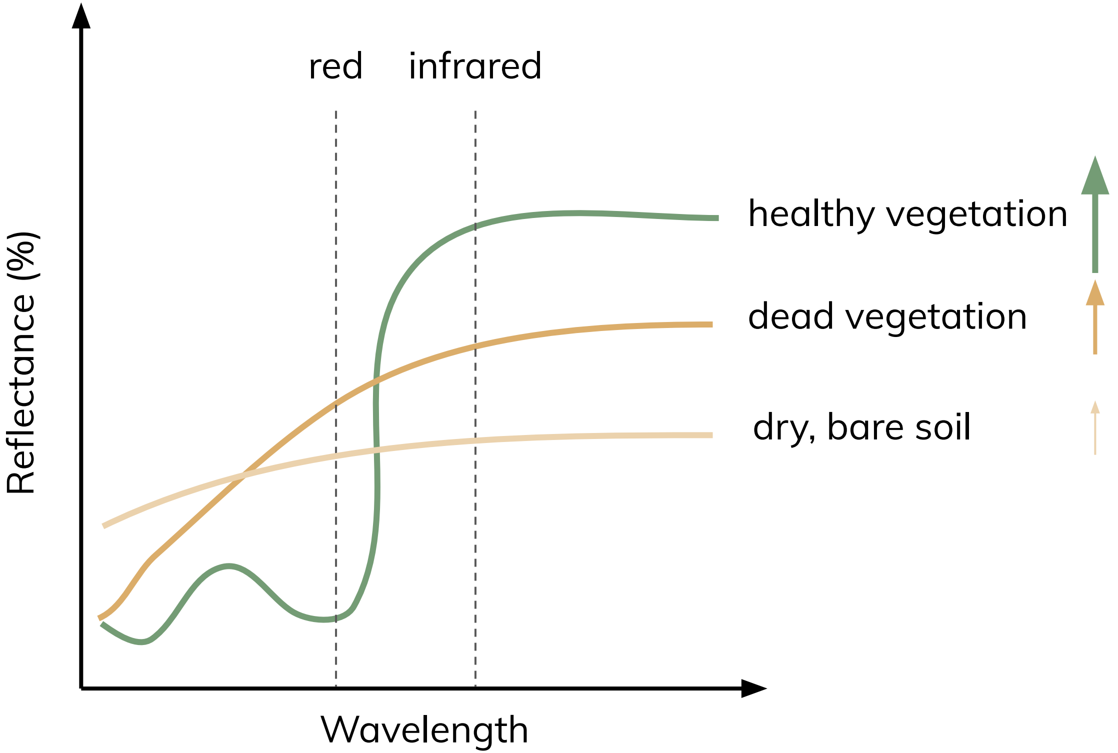

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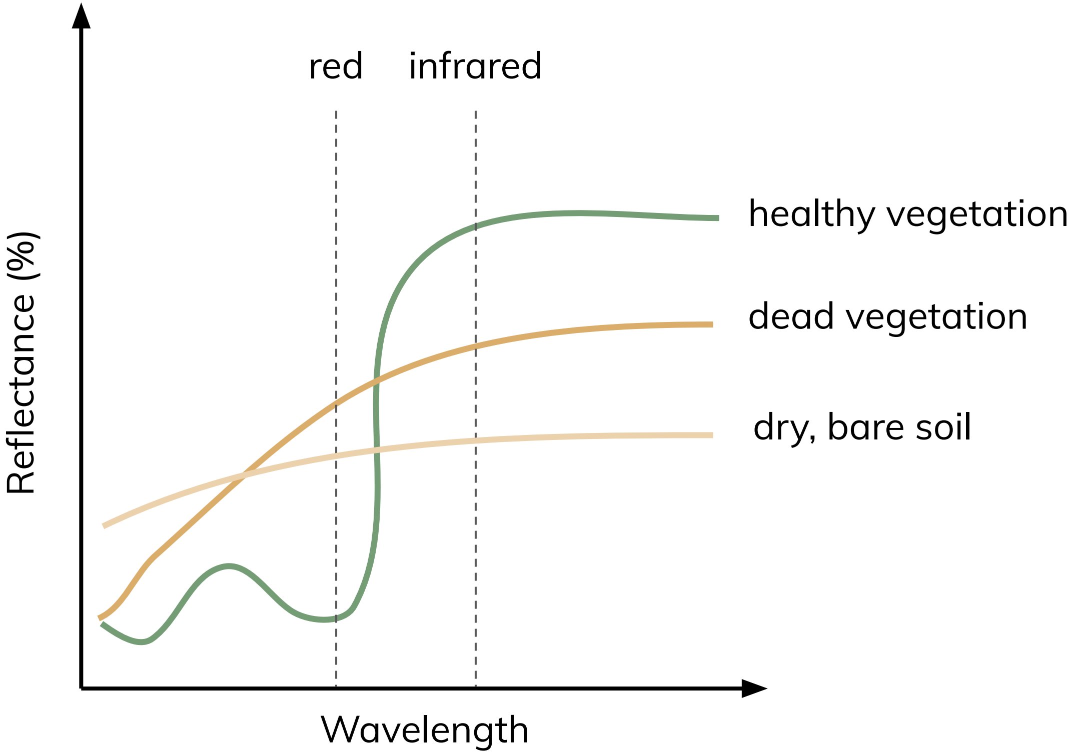
But, division by zero errors....

Vegetation indices



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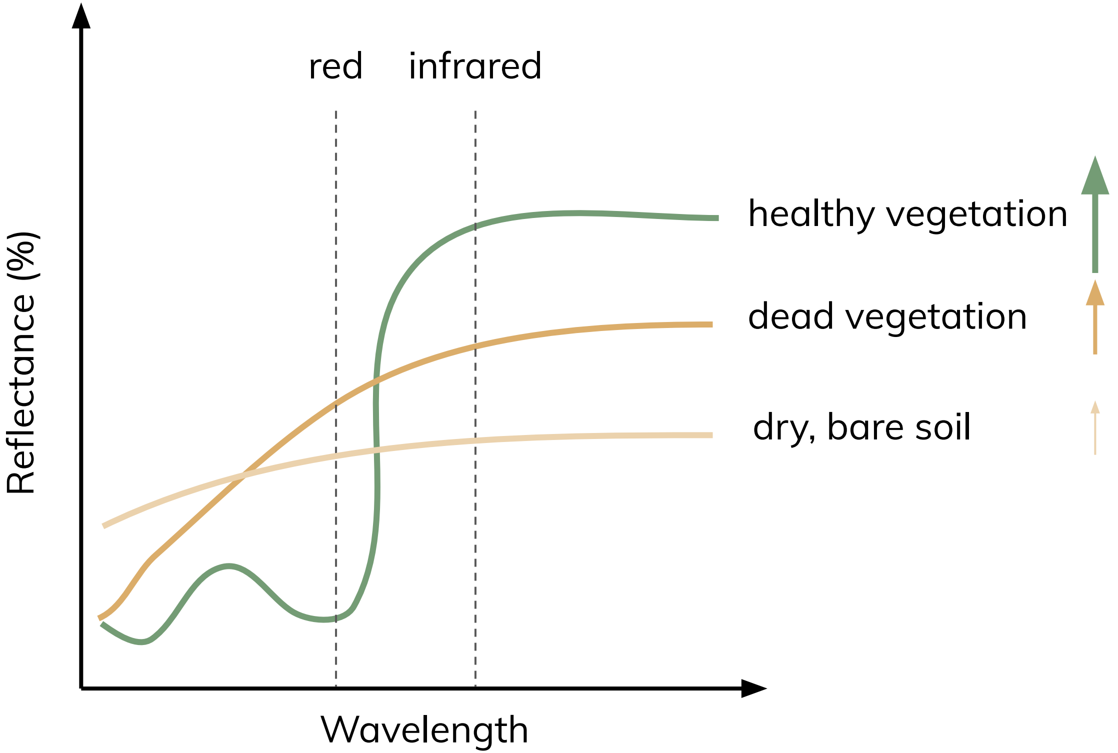
Normalized Difference Vegetation Index

$$\text{NDVI} = \frac{\text{Near infrared} - \text{Red}}{\text{Near infrared} + \text{Red}}$$

Vegetation indices



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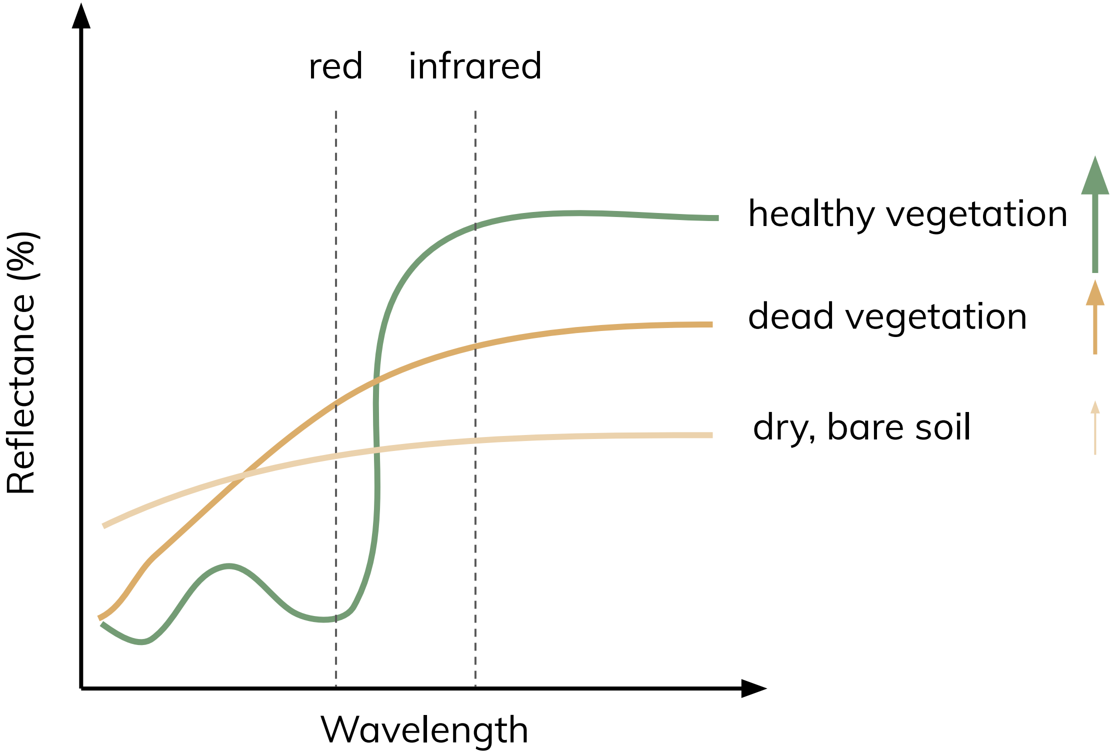

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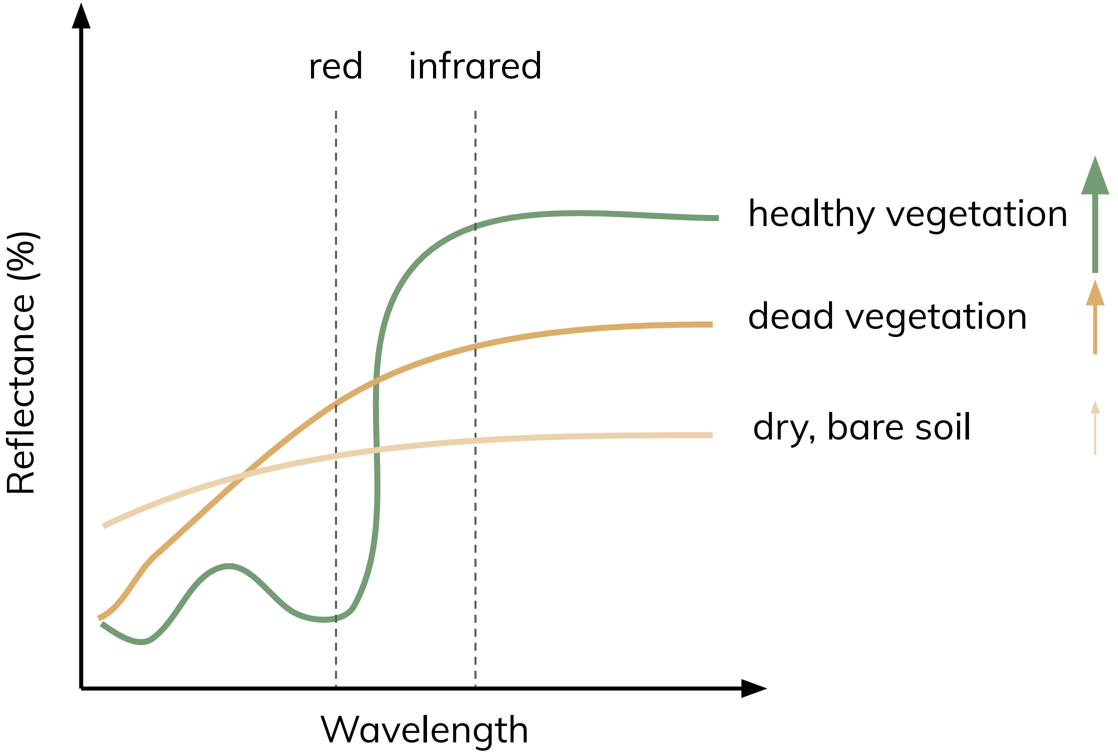

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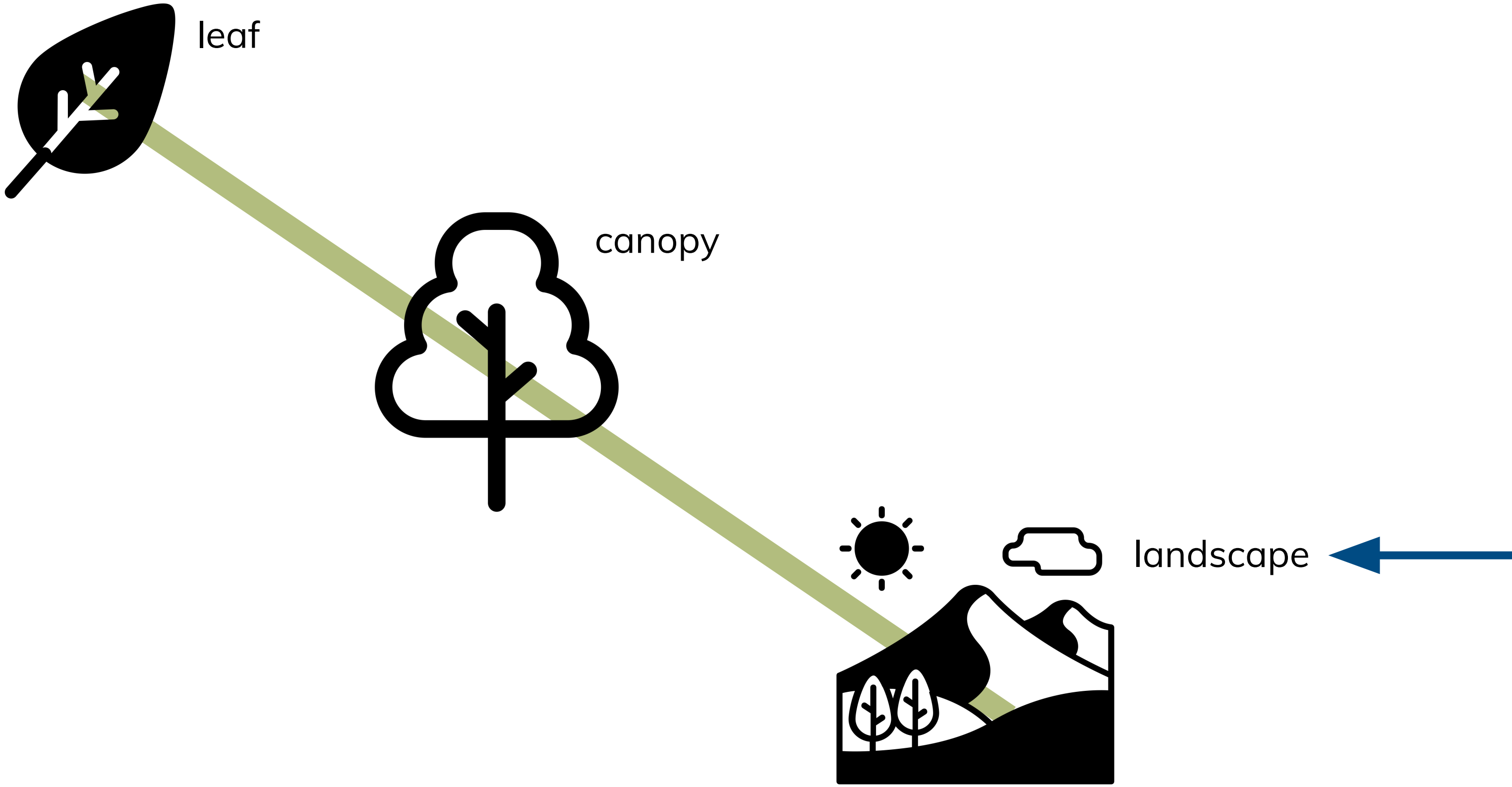
$$\text{NDVI} = \frac{\text{Near infrared} - \text{Red}}{\text{Near infrared} + \text{Red}}$$

Rarely divides by zero

Remote sensing of vegetation



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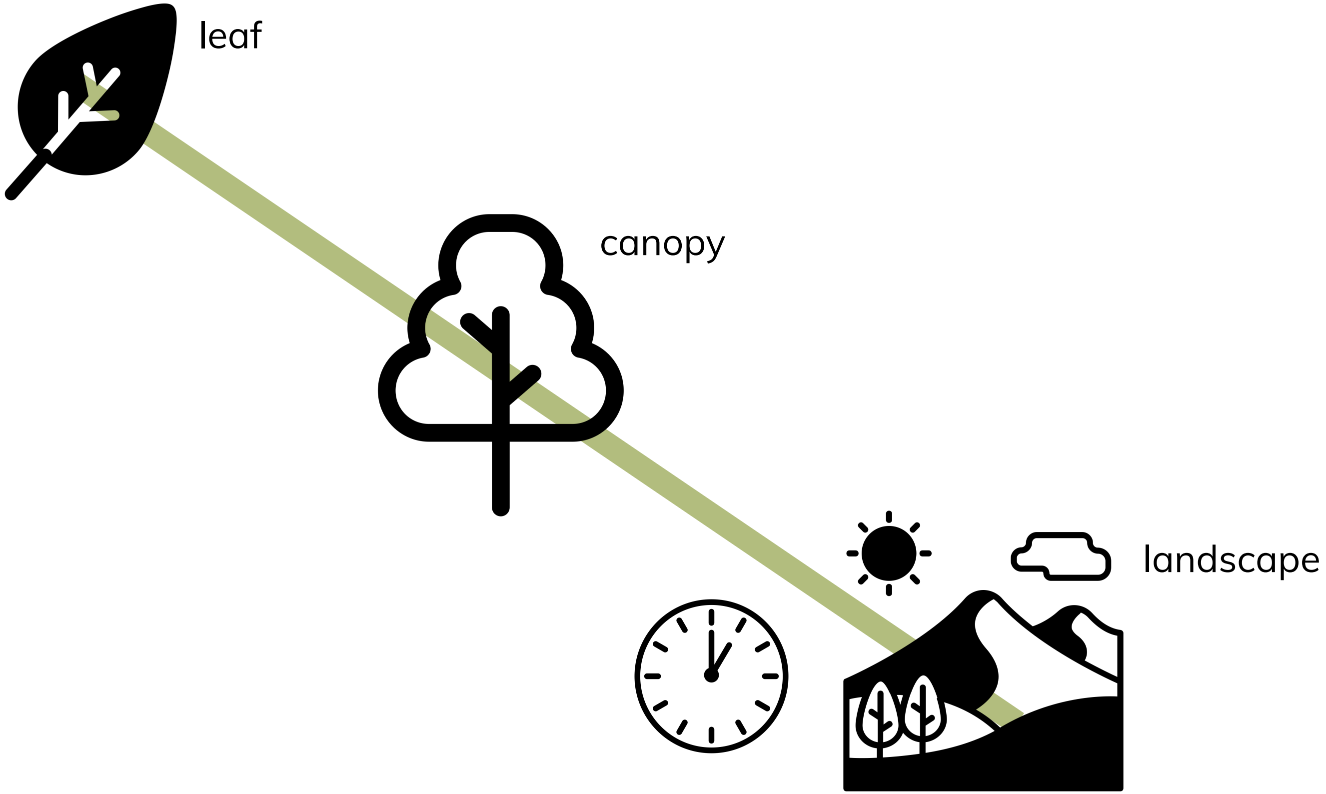
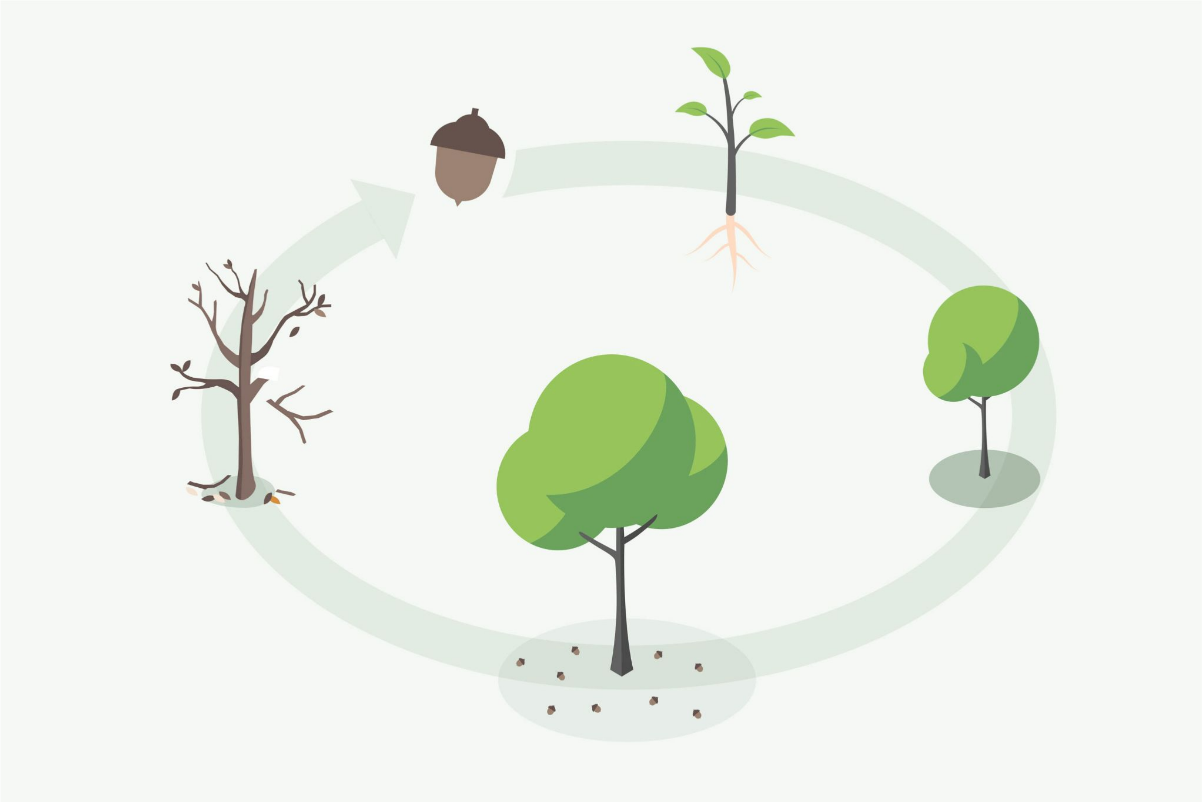


Vegetation phenology



Source: EcoTree

Vegetation phenology

Goals:

- Understand the phenological cycles of plant communities near the Santa Clara River

Approach:

- Estimate NDVI from monthly Landsat images
- Use study sites representing:
  - Riparian forest
  - Grasslands
  - Chaparral shrublands

Source: The Nature Conservancy

How to solve an environmental data science problem

- Break the problem into parts
    - What data do you need?
    - What tools do you need?

- Make a plan
    - What are your inputs?
    - What outputs do you want to create?
    - How can you apply your tools to turn your inputs into outputs?
    - Create a diagram

- Develop your plan
    - Turn our diagram into code

- Test your plan
    - What are the outputs at each step?
    - Do they look right?

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- **Break the problem into parts**
  - **What data do you need?**
  - **What tools do you need?**

- Data:
  - Monthly satellite data
  - Information on location of vegetation communities
- Tools:
  - Raster and vector tools

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  - **What outputs do you want to create?**
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- Inputs:
  - Monthly satellite reflectance data
  - Polygons of study sites for each veg community
- Outputs:
  - Time series of NDVI for each veg community

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