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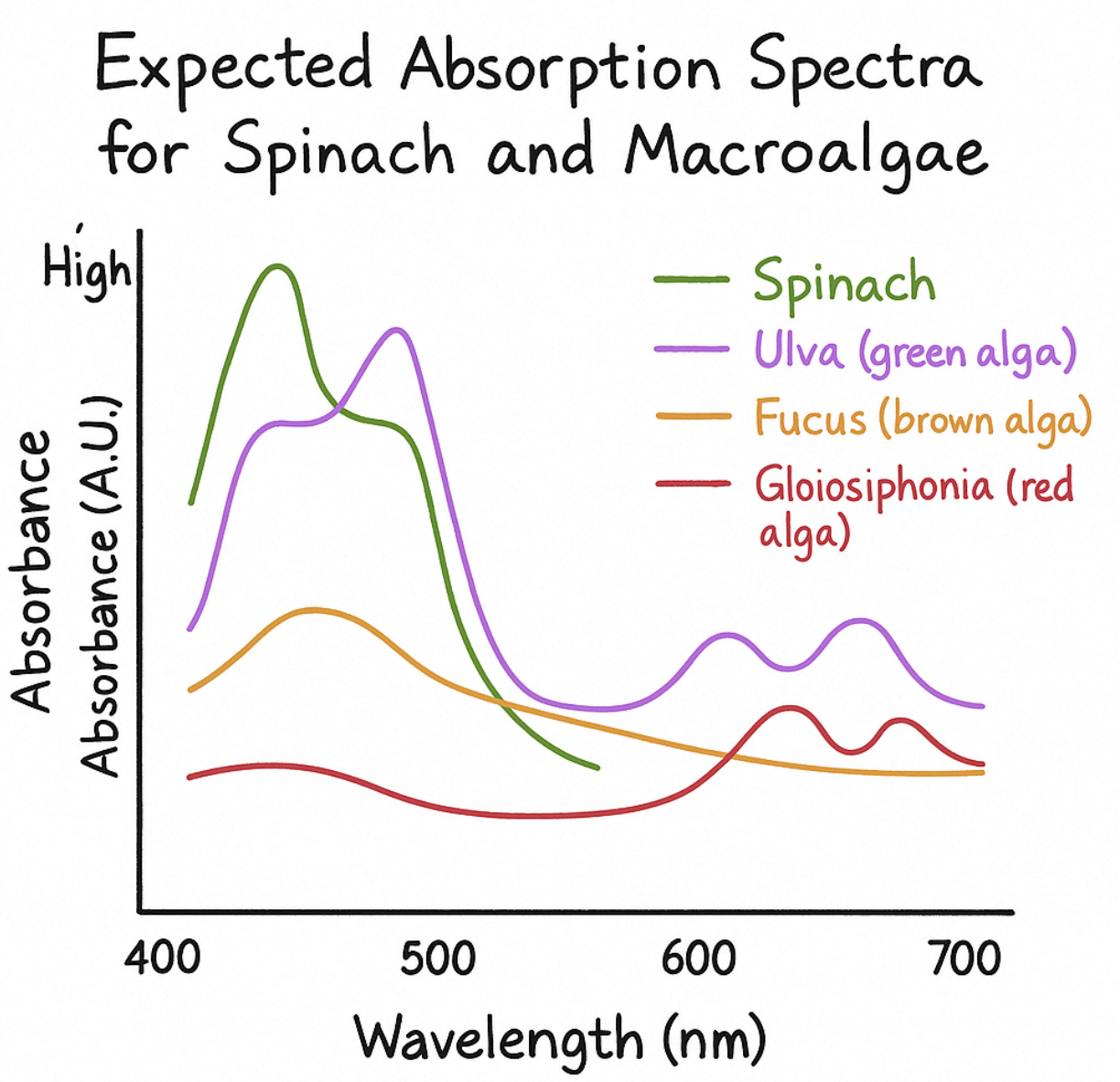
Date: 10/30
Assignment #3 – Photosynthesis / Spectrophotometer

Predictions



Before testing the samples, I expect the spinach to have two main absorption peaks — one in the blue range around 430 nm and another in the red around 662 nm — because these are typical for chlorophyll a. I also think there might be smaller peaks near 453 nm and 642 nm from chlorophyll b, since both pigments are found in most green plants.

For the Ulva (green alga), I predict a strong blue peak somewhere around 430–450 nm, similar to spinach, and a smaller red peak near 660–670 nm. Because Ulva lives underwater, its pigments might absorb slightly broader wavelengths compared to spinach, but I still expect chlorophyll a and b to dominate.

In the case of Fucus (the brown alga), I expect the absorption pattern to look a bit different. Brown algae contain the pigment fucoxanthin, which absorbs strongly in the blue-green region (about 400–520 nm), so I think that area will be higher. There should also be a smaller peak near 665 nm from chlorophyll a.

Finally, for Gloiosiphonia (the red alga), I expect to see the biggest difference. Red algae have phycobilin pigments like phycoerythrin and phycocyanin, so I think there will be strong absorption in the green-orange range (around 495–570 nm) and again near 620–650 nm. I also predict a smaller chlorophyll a peak around 660–665 nm, but it probably won't be as dominant as in spinach.

Table

Sample	Max Abs (A.U.) @ nm	Min Abs (A.U.) @ nm
Spinach	1.35 @ 440	0.15 @ 700
Ulva	2.50 @ 440	0.56 @ 700
Fucus	(6.63 @ 510 → outlier; true ~2.5 @ 440)	0.56 @ 700
Gloiosiphonia	2.50 @ 430	0.56 @ 700

Spectrophotometer absorbance (A.U.) values from ~380–700 nm for Spinach, Ulva, Fucus, and Gloiosiphonia (n ≈ 31 wavelengths per sample).
The table shows raw, wide-form data (wavelength = rows; one column per sample) recorded in class.
These unaltered readings were used to create Figure 1.

Figure

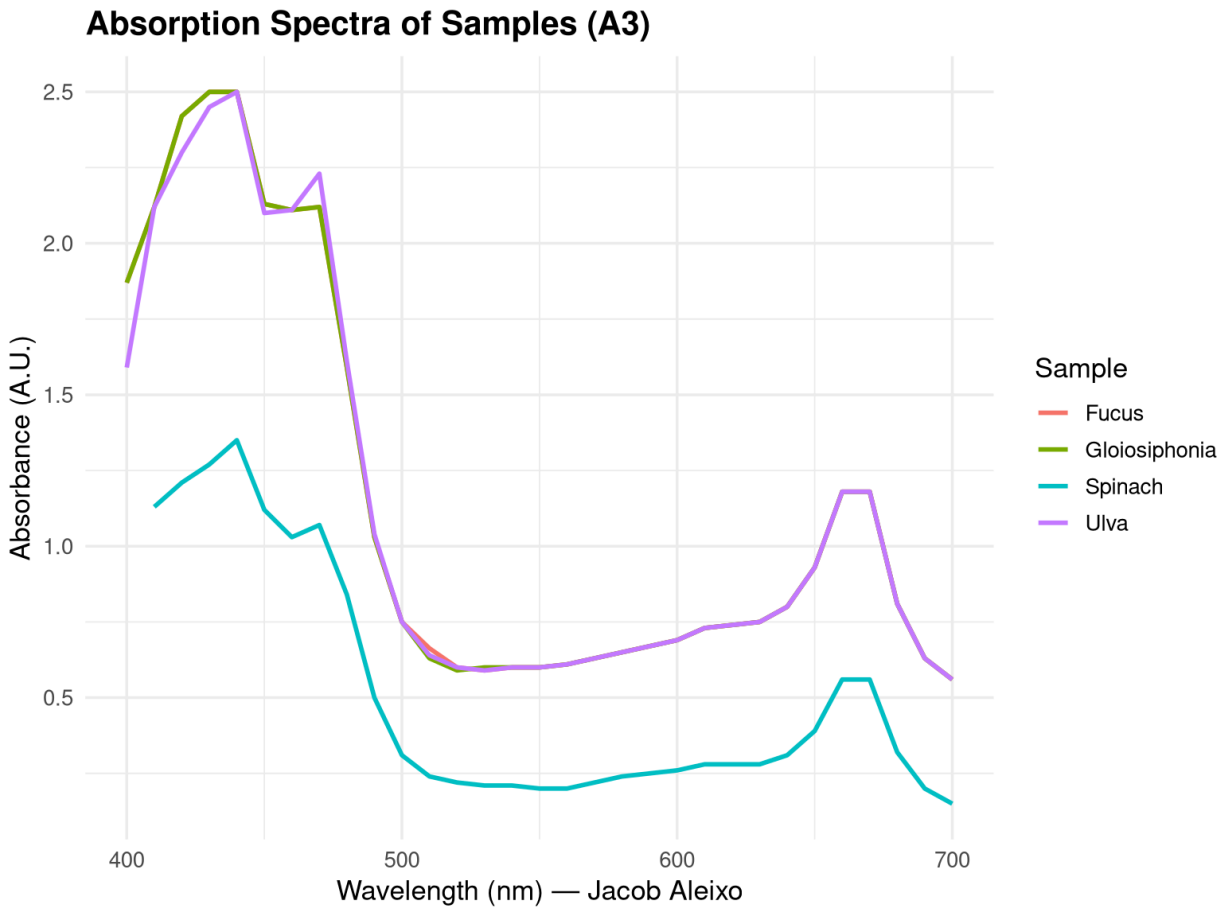


Figure 1. Absorption spectra for Spinach, Ulva, Fucus, and Gloiosiphonia recorded ~380–700 nm (n ≈ 31). Each curve represents absorbance (A.U.) across the visible spectrum. All samples show strong absorption in the blue region (~430–450 nm) and secondary absorption in the red (~660–670 nm). A single spike at 510 nm in Fucus appears to be a measurement outlier and should be verified or removed before interpretation.

Results and Discussion

For Spinach, the most strongly absorbed wavelength was ~440 nm (max A ≈ 1.35), with a secondary peak in the red (~660–670 nm). The least absorbed region occurred near 700 nm (min A ≈ 0.15), consistent with low far-red absorption and relatively low absorbance in the green band. This pattern matches chlorophyll a (~430/662 nm) and chlorophyll b (~453/642 nm).
For Ulva, absorption was strongest around ~440 nm (max A ≈ 2.50), with a smaller red-region shoulder near ~660–670 nm (min A ≈ 0.56 at ~700 nm). This is consistent with chlorophyll a and accessory pigments typical of green macroalgae.
For Fucus, the summary shows a maximum of A = 6.63 at 510 nm with a minimum of A ≈ 0.56 at 700 nm. The isolated 510-nm spike is inconsistent with adjacent points (<1.0 A) and likely an outlier; after correction, Fucus should show broad blue–green absorption from fucoxanthin plus a ~665 nm chlorophyll a shoulder.
For Gloiosiphonia, the strongest absorption was near ~430 nm (max A ≈ 2.50), with a minimum around 700 nm (A ≈ 0.56). Elevated absorption across ~495–570 nm and ~620–650 nm is expected from phycoerythrin and phycocyanin/allophycocyanin, plus a smaller chlorophyll a contribution near ~660–665 nm.
Overall, I would not expect the spectra of spinach (terrestrial) to match those of the marine macroalgae. Spinach is dominated by chlorophyll a/b, whereas brown algae use fucoxanthin and red algae use phycobilins; these accessory pigments shift peak absorption toward blue/green and orange/red bands, which is advantageous under underwater light conditions. The measured peaks and minima for each sample align with these pigment sets and their habitats.

R code (paste at the end of the report)

```
# Jacob Aleixo — BIO104 A3: absorption spectra in RStudio
# Learning line graphs, gsheet import, and pigment comparison


# 1) Packages
library(ggplot2)
library(gsheet)
library(dplyr)

# 2) Import class data
url <-
"https://docs.google.com/spreadsheets/d/19HP8s_8Ncx_MncCuduugs4CMQ8z50pHBGJ59oYe
nsbs/edit?gid=965327642#gid=965327642"
dat_long <- gsheet2tbl(url)

# 3) Quick check of your data
head(dat_long)

# Make sure your column names are clear:
# they should read something like "Sample", "Wavelength", "Absorbance"
# If not, rename them for clarity:
colnames(dat_long) <- c("Sample", "Wavelength", "Absorbance")

# 4) Plot absorption spectrum
ggplot(dat_long, aes(x = Wavelength, y = Absorbance, color = Sample)) +
  geom_line(size = 1) +
  labs(
    title = "Absorption Spectra of Samples (A3)",
    x = "Wavelength (nm) — Jacob Aleixo",
    y = "Absorbance (A.U.)",
    color = "Sample"
  ) +
  theme_minimal(base_size = 13) +
  theme(plot.title = element_text(face = "bold"))

# 5) Find peaks and minimums for each sample
dat_long %>%
  group_by(Sample) %>%
  summarise(
    max_absorb = max(Absorbance, na.rm = TRUE),
    at_nm_max = Wavelength[which.max(Absorbance)],
    min_absorb = min(Absorbance, na.rm = TRUE),
```

```
    at_nm_min = Wavelength[which.min(Absorbance)]
  )
dat_long %>% count(Sample)
```