ALGAL ID LAB

Part I. Techniques

Objective

This lab will introduce techniques for the examination and identification of algae. Part I is a guide to general characterization and preservation. Part II introduces the internal and external features used in identification of algae. Keep a lab notebook and be sure to look at all the species presented, even if you are not asked to draw every one.

Laboratory Supplies

For laboratory exercises, you will be taking notes, answering questions, and drawing algae. This will require a bound sketchpad of 8½" by 11" paper. Spiral bound pads are recommended. A good eraser and pencils are also necessary. Colored pencils are even better.

In the lab, you will dissect and prepare algae for observation under the microscope. You will need the following supplies for a dissecting kit:

- Forceps
- Probe
- Ruler (15 cm)
- Pipette bulb

Collecting, Keying, and Pressing Algae

When you collect algae, you may need certain tools, such as a knife to pry algae off of rocks, and a bucket or bag in which to carry the algae. Also, consider whether you will need to collect the entire plant and/or reproductive material for keying or pressing. Some intertidal algae may only be reached during very low tides, so consult tide tables beforehand (check the web for tide tables in your area). See table below for guidelines on collecting algae.

To key out your algae, you will need an algal key. In California, a preferred book is *Marine Algae of California*, by Isabella A. Abbott and George J. Hollenberg. Once you have determined the Division to which your alga belongs, use the dichotomous key to find the Genus and species. Writing down each step as you key facilitates re-keying any misidentified alga.

DO	DON'T
Obtain a collecting permit or California fishing license (for collecting up to 10 lbs of algae)	Don't collect if there are fewer than 10 individuals of the same species
Try to collect reproductive material and entire plant, including holdfast, for identification	Don't forget to remove snails and other large invertebrates from your algae while still in the field
Key out and label specimens before pressing	Don't store your collected specimens in water
Press algae as soon as possible, writing species name on the paper lightly, in pencil	Don't collect *Phyllospadix* seagrasses (see image below)
Store algae, if needed, in a dry plastic bag in the fridge for up to 1 week, "fluffing" daily	Don't put *Desmarestia*, "acid weed," in container with other algae
Collect drift algae/beach wrack when possible	Don't collect at State Parks or protected areas

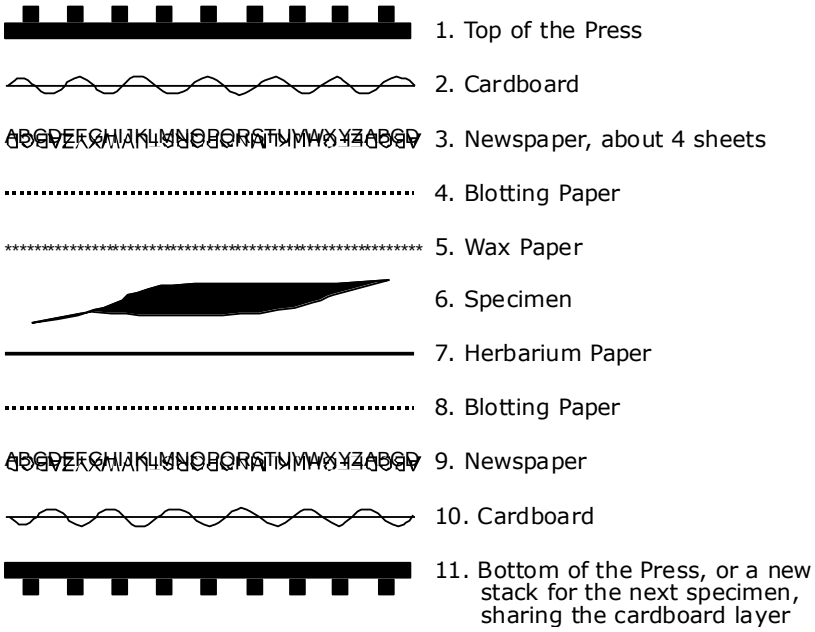
Phyllospadix seagrasses

Pressings

An important part of this course is preparing a collection of pressed algae. This requires a press, which includes:

- Wood slats and straps
- Blotting paper/Newspaper
- Cardboard
- Herbarium paper

Presses are simple to make. Herbarium paper may be purchased at an art supplies shop, or you may wish to order it online from a company such as Pacific Paper.
When pressing algae, you should follow the layering order shown in the diagram below.



Tips for Good Pressing

- Keep a log of where and when each specimen was collected.
- Record each specimen's data lightly, in pencil, in the lower right hand corner of the herbarium paper.
- Rinse algae with seawater before pressing.
- Arrange each alga, exhibiting thallus characteristics clearly.
- Dry by leaving the press on a sunny windowsill (as long as it is dry) or under incandescent light bulbs.
- Change blotting paper and newspapers often (daily for thicker specimens), to prevent molding of the algae.
- When specimen is dry, prepare a display label like the example below.

Your School Name

ALGAE OF *Al Gee*

Name *Ulva intestinalis*

Location *Cabrillo Aquarium, San Pedro, California*

Habitat *found in high intertidal, growing on rocks*

Collected by *Al Gee* Date *August 1, 2003* No. *1*

Identified by *Al Gee* Date *August 2, 2003*

A. Identifying Algal Divisions

Before pressing your algae, you must key it to Genus and species. However, before you can key, you must first determine to which Division your algal sample belongs—Rhodophyta, Phao, or Chlorophyta. Despite their descriptive names, red, brown, and green algae are not always the colors you expect. See table below to help identify algae to Division.

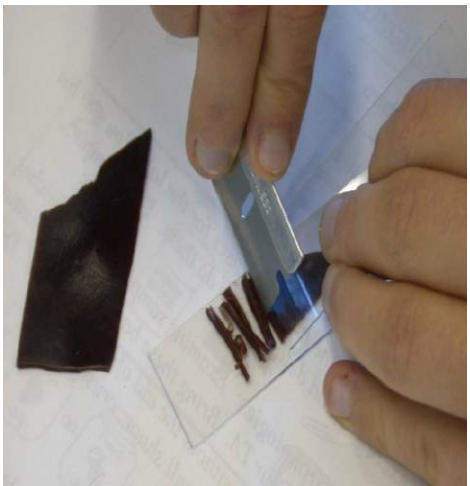
1. **Look at the examples** of each algal Division and note the variety of coloration. Do you notice any trends in pigmentation? Browns can sometimes be olive green, but are almost never the bright grass green of Chlorophyta. Reds and browns are confused most often.

2. Now **observe** two unidentified species. **Try to determine** in which Division each species belongs. **Use tests** from the table below to see whether you're correct. If time permits, **key out** these species, taking note of each step in the dichotomous key.

Specimen	Color if Untreated	Color after *Treatment	Blades	
Green alga	grass green	yellowish or nearly colorless	not more than 2 cells thick	
Brown alga	olive to golden brown, some black-brown	brownish	observe brown plastids easily	
Red alga	dark rose, violet, purple, some brown, yellow-green, or blackish	reddish-orange	most 10-30 cells thick (except *Porphyra*); cannot see red plastids easily	***Treatment**: Place plant into hot (**not** boiling) water for 5 minutes, then dip it in alcohol (removes dominant green pigment).

Cross Sectioning Algae

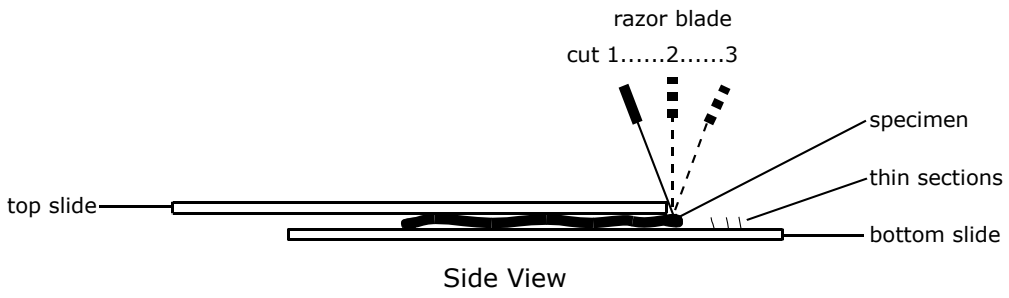
Some algal features may only be seen in a squash or in a thin cross-section. To make a squash, simply smash a small piece of alga between a slide and a cover slip. To make thin sections, you will need some tools: razor blade or scalpel, forceps, probe, glass slides, and cover slips. Ideally, thin sections are only one or two layers of cells. Here's how to make thin sections *thin*.



- First, **cut off a manageable piece** (1-2 cm^2) of an alga and position it on a glass slide.
- Use another slide to **hold down the alga** firmly.

- **Angle** a sharp razor blade or scalpel **away** from the top slide (see diagram below). Carefully **pull the razor** blade along the edge of the top slide, slicing the alga.
- **Angle** the razor blade **perpendicular** to the slide and **slice** the alga again.
- Make a third **slice**, this time **angling** the razor blade **towards** the top slide.
- **Move the top slide** very slightly to expose the edge of the alga. **Repeat** the above motions, making many thin sections. **Discard** any large pieces.
- You may need to turn the sections on their sides. To do so, add some salt water to the slide and nudge the sections onto their sides using the tip of the razor blade, probe, or forceps.

(Image after original UCSC Marine Botany Lab Manual.)



Part II. Morphology and Ecology

Objective

To identify algae, you will need to know some phycological terms. There are several ways to describe algae: (a) morphologically, using external and internal characteristics, and (b) ecologically, by distribution and habitat. The following lab exercises will introduce you to external and internal algal morphology. As a reference for the field, ecology and distribution terms for algae are included at the end of this section. These terms will aid in identification of algae, as well as in understanding their morphological features.

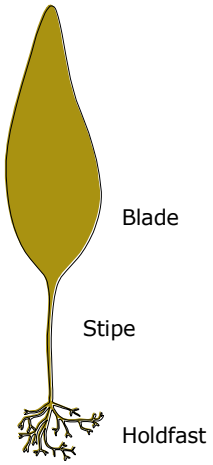
External Morphology Terms

Thallus Forms

A thallus is a term for the mass of cellular tissue forming a plant body without true stems, roots, leaves, or vascular system. A variety of terms used to describe thallus morphology follows, with species examples.

Articulated Calcified segments connected by uncalcified joints. (*Corallina*)
Bladed Flattened leaf-like thallus or thallus part.
Branching Alga with axillary divisions.
Corticated Pigmented cells (cortex) growing as an outer layer. (*Polysiphonia*, *Sarcodiotheca*)
Crustose Grows flat along the substrate; crust-like. (*Ralfsia*, nongeniculate corallines)
Filament Thread or hair-like. (*Cladophora*, *Chaetomorpha*)
Foliose A sheet of cells; blade-like.
- **monostromatic** One cell thick. (*Porphyra*, *Monostroma*)
- **distromatic** Two cells thick. (*Ulva*)
- **polystromatic** Many cells thick. (*Mazzaella*)

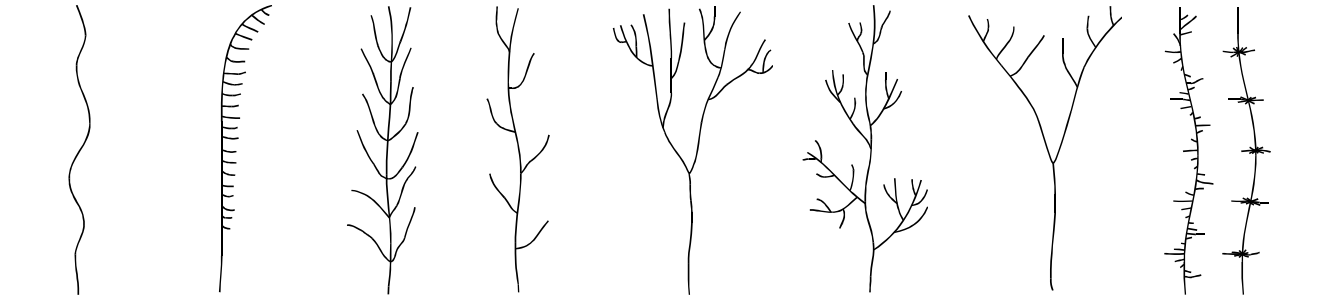
Prostrate Trailing on the ground; procumbent. (*Laminaria sinclairii*)



Saccate Sac-like. (*Halosaccion*)
Singe cell Microalgae. (diatom, cyanobacterium, *Porphyridium*)
Stipitate Having a stipe—a thick, stem-like structure bearing other structures like blades.
Stoloniferous Proliferating by vegetative branches that creep along the substrate and establish new plants. (*Laminaria sinclairii*)
Tubular Thallus made up of a tube of cells, hollow in center. (*Enteromorpha*)
Upright In an erect position or posture; vertical or nearly so; pointing upward.

Branching Forms

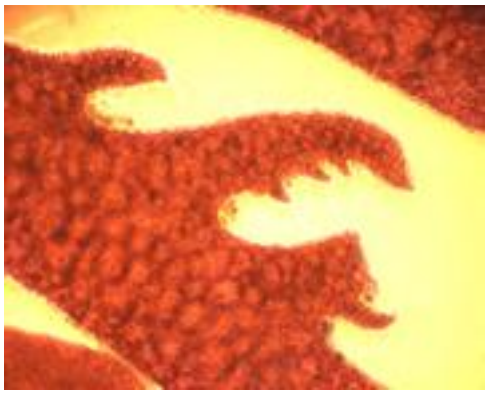
As well as being a useful tool for identification, branching form indicates the growth habit and meristem type of an alga. Here are the main branching forms you'll encounter.



Simple	Pectinate	Pinnate or Distichous		Dichotomous	Monopodial	Sympodial	Whorled
		Opposite	Alternate		Percurrent axis		
Enteromorpha	*Microcladia borealis*	*Bryopsis*	*Microcladia coulteri*	*Fucus*	*Gelidium*	*Pelagophycus*	*Neorhodomela, Odonthalia*

Dichotomous/Bifurcate Branching by forking in pairs. May be equally or irregularly dichotomous. (*Fucus*, *Silvetia*)
Distichous Branching on both sides of an axis.
Irregular No detectable branching pattern. (*Chondracanthus canaliculata*, *Mastocarpus*)
Monopodial Having a distinct main axis of continual growth and giving off branches. (*Microcladia*, *Neorhodomela*)
Pectinate/Secund Having unilateral branching on one side of the axis, like the teeth of a comb. The side branches may be equal or unequal in length. (*Plocamium violacea*, *Microcladia borealis*, apical tip of *Macrocystis pyrifera*)

Macrocystis pyrifera apical tip
Examples of pectinate branching.



Plocamium violacea

Percurrent Extending through entire length of structure, usually said of a persistant axis.
Pinnate Feather-like branching.

opposite Branches oppose each other on the main axis.

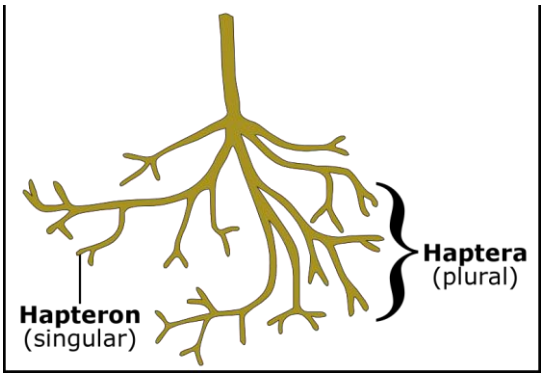
alternate Branches alternate on the main axis.

Reticulate Net-like. (*Hydroclathrus*)

Simple Unbranched, undivided thallus or blade. (*Mazzaella, Ulva, Laminaria, Enteromorpha*)
Verticillate/Whorled Radial branches attached at a common level on the main axis, or branches spiraling off the main axis. (*Neorhodomela, Rhodomela, Odonthalia*)

Holdfast Characteristics

A holdfast is a structure by which an alga attaches to the substratum. Some algae may be free-floating, and therefore have no distinct holdfast.
Basal disk Disk at base of plant attaches to substrate. (Fucales)
Discoid Disc-shaped.
Haptera The network formed by multiple haptera clasping the substrate (often rock).
Hapteron A single branch within a holdfast, singular of haptera. (*Postelsia palmaeformis*)



C. Observing Thallus and Branching Forms

1. **Observe** samples of common thallus forms, such as crustose, filamentous, upright, etc.

2. An array of live specimens showing various algal branching forms should be available for observation in lab. **Compare** the live specimens to the diagram of branching forms above. **Choose three algal specimens** with different branching forms to **sketch** and **label**, including the holdfast if possible. You may need to use the dissecting scope to see details in the branching forms.

Distribution and Ecology Terminology

Biogeographic Distribution

Boreal Growing in northern, colder waters.
Cosmopolitan Found in many parts of the world.
Tropical Growing in near-equatorial, warmer waters.
Temperate Growing in regions between either tropic and its corresponding polar circle, in moderate temperatures.

Tidal Distribution

Intertidal/Littoral - Lying between high and low tide levels, exposed at low tide.
Subtidal/Sublittoral - Below the lowest low-tide level.

Substrate Habitat

Benthic Attached to substratum, not planktonic.
Endophytic Living on and deriving nourishment from another plant.**Epiphytic** Growing on surface

of another plant, usually not parasitic. (*Microcladia*)
Hypolithic Living on lower surface of rocks.
Neritic Living in coastal ocean waters.
Pelagic Living in the open ocean.
Parasitic Living on or in another plant and harming it by using its metabolites.
Planktonic Drifting, unattached.
Psammiphytic Living on sand.
Saxicolous/Epilithic Living on rock. (*Fucus*)

For distributions of common species in the intertidal and subtidal zones, see diagrams below.

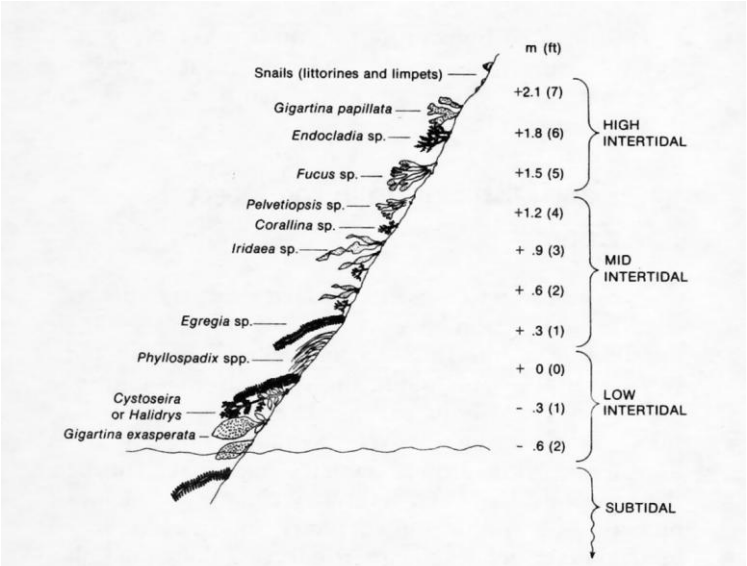


Fig. 2. Vertical zonation of some common seaweeds in the rocky intertidal zone

These two images are from *Seashore Plants of California*, by E. Yale Dawson and Michael S. Foster.

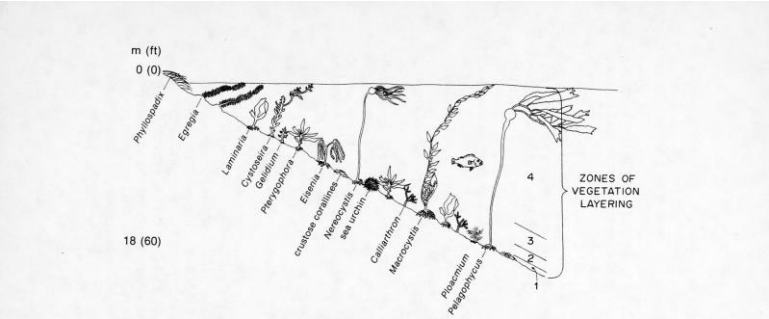


Fig. 3. The distribution of some common subtidal seaweeds. Four vertically arranged layers of vegetation include: *1*. Turf species such as encrusting corallines and *Pterosiphonia* spp.; *2*. Plants up to 0.5 m (20 in) tall (*Gelidium*, *Calliarthron*, *Plocamium*); *3*. Plants up to 2 m (6.5 ft) tall (*Eisenia*, *Pterygophora*, *Laminaria*); *4*. Midwater and surface canopy species such as *Egregia*, *Cystoseira*, and *Macrocystis*

Useful Resources:
Marine Algae of California, by Isabella A. Abbott and George J. Hollenberg
Seashore Plants of California, by E. Yale Dawson and Michael S. Foster
www.mbari.org/~conn/botany/glossary/glosss.htm
James D. Mauseth's *Plant Anatomy* images, see website:
http://www.esb.utexas.edu/mauseth/weblab/index.htm