

Seaweed Aquaculture in the Classroom – Hollarsmith, et al.  
Appendix A. Tumble Culture Resources



# Tumble Culture Assembly Manual and Materials List

Growing Seaweed in the Classroom



k'áach (dulse, red ribbon seaweed)

## Tumble Culture Assembly Manual

### Components of the Tumble Culture

- A. Tumbler
- B. Chiller and pump
- C. Hanging light structure
- D. Miscellaneous

\* These are instructions to build a one action packer, 3 bucket unit. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

### A. Tumbler

1. Cut 3 5-ft sections of  $\frac{1}{8}$ " inch clear vinyl tubing
2. Poke holes, spaced 2 inches apart, on half of the  $\frac{1}{8}$ " clear vinyl tubing sections
3. Use 8" zip ties to attach adhesive backed mounting bases to the half of the  $\frac{1}{8}$ " clear vinyl tubing sections that have holes poked through
4. Stick the mounting bases with the  $\frac{1}{8}$ " clear vinyl tubing sections attached to the base of 5 gallon buckets in a swirl, starting from the center and moving outward toward the bucket wall (One  $\frac{1}{8}$ " clear vinyl tubing section per bucket)
5. Place 3 buckets in one Action Packer tote
6. Prop the air pump between the two Action Packer totes where the  $\frac{1}{8}$ " clear vinyl tubing sections can reach it
7. Attach the section of  $\frac{1}{8}$ " clear vinyl tubing section without holes to the air pump
8. Fill 5 gallon buckets with 3-4 gallons of sea water or mix artificial seawater (e.g. Instant Ocean) and add nutrients according to package instructions
9. Fill action packer  $\frac{2}{3}$  full with freshwater
10. Optional: secure an Onset HOBO logger to one of the buckets to monitor temperature in the bucket

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1. If water pump does not come with an grounding plug, wire a grounding plug to the electrical wires of the pump
2. Attach the 1" x 1" Fitting Pipe Size coupling, Female NPT x Female NPT to the intake and the outtake of the water pump
3. Use two - 1" MPT X 1" Barbed Insert Adaptor to screw into the couplings on the water pump
4. Use two - 1" MPT X 1" Barbed Insert Adaptor to screw into the intake and outtake on the water chiller
5. Use a wrench to tighten all adaptors and couplings
6. Use pipe thread to wrap all of the barbed insert adaptors (4 total)
7. Cut the 1" clear vinyl tubing into two 4-ft sections and one 3-ft section
8. Place the end of the 4-ft section into the freshwater in the Action Packer and secure the other end to the intake of the water pump/adaptor
9. Secure the end of the 3-ft section to the outtake of the water pump and secure the other end to the intake of the water chiller
10. Secure the end of the remaining 4-ft section to the outtake of the water chiller and place the other end in the freshwater in the Action Packer
11. Use hose clamps to secure 1" clear vinyl tubing around adaptors

**C) Hanging light structure**

1. Cut PVC piping in sections to build two hanging light structures that a rectangular cube with 4' x 2' x 1.5' dimensions (this structure is meant to go around the action packer totes so the dimensions need to be the length x width x height of the action packer tote + wiggle room)
2. Assemble the PVC sections with the PVC tees and elbows into the cube
3. The top section of the cube (where the light is secured to) needs to have a PVC pole running down the length of the cube in the middle (see photo)
4. Secure hanging attachment to grow light
5. Hang grow light from top middle PVC pipe
6. Program the timer for 16 hours of light and 8 hours of dark
7. Attach the timer to the power strip and plug the light in

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**D) Miscellaneous**

1. Read instruction manual for water chiller and set temperature range to 48-52 degrees F
2. Connect water chiller to a power source separate from the rest (to an outlet not used by anything else is best)
3. Use a power strip and extension cord to organize and supply power to the air pump, water pump, and lights.
4. Turn on air pump, water chiller, water pump, and lights
5. Check every 24 hours to ensure that everything is working properly and secured for the first week

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Item	Number	Cost per unit	Total Cost	Vendor	Purpose
<b>1) Tumbler</b>					
48 gallon Rubbermaid action packer tote	1	\$133.39	\$133.39	Amazon	Holds 3 5-gallon buckets each.
5 gallon bucket	3	\$4.76	\$14.28	Home Depot	Where kelp tumbles.
15 ft x clear vinyl tubing 1/8 inch	1	\$23.18	\$23.18	Home Depot	Delivers air from air pump to 5 gallon buckets where kelp tumbles.
12 ft x clear vinyl tubing 1 inch	1	\$26.93	\$26.93	Home Depot	Delivers water through intake and outake on chiller and water pump.
EcoPlus commercial grade air pump	1	\$29.99	\$29.99	Amazon	Delivers air through vinyl tubing to 5 gallon buckets.
Onset HOBO data logger	1	\$75	\$75.00	Onset	To track temperature. Good way to cross check that the chiller is working.
Adhesive backed mounting base (pack of 10)	2	\$10.44	\$20.88	Home Depot	Used to attach clear vinyl tubing to bottom of 5 gallon buckets.
8" zip ties (pack of 100)	1	\$8.97	\$8.97	Home Depot	Secure attachment of small width vinyl tubing to mounting base in 5 gallon buckets.
<b>2) Hanging Light Structure</b>					
Grow light (with hanging attachment)	1	\$70	\$69.84	Amazon	Wide range of lights available. LEDs are more expensive but do not emit heat.
32 ft x PVC pipe, 3/4 inch	32	\$1	\$41.92	Home Depot	Structure around tumble culture that supports hanging lights.
PVC tee, 3/4 inch	2	\$1	\$2.00	Home Depot	To connect PVC pieces into rectangular structure for hanging lights.
PVC elbow, 3/4 inch	8	\$2.46	\$19.68	Home Depot	To connect PVC pieces into rectangular structure for hanging lights.
Outlet timer	1	\$8.99	\$8.99	Amazon	Regulate light schedule.
<b>3) Chiller and Pump</b>					
Tradewind IL-15-S chiller	1	\$600	\$600.00	Tradewind	To regulate temperature of water. Water pump is not included.
Iwaki MD-20RXT - 822 GPH water pump	1	\$229.99	\$229.99	Bulk Reef Supply	Pump water from action packer through chiller and back in. Submersible pump not recommended. Only need about 7-10 gpm for the chiller to work properly. Connections: Hose 1" NPT 1".
Water pump electrical plug	1	\$3	\$3.38	Home Depot	Electrical outlet for pump. Referenced pump does not come with an electrical plug. Check if your pump needs this as well.
1 in. MPT X 1 in. barbed insert adaptor	4	\$2	\$8.00	Ace Hardware	Connect clear vinyl hose to coupler of pump and to chiller. Needs to fit size of coupler and inside diameter of clear vinyl hosing.
Hose clamp (1 in)	4	\$2	\$6.80	Home Depot	Secure clear vinyl hose around adaptor. To secure over 1 inch vinyl tubing and coupler interface.

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Item	Number	Cost per unit	Total Cost	Vendor	Purpose
Coupling: 1 in x 1 in fitting pipe size, female NPT x female NPT	2	\$1	\$2.00	Grainger	Adaptor for chiller intake and outtake, and water pump intake and outtake. Needs to fit the size of the intake and outtake of the chiller and water pump.
<b>4) Growth Media</b>					
F/2 nutrient solution and F/2 trace metal solution	1	\$30	\$30.00	Algae Research and Supply	Mix in 5 gallon buckets weekly. Recurring charge for as long as tumble culture is running, one quart will last one school year.
Salt water kit (Instant Ocean)	1	\$60	\$60.00	Petco	Change water in 5 gallon buckets weekly. Recurring charge for as long as tumble culture is running, one 60 lb bucket will last one school year.
<b>5) Miscellaneous</b>					
PVC pipe cutter	1			Home Depot	General use.
Scissors	1			Amazon	General use.
Wrench	1			Home Depot	General use. Big enough to secure one inch intakes and outtake adaptors.
Extension cord	2			Home Depot	Depending on proximity to outlets.
Saw	1			Home Depot	General use.
Power strip	2			Home Depot	For various plugins. May be helpful to attach velcro to mount to a nearby wall.
Photometer	1			Amazon	Test light for kelp. Light from grow lights should emit at least 200-400 $\mu\text{mol photons m}^{-2}\text{s}^{-1}$ at the top of the 5 gallon buckets.
Pipe thread	1			Home Depot	Secure attachment of large width vinyl tubing around intakes and outtakes