Section 2

AQUARIUM SETUP AND MAINTENANCE

Equipment for Aquarium Setup and Maintenance

- **48-gallon circular re-circulating tank (including filtration system)**

- **Biological filter material** – can be made from plastic pan scrubbers, cut up straws, whiffle balls, bottle caps, biobeads and/or anything plastic with a lot of surface area for bacteria to grow on.

- **Incubation jar** – used to incubate eggs until hatching. (See directions on Page 29.)

- **Fry basket/nursery** – used to hold newly hatched fry until strong enough to swim throughout the tank. (See directions on Page 30.)

- **Air stones** – oxygenate the water.

- **Pipettes** – for moving eggs and small hatchlings and removing dead or fungal eggs.

- **Aquarium vacuum** – a long tube siphon, used when necessary to remove excess debris and dirty water from the tank.

- **Fritz Guard** – dechlorinator and conditioner used to remove chlorides and chloramines from tap water and help replenish the fishes' slime coat to prevent disease.

- **Nitrifying bacteria** – bacteria that feed on ammonia compounds (waste from food and fish). The presence of these bacteria clears water and reduces odor.

- **Fish nets** – used to remove live fish from bucket or tank.

- **Water quality test kits** – to test for ammonia compounds (NH_3 / NH_4), nitrates (NO_3) and nitrites (NO_2) and to measure pH levels. These water quality parameters need to be maintained at proper levels to prevent stress on fish. The test kit used is the Tetratest Laborett.

- **Fish food** – high-protein crumble, brand name Rangen (provided by hatchery), or live *Daphnia* spp. The high-protein crumble must be kept frozen.

- **Automatic feeder** – delivers the frequent feedings larval fish require. An automatic feeder such as the Sweeney vibratory feeder ensures fry and fingerling receive enough food.

- ***Daphnia* setup** – (optional) used to rear a *Daphnia* spp. colony. (See Page 33.)

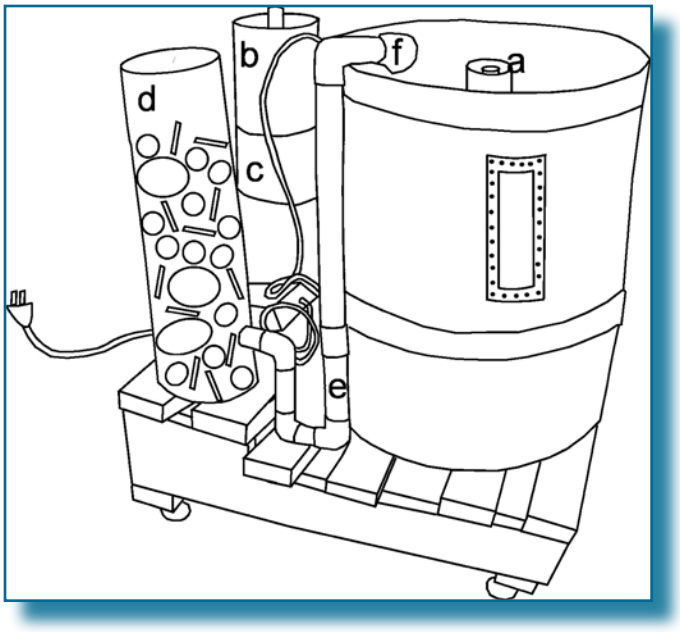
- **E6000** – a strong adhesive used to seal leaks in the aquarium setup.

Aquarium Setup

- The aquarium should be set up at the beginning of the school year in order to support larval fish in the spring, the tank must run for a few months before acquiring paddlefish fry or eggs to allow time for nitrifying bacteria to establish.
- To check for leaks in your new tank or your empty tank that has been sitting over the summer months, fill the tank outdoors. Make sure that the lower ball valve is closed.
- If there is a leak, drain the tank, dry it and apply E6000 as needed. This should be done outdoors or in a well-ventilated area. Allow adhesive to cure for 24 to 72 hours.
- If the tank is leak free, fill it in the classroom.
- Plug in the air pump and make sure the air stone is new.
- Add the amount of Fritz Guard recommended in the instructions on the bottle to remove chlorine and to condition the water.
- Run the tank for several days, then add native fish such as *Gambusia* spp. or bluegill sunfish to help establish good bacteria colonies in the tank. The Booker Fowler Fish Hatchery can provide fish for this purpose.
- In two to three weeks, a brown slime coat will begin to cover the filter material – this is bacteria.
- This tank takes longer to set up than most because the temperature needs to remain low, ranging from 15°C to 18°C (60°F to 65°F) to allow proper hatching of paddlefish fry. When water temperatures are cooler, bacteria grow slower.

<u>The aquarium has several major features:</u>

- The tank is equipped with a double standpipe (a), which includes an internal and external standpipe. This allows water to be drawn from the bottom of the tank to the filters. To keep fry from entering the filter system, cover inner standpipe with a plastic canvas sleeve.
- In the first filter, water travels through the physical filter (b). Water comes in near the bottom of this filter, which traps large food particles or debris at the filter floss barrier (c).
- Water travels across to the second filter, the biological filter (d), where bacteria feed on organic compounds in the water, converting them to nonharmful compounds.
- Water then travels to the airlift (e), which pumps oxygenated water from the biological filter into the tank.
- The top of the airlift brings water back into the tank and should be angled (f) to encourage a circular flow of water.
- The process is then repeated. This is why it is called a re-circulating tank.



Logbook

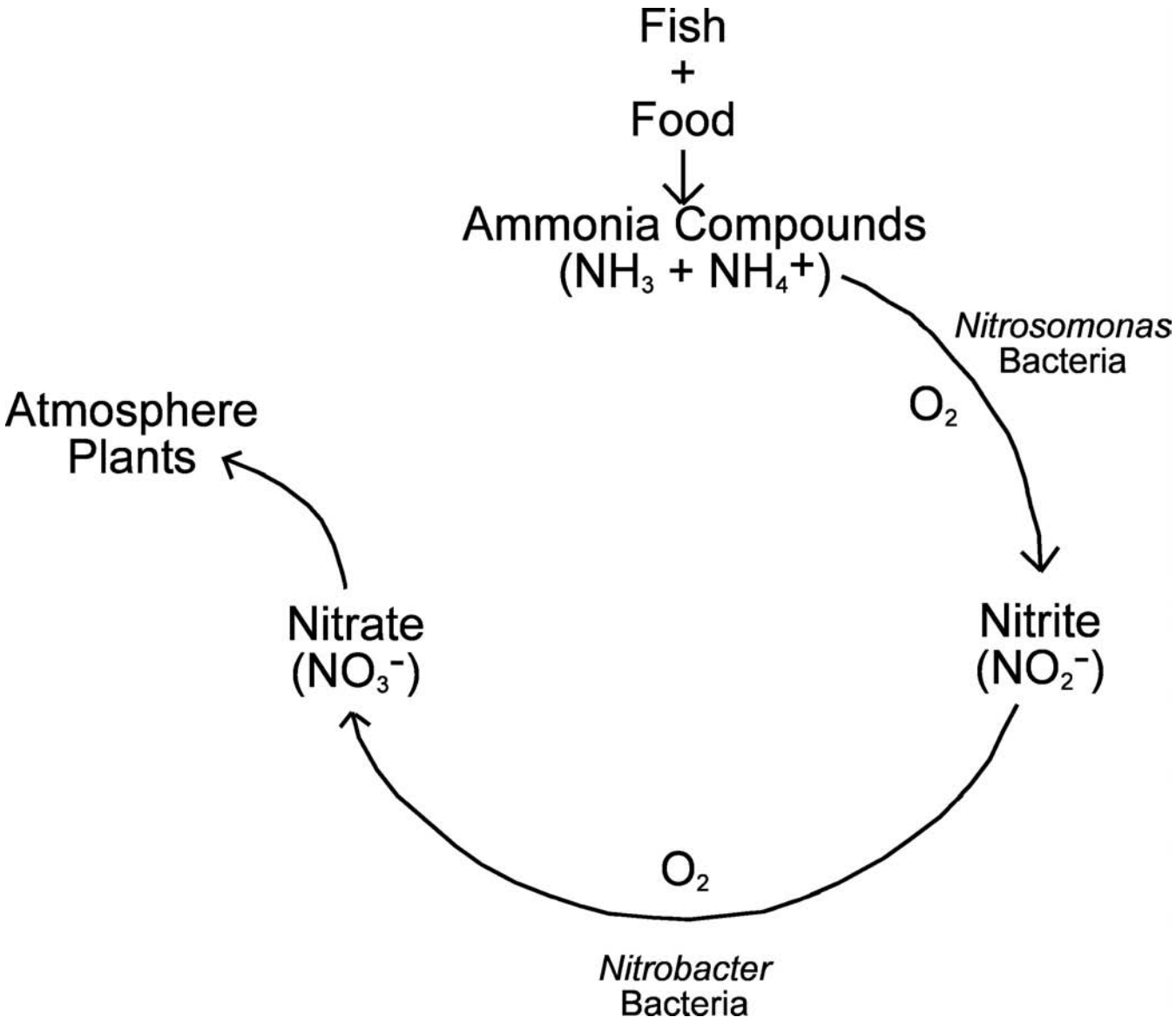
The logbook will be used to monitor the development of paddlefish from eggs to fingerlings, water quality and other physical features and anomalies. See Appendix # V for a sample log. Take daily readings of temperature, pH, nitrate, nitrite, ammonia compounds and dissolved oxygen when the tank is first set up until water quality parameters do not fluctuate. Monitor water quality semiweekly (twice a week) after parameters become stable. Once eggs arrive, daily water quality testing should begin again. Continue daily monitoring through the first two weeks after fry start feeding. Once minimal fluctuation of water quality parameters is observed, then semiweekly readings may resume.

Water Quality Monitoring

Water quality must be maintained in order for the fish to survive and grow properly. Water should be tested daily for temperature, dissolved oxygen (DO), ammonia compounds (NH_3 or NH_4^+), nitrates (NO_3), nitrites (NO_2) and pH. For any water changes or additions, water must be dechlorinated before adding it to the tank. (See the next page for a diagram of the aquatic nitrogen cycle.)

Water Quality Parameter	What It Measures	Desired Range	Danger Reading – How Fish are Affected	Remedies
DO	Amount of oxygen in water	7 to 9 ppm	1 to 5 ppm causes respiratory stress. Zero ppm is an anoxic condition, and fish will die.	1) Change air stone every two weeks. 2) Check that water level in biological filter is high enough to allow airlift to pump water sufficiently.
pH	Acidity or alkalinity of water	6.5 to 8.5	Less than 4.5 or higher than 11 is fatal to fish.	1) Change 50% of water. (11<pH<4.5) 2) Add ¼ cup baking soda. (pH<4.5)
NO_2	Partially decomposed material in water	0 to 1 ppm	Above 1 ppm leaves fish more susceptible to bacterial and viral infections.	1) Change 50% of water. 2) Add nitrifying bacteria. 3) Add zeolite or other ammonia reducer if levels do not decrease.
NO_3	Decomposed material in water	0 to 10 ppm	At above 10 ppm prolonged exposure will decrease fish's osmoregulation.	1) Change 50% of water. 2) Add nitrifying bacteria.
NH_3 or NH_4^+	Amount of waste in water	Less than 0.06 ppm	Increases as pH increases; 0.06 to 0.2 ppm damages gills, eventually killing fish.	1) Change 50% of water. 2) Add nitrifying bacteria. 3) Add zeolite or other ammonia reducer if levels do not decrease.
Temperature	Average amount of heat in water	Eggs: 15° C to 18° C (60° F to 65° F) Fry/fingerlings: 17° C to 22° C (63° to 72° F)	Eggs: above 18° C (65° F) fungus growth increases and hatching is premature. Fry: above 22° C (72° F) more susceptible to disease.	Prepare gallon jugs with dechlorinated water and place in freezer. If water is too warm, place frozen jugs in tank until water cools. Keep air temperature about 17° C (63° F).

Aquatic Nitrogen Cycle:



How to Change the Water

There is no need to change the water in the tank unless uneaten food is collecting on the bottom or water quality parameters are far outside the desired ranges. If these conditions occur, use the aquarium vacuum to remove water from the tank.

Vacuuming

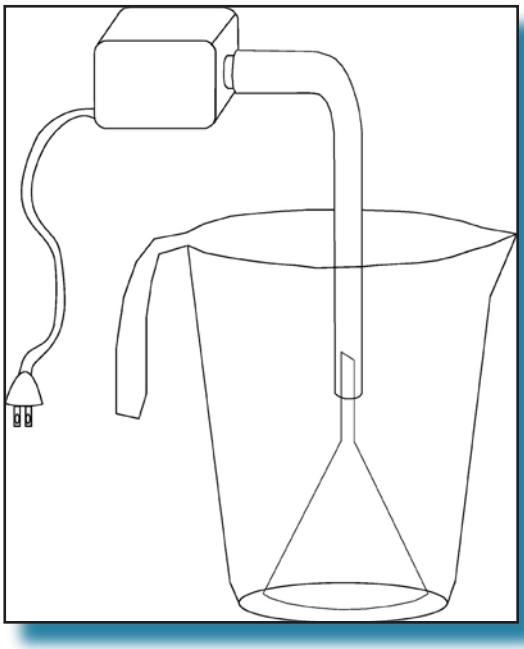
- To vacuum the tank, fill the tube with water by submerging the wide end of the vacuum first. Slowly submerge the rest of the tubing, making sure there are no air bubbles in the tubing of the vacuum.
- While all the tubing is under water, place your thumb over the small end of the tube to make a tight seal. With your other hand, grasp the large end so that its opening is near the bottom of the tank and away from the paddlefish fry.
- Next, remove the small end of the tube from the water while holding your thumb tightly sealed over the opening and place this end into a bucket. Release your thumb. Water will now run from the tank into the bucket.
- Move the wide end of the tube along the bottom of the tank to vacuum food and dead fry.
- Once the bucket is almost filled with water, pull the wide end out of the tank and let the remaining water flow into the bucket.
- Fresh water must be dechlorinated before adding it to the tank.

Incubation Jar Setup

Note: Before receiving paddlefish eggs, remove any fish that were previously occupying the tank and place them in a separate aquarium.

McDonald Hatching Jar
(Photo by Jan Dean)

The incubation jar is designed to mimic the McDonald hatching jars used by state hatcheries. The incubation jar apparatus is made out of a plastic pitcher that narrows at the bottom, a small water pump, about 5 feet of 1/4-inch vinyl tubing and a glass funnel. The funnel must be glass because a plastic funnel will float up from the bottom of the pitcher.



- To set up the incubation jar, dip the pitcher into the tank and fill it with water.
- Place the pitcher handle over the side of the tank and position a piece of foam or wood between the pitcher and the outside of the tank to keep the pitcher from resting at an angle. Secure the foam or wood to the pitcher handle with duct tape.
- Attach the vinyl tubing to the water pump. Make sure that the correct size adapter is attached to the opening of the air pump to fit the 1/4-inch tubing. It may be necessary to heat the end of the tubing to make it more pliable to stretch over the water pump fitting.

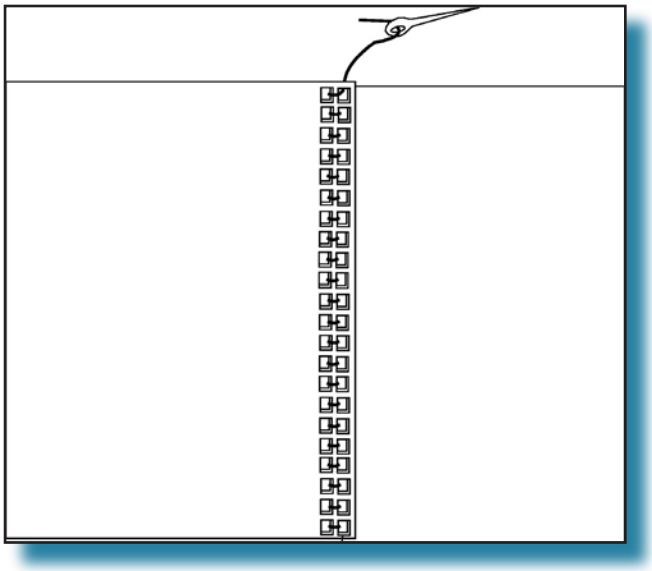
- Carefully attach the vinyl tubing to the glass funnel. Heat the end of the tubing if necessary to stretch the tubing over the funnel. Always be careful when using glass.
- Once the tubing is attached to the water pump and funnel, place the wide end of the funnel down into the pitcher. (See diagram, Page 29.) Next, place the water pump inside the biological filter or tank, about one foot from the top.
- Plug in the water pump, and water will begin to circulate in the pitcher.
- Add eggs to the incubation jar. Gently pour eggs from the plastic bag into the pitcher.
- Make adjustments to the speed of the air pump so eggs gently tumble. If the eggs are whirling rapidly in the incubation jar, the larval fry developing inside the eggs may suffer spinal cord damage and die.
- Remove the incubation jar once eggs are hatched.

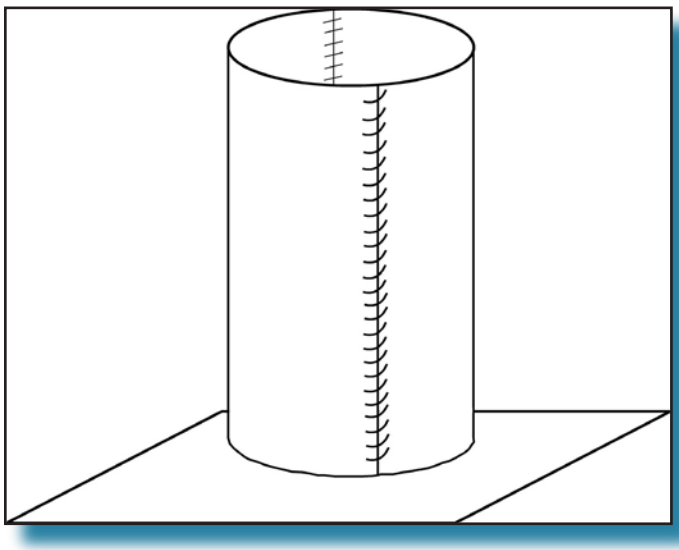
Fry Basket/Nursery Setup

The fry basket will be used for newly hatched fry. They will swim out of the spout of the incubation jar into the fry basket after hatching.

Materials needed to build fry basket/nursery:
- 3 pieces of No.10-point mesh plastic canvas
- colored monofilament line
- marker
- scissors
- large embroidery needle
- E6000 adhesive

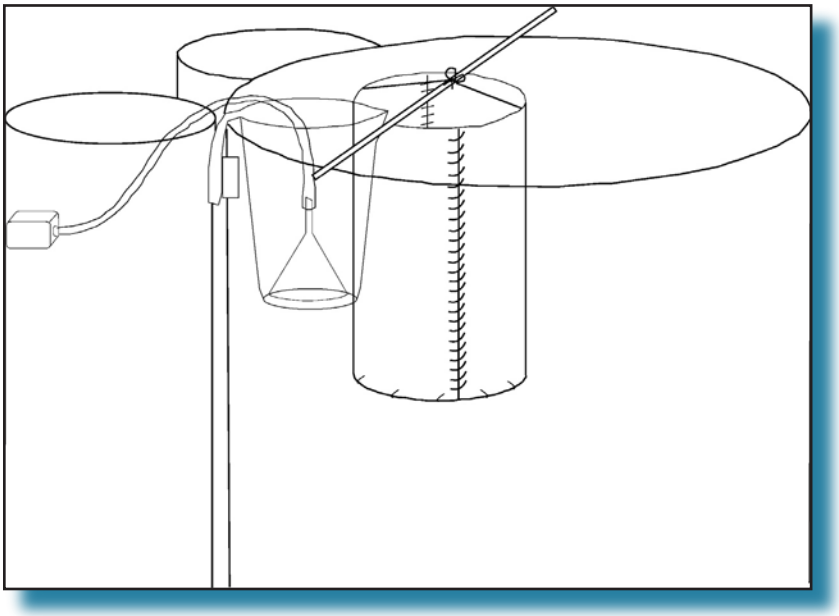
1. Place two pieces of No.10-point mesh plastic canvas together so that they overlap by two rows of mesh holes.
2. Thread the monofilament line through the embroidery needle and sew the pieces of plastic canvas together.
3. After the two pieces are sewn together, bend the ends towards each other to form a cylinder.
4. Repeat steps 1 and 2 on the open side of the cylinder.





5. Place the cylinder of plastic canvas on top of the third piece of plastic canvas.
6. Place a bead line of E6000 adhesive along the seam inside and outside of the plastic canvas base. Smooth out the bead line of adhesive. Place the cylinder of plastic canvas with the glued side up to dry.

7. Once the adhesive has dried, use scissors to cut away excess plastic canvas.
8. On the open end of the basket, cut a triangular shaped notch to allow the basket/nursery to fit flush against the incubation jar.
9. Now the basket is ready to use.
10. Evenly attach four 1-foot lengths of monofilament to the open end of the basket. These pieces will be tied together and used to hang the basket/nursery from a dowel or yardstick across the top of the tank.
11. Place a dowel or yardstick across the top of the tank.



12. Make sure the side with the triangular cutout is lined up with the spout on the incubation jar. Now, attach the monofilament line to the dowel or yardstick.

The fry will remain in the basket/nursery for more than a week. This will give the young fish time to learn to swim and absorb their yolk sacs.

While fry are in the basket/nursery, food can be introduced. If food gets stuck in the mesh holes and starts to accumulate, gently move the basket up and down and the food will be released.

The fry will be ready to be released from the basket/nursery when their yolk sacs are completely absorbed and they are swimming freely. When fry have been released from the nursery basket, remove the basket, clean and store the equipment for next year.

Feeding

Fry will be eating an artificial food source, Rangen, which is a hatchery fish food. The fish food contains 40 to 45 percent protein and is manufactured in several sizes (0 to 2). *Daphnia* spp. can be supplemented into the fishes' diet. (See section on maintaining a *Daphnia* spp. colony.)

Rangen is perishable and must be stored in a freezer. It should be discarded after three months. Never use food from the previous year. Old food has a significantly lower nutritional value and will leave fish susceptible to disease. For example, vitamin C in the feed will decrease by 80 percent in seven months.

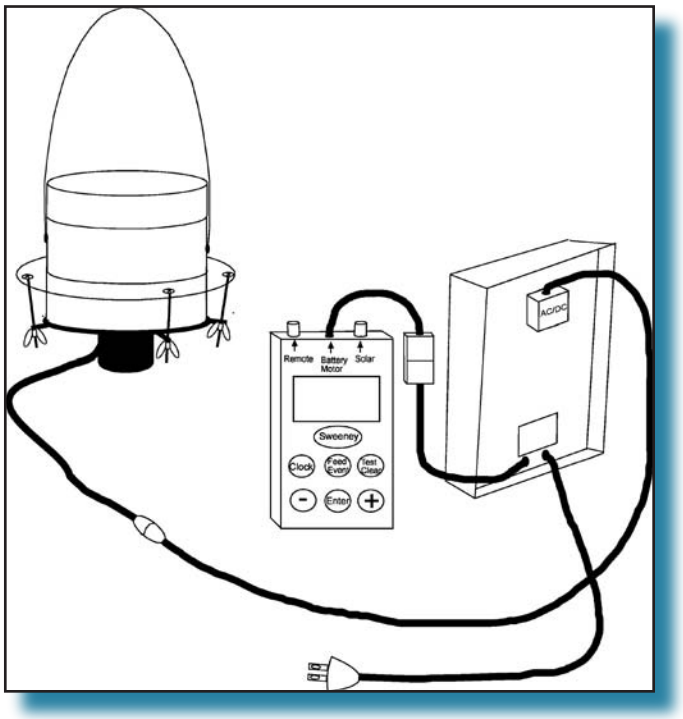
Feeding should start about five days after hatching. This is when the fry lose their gut plug and have used up their nourishing yolk sac. Carefully watch your newly hatched fry to look for any that have very little yolk sac left. Once the first few start to have a very small yolk sac, it is time to introduce food into the tank. When the fry start to eat, expect a large die off because some fry cannot adapt to the artificial food source.

When introducing food, sprinkle a pinch of crumble inside the nursery basket. A large salt shaker is an effective way to deliver smaller amounts of food evenly across the water surface. This can be done several times a day to introduce fry to the feed. Once fry feeding behavior is noticed, it is time to use the automatic feeder.

Start with the smallest crumble (size 0). When the fry are about 1 inch in length start mixing in the larger crumble (size 1). Once all fish have reached that length, use only size 1.

How to Use the Automatic Feeder

There are three parts to the Sweeney vibratory feeder: food dispenser, display pad and control box.



The food dispenser is attached to the display pad, and the display pad is attached to the control box. The control box is plugged into the wall.

The food dispenser will hang over the tank on a swivel apparatus made of two “U”-shaped brackets, 71 inches of 1-inch diameter PVC piping, a PVC “T” coupling and four wood screws. Use a PVC cutter or saw to cut the PVC into two segments – one 22 inches and the other 49 inches long. See photo below for assembly.

Tank with food dispenser on swivel apparatus
(Photo courtesy Kathleen Nichols)

The blue cap on top of the dispenser can be removed to add food.

The butterfly screws (wingnuts) on the bottom of the dispenser adjust to increase or decrease the amount of food that is released at each feeding.

Use the display pad to set the clock. The feeder can handle up to 24 feedings per day.

Set the display to release food each day at a speed of 10, for a duration of two seconds every four hours. As the fish grow, increase the duration to three seconds every four hours.

Before the fish are ready to feed, make sure that the timer is working. Set the timer and release feed over a bucket. If the feeder is not working properly and you have double-checked the settings, call the manufacturer, Sweeney, for help at (800) 443-4244.

Watch the location of your feeder to avoid dropping food into the external standpipe.

Double-check the settings on the timer to ensure that the proper amount of food is added to the tank. Excessive feeding will cause water quality problems in the tank.

If the power goes out or the timer is unplugged, the settings for feedings will not be affected unless they are deleted. The clock will go out and must be reset.

Tips to keep the automatic feeder functioning:

- Always properly secure the lid on your feeder by carefully fitting the studs into the holes. If water gets into the feeder, it will make the food clump together and will require extensive cleaning.
- Do not use the **Test/Clear** button on the timer to excessively disperse feed, as this may delete your programmed feed events.
- When setting a feed event on your timer, make sure that each field (time, duration and speed) are set with valid entries. Partially set feed events will prevent the timer from functioning properly. If you are uncertain how to set your timer, refer to the directions on the back of the timer or call a program manager.
- Only use Rangen fish feed from LDWF.

Daphnia spp. Setup (optional)

Daphnia spp. are small crustaceans that live in fresh water and are commonly known as "water fleas." *Daphnia* spp. live about one month and will reproduce about every three days. It can be difficult to start a colony of *Daphnia* spp., but once a colony has formed, it is very easy to maintain.

To start a *Daphnia* spp. colony you will need:

- Culture of *Daphnia* spp. (See lesson entitled "Pass the Water Fleas, Please" for information on where to obtain *Daphnia* spp.)
- Hard water
- Clean, clear container such as a 3-liter bottle or a small tank (5 to 10 gallons)
- High-protein fish food pellets
- A garbage can with a lid (great way to store extra water, in case of water changes)

1. Add water and a few pellets of food to the container and let it sit for at least 10 days.

2. Add *Daphnia* spp. and place the container in an area with indirect sunlight (near a window or light). *Daphnia* spp. need eight hours of light a day.

3. The container can be aerated, though *Daphnia* spp. will grow fine without extra air as long as they are not overfed.

4. For larger populations and more frequent feedings, aeration with large bubbles at a slow rate is best.

5. Place one pellet of high-protein fish food in the container. Once the pellet dissolves, add another. It may take up to one week for a pellet to dissolve.

6. Change water no more than once every three weeks. Up to 50 percent of the water can be changed at once. Use only aged (10-day-old) water. Remember, slightly dirty containers grow the best *Daphnia* spp.

Problem Solving

What to do if …

- **The aquarium water is cloudy and smelly.**
  The water may turn cloudy as nitrifying bacteria begin to multiply in the tank in response to an increased nutrient load. Once paddlefish begin to feed, there will be increased waste from the fish and uneaten food that may start to decay. Bacteria will multiply to keep up with the demand, however, before they become sessile (attach to a substrate, such as biobeads), they will float, causing water in the tank to look cloudy. Once bacteria attach to a substrate, the water will clear up. It is imperative that the tank is set up and running at the beginning of the school year. This will allow for the biological filter to be seeded properly with nitrifying bacteria and prevent water quality problems once paddlefish are introduced.

  If the water turns cloudy when paddlefish are introduced, make sure that all water quality parameters are within the normal range. If water testing shows normal levels, nothing further needs to be done, and the water should clear up in a few days. If water testing shows abnormal levels, see the water quality monitoring section (Page # 27) for remedies.

- **There is not enough water flow from the airlift.**
  The airlift may not be working for several reasons:
  a. The air stone may be broken or clogged with brown algae. Make sure that the air stone is replaced about every two weeks. A clogged air stone can be cleaned and reused. Throw away broken air stones.
  b. The tank does not have enough water in it. Water will evaporate from the tank. Check the water level in the tank by observing the level of water in the biological filter. If the biological filter is low on water, this will slow down the amount of water that the airlift is able to pump into the tank. Remember to add only dechlorinated water.
  c. The air pump may not be working properly and may need to be replaced. Remove the air pump, hook it up to another water source and observe if it is aerating properly. If not working, replace the air pump.

- **The filters are turning brown. Should they be cleaned?**
  The filters will turn brown as food particles and other debris begin to collect in the physical and biological filter. There is no need to clean the filters unless water flow is impeded from one filter to the other. If there is an excessive buildup of debris in the physical filter, simply remove the floss pads and rinse with water. NEVER WASH ANY FILTER MATERIALS WITH SOAP OR DETERGENTS OF ANY KIND. THIS WILL KILL FISH! It is normal for the biological filter to turn brown as bacteria build up on the substrate, biobeads or other materials in the filter. Never wash or rinse the substrate or biological filter materials. This will destroy beneficial bacteria that drive the nitrogen cycle in the tank.

- **What if the eggs start to grow fungus?**
  There are several reasons why fungus may begin to grow on paddlefish eggs:
  a. The water temperature is over 18°C (65°F). Increased water temperatures will encourage fungal growth and kill paddlefish eggs.
  b. The eggs are dead. This occurs in the hatchery system, also. Eggs die and fungus begins to grow.

c. Eggs are not tumbling enough in the incubation jar. Eggs that come in contact with each other may start to stick together. Contact promotes fungal growth. Remember, eggs should gently tumble around in the incubation jar.

In all cases, eggs with fungus will not hatch, so remove them immediately from the tank to prevent a fungal egg from spreading fungus to a healthy egg.

- **The ammonia level is above 0.06 ppm.**

Ammonia level is the most critical water quality parameter to monitor. Ammonia levels are safe below 0.06 parts per million (ppm). Larval fish are extremely susceptible to increased ammonia levels. Fish gills can be damaged when ammonia levels reach 0.1 ppm to 0.2 ppm. High ammonia levels are accompanied by high pH levels, due to the amount of hydroxide ions in the tank. So, if the pH is increasing, make sure that ammonia levels are monitored closely.

Increased ammonia levels are caused by insufficient numbers of nitrifying bacteria in the tank. Ammonia is a by product of fish waste and uneaten, decaying fish food. Nitrifying bacteria consume waste products and keep ammonia levels at a normal level.

IMPORTANT: The tank must be set up early. If the tank is not allowed to run for a few months before acquiring paddlefish fry, nitrifying bacteria will not have had enough time to become established in the tank.

To decrease ammonia levels:

1. Change 50 percent of the water, and then check the ammonia level.
2. Add nitrifying bacteria to the tank. Remove filter floss in the physical filter for one day to prevent new bacteria from attaching to this substrate. Replace the filter floss the next day.
3. If the ammonia level is still high, add zeolite (or other ammonia reducer) to the tank.
4. More water changes may be necessary. Repeat steps above.

TIP: If the tank is allowed to run for several months before paddlefish eggs are acquired, water changes should not be necessary.

- **How do I know if I am overfeeding?**

Overfeeding occurs when fish are given more food than they can eat. It can lead to increased ammonia levels. Signs of overfeeding include food accumulating on the bottom of the tank and fungal growth.

The amount of food released into the tank is directly proportional to the space where the food is shaken out of the automatic feeder. To decrease the volume of food dispensed, either decrease the size of the opening on the dispenser by turning the butterfly screws clockwise, or reset the timer on the automatic feeder for a shorter duration.

- **How do I set my timer on the automatic feeder?**

The feeder can handle up to 24 feedings per day. Use the display pad to set the clock. Set the display to release food each day for duration of two seconds every four hours at speed 10.

Setting the clock:
Press the **CLOCK** button and hold. The **HOUR** will flash. Use the **+** and **–** buttons to find the desired hour. To set, press **ENTER**. Use the **+** and **–** buttons to find the desired **MINUTES**. To set, press **ENTER**.

Setting the automatic feeding events:

1. Press and hold the **FEED EVENT** button until the number flashes. Use the **+** and **–** buttons to assign the first feeding, **1**. Press **ENTER** and wait.
2. The HOUR will flash, use **+** and **–** buttons to select the hour of the first feeding. Include **A.M.** or **P.M.** Press **ENTER** and wait.
3. The **MINUTES** will flash, use **+** and **–** buttons to select the minutes of the first feeding. Press **ENTER** and wait.
4. **DURATION** will now flash. Select **two seconds** for the duration of the feeding using the **+** and **–** buttons. Press **ENTER** and wait.
5. In the same spot on the display, **SPEED** will flash. Set the speed using the **+** and **–** buttons to **FS** (full speed). It is speed **10**, the lowest setting. Press **ENTER**.
6. Repeat the process for five more feeding events starting four hours after the first feeding event time. Remember to increase the **FEED EVENT** number each time.
7. To check your setting, press **FEED EVENT**. When **1** flashes, press **+** or **–** to check the next setting. Repeat to double-check that all feeding events are accurately set.
8. To set **TEST,** press **FEED EVENT**. Use the **–** to select **0**. Next, select the **DURATION** of **two seconds** and **FS SPEED**. Press **ENTER**. The test feature is now set, and each time it is pressed, feed will be released.

Double-check the settings on the timer to ensure that too much food is not added to the tank. Excessive feeding will increase water quality problems in the tank.

If the power goes out, or the timer is unplugged, the setting for feedings should not be affected, however, the clock will go out and must be reset.

- **When should I start feeding the fish?**

Test the automatic feeder well in advance of receiving paddlefish. This will allow the user to become familiar with the apparatus and determine if the feeder is working properly. A broken feeder can lead to starvation of fry. Start to introduce a small pinch of food to the nursery/fry basket when the first fry are about 3 days old. This will get the fish accustomed to the presence of food in the water.

Feeding behavior is easy to observe. Fry swim constantly, usually in a straight manner. When food is introduced, the fry will swim through the food, detect the food, turn and zigzag or swim in circles through the food. Once feeding behavior is noticed, the automatic feeder should be set up immediately and set for regular around-the-clock feedings.

- **What if the pH is too high (above 8.2) or too low (below 6.5)?**

The pH measurement is one of the most common water quality tests performed. Although pH indicates the sample's acidity or alkalinity, it is a measurement of the hydrogen and hydroxide ions found in a substance.

The pH scale ranges from a value of 0 to 14. A substance with pH lower than 7 is an acid and has a high concentration of hydrogen ions. A substance with pH higher than 7 is a base and has a high concentration of hydroxide ions.

An optimal pH range is 6.5 to 8.2 for most fish reproduction and development. Generally, fish cannot live in a pH below 4 or above 11. These extreme pH levels may affect body functions (physiology) of aquatic organisms making it very important to maintain pH levels in the aquarium. When troubleshooting water quality problems, such as pH, test the tap water. Hard tap water in some areas may be slightly alkaline because it may contain elevated levels of calcium carbonate and dissolved carbon dioxide. Because the pH of hard tap water ranges from 7.0 to 8.5 the water may need to be monitored more frequently.

The pH of a tank may decrease (become more acidic) due to fish, algae and plants releasing carbon dioxide (CO_2). Another reason pH may decrease is from the release of hydrogen ions caused by the reduction of ammonia during the nitrogen cycle. If the pH in the tank is below 6.5, the pH can be corrected by adding baking soda (sodium bicarbonate). Baking soda contains pH-stabilizing carbonates. These carbonate molecules can freely give or take hydrogen ions.

Increasing pH:
Begin by dissolving two teaspoons of baking soda in a large beaker filled with tank water. Pour this solution into the tank. Retest the water in two hours. If the pH is still low, wait 24 hours before adding more baking soda. Baking soda should be added in small amounts to increase pH because the fish are acclimated to the lower pH level. Most likely the pH gradually became more acidic; therefore, in order for the fish to safely acclimate, pH should be gradually raised no more than one pH unit per day.

The following day, test the pH again. If it still remains below 7.0, add more baking soda – the exact amount is up to your discretion. For instance, if the pH is 6.5, adding two more teaspoons of baking soda will increase the pH too much. Therefore, baking soda may need to be added in smaller increments than a teaspoon. It may take several days to adjust the pH back to an optimal range.

Decreasing pH:
If the pH of the tank is too high (above 8.5), test the ammonia level in the tank. If the ammonia level is above 0.1 ppm to 0.2 ppm a water change will be required. Refer to the problem solving section, "The Ammonia level is above 0.06 ppm." on Page # 29 for details on how change the water.