Fish Formation

Below are suggested additions to the Fish Formation (Lawrence Hall of Science MARE 1991) to incorporate information learned from Dr. Jensen's presentation and subsequent discussion.

Fish-Formation Pattern Sheet

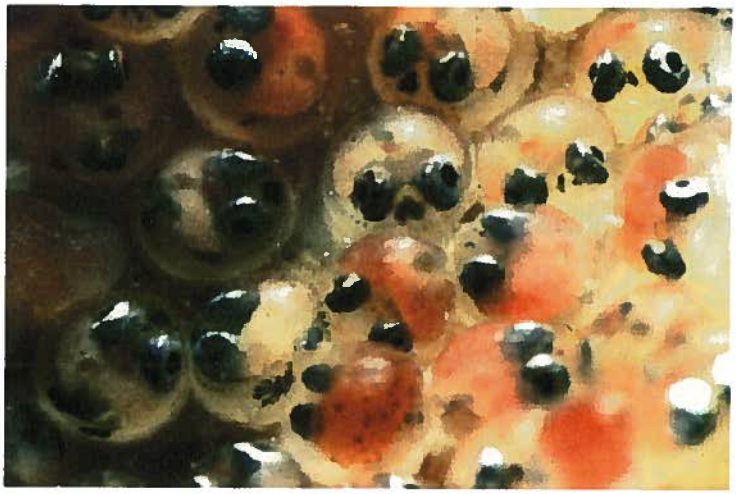
Gender Roles-

Similar to the counter-shading adaptations you can create a yellow pattern and a blue to white/black to green pattern to mimic the color differences of Bluehead Wrasse. You can place these patterns on opposite side of the students to show that the different sexes may have different colors.

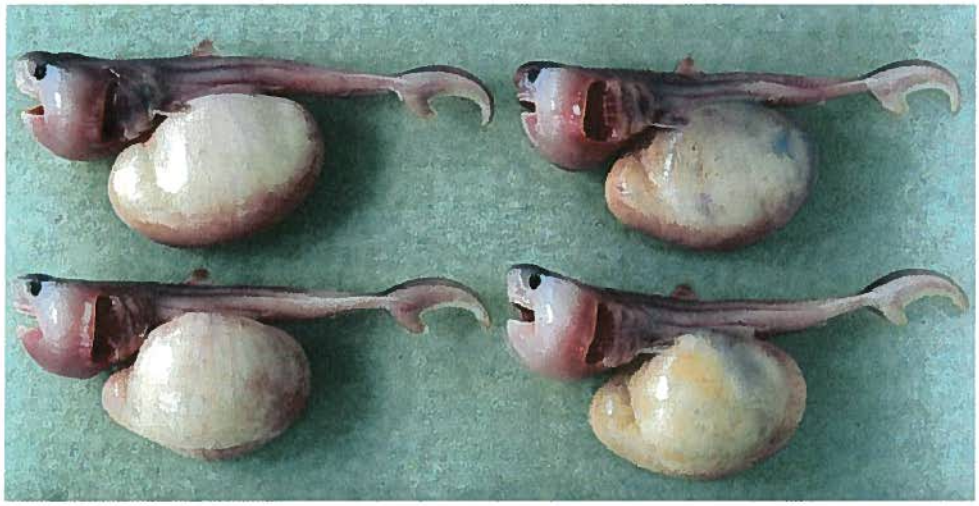
Reproductive Strategies-

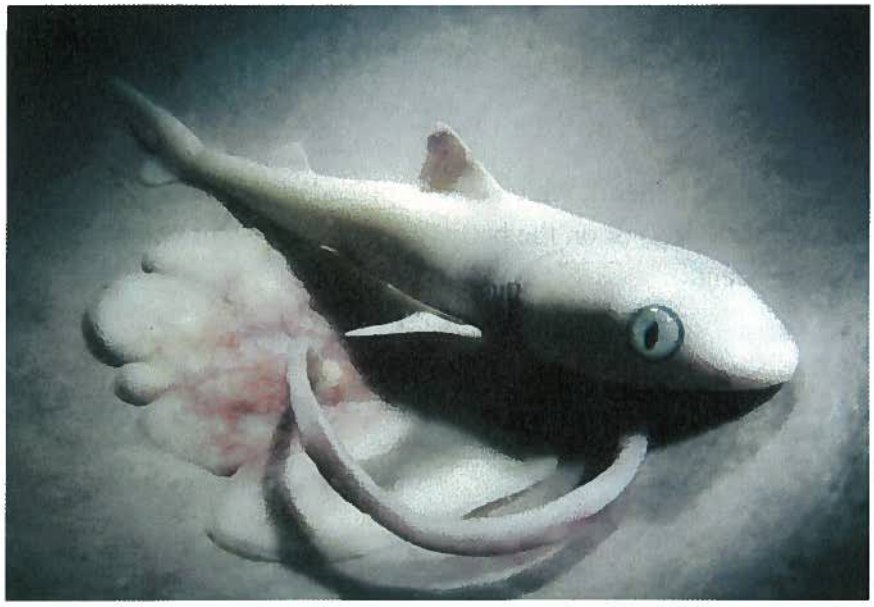
You can print these three images (or recreate them), which can be placed either on the floor (to represent eggs that are laid outside of the body) or on the belly (either to represent yolks sack young or the young attached with a placenta).

On the floor:



On the stomach:





Fish-Formation Script

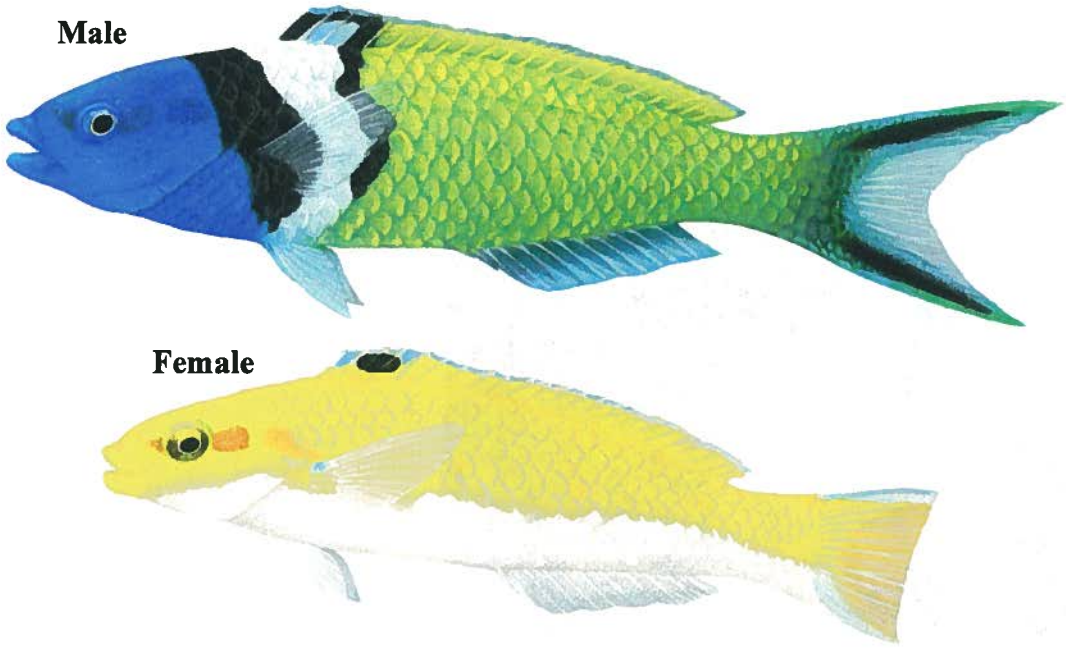
Consider adding a component about different fish reproductive strategies or gender roles at the end of the activity.

Gender Roles-

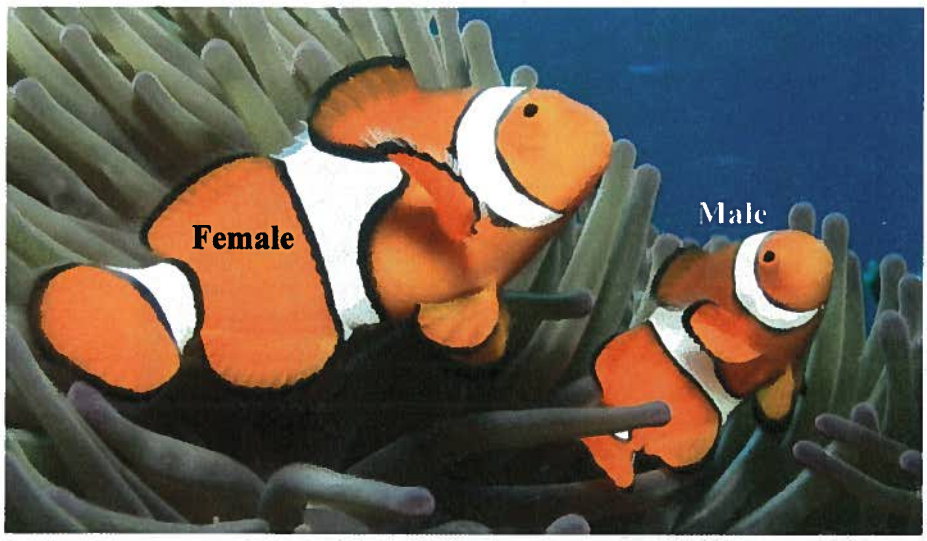
Teacher: How would be know if Toni was a boy fish or a girl fish? Actually, it is very hard to tell if fish are a boy or girl from the outside. Sometimes boys and girls will be different colors (like in the Bluehead Wrasse, *attach the different color patterns to the two side of Toni*) and sometime they are different sizes (like Anemone Fish), but most often it is hard to tell them apart. In fact sometimes fish can change from a boy fish to a girl fish or the other way around (like Black Sea Bass)! In fact, both of the examples below are of fish species that change from one to another in their lives. It is a weird thing to be a fish.

Images:

Bluehead Wrasse:



Anemone Fish:



Reproductive Strategies-

Teacher: OK, now that Toni looks like a fish how will she have baby fish? Are fish like people? Well some might be more similar than you think. While most fish lay eggs (like frogs, *place the image of the eggs on the floor*) some fish keep the eggs inside. Who can tell me why Seahorses are so special?

Class: The dad Seahorse keeps the babies/eggs inside of his stomach until they hatch! (The students may suggest that the dad Seahorse gets pregnant, but actually the fertilization happens in the female and then she transfers the fertilized eggs into an exterior stomach pouch on the male. He does not provide any nutrients to the eggs but rather just guards them until they hatch, so it is not that the dad is pregnant.)

Teacher: Yes you are correct. Some fish keep the eggs with their yolk sacks inside the mother to protect them. Why would fish want to do this? Would their babies be more protected inside of the mother than floating in the ocean?

And some fish, like sharks, even have babies similar to us. There is no yolk sack but the babies are connected to the mother through a placenta (you can see the encasing membrane below). This allows the mother fish to provide more nutrients to the babies as they are developing.

Babies inside of a mom fish are protected from potential predators and get more nutrients and so they grow larger before the hatch from their eggs. Therefore for fish species that keep their babies inside the mother, the babies are born alive and look like little adults.

Wow! The more we learn about fish, the crazier they seem!

FISH-FORMATION

MARE Teachers' Guide to the Kelp Forest
Discipline: Biology
Themes: Evolution, Scale and Structure

KEY CONCEPT: *DIFFERENT KINDS OF FISHES HAVE MANY SIMILARITIES SINCE ALL ARE ADAPTED TO LIFE IN WATER.*

SYNOPSIS: A student is transformed into a fish to demonstrate the major adaptations of fishes to life in water. Classmates contribute to the dress-up demonstration by suggesting adaptations to solve different aquatic needs (like swimming, turning and feeding).

FOR THE TEACHER: With over 20,000 different kinds of bony fishes, learning about them may seem a very difficult task. But it helps to remember that different fishes share many traits, because they're all adapted to aquatic life. Also, fishes have to perform many of the same tasks we do in order to survive. So they must eat, move, breed, breathe, sense their environment, and avoid danger.

The water surrounding the fishes is very different than the air around us, so it's not surprising that they look quite different from us. Water is 800 times denser than air, so most fishes are streamlined to cut down on drag, and have fins to help them swim. Fin and body shape reflect each fish's lifestyle. Here are a few examples: Sleek fishes with large eyes and crescent-shaped tails (like tunas) are fast, constant swimmers. Fishes with rounded or squared off fins and stocky bodies (like sculpins) are typically bottom dwellers. Fishes that live in crevices (like moray eels) may have reduced fins and snake-like bodies. Highly maneuverable fishes (like butterfly fishes) have disc-like bodies, that are flattened side-to-side. Fishes, like the flounder, that live on flat sand bottoms are pancake-shaped.

Water conducts sound much better than air, so fishes don't need external ears like we do. There is far less oxygen in water than in air, so most fishes have gills instead of lungs. The gills have a very high surface area, and are so thin and delicate that the blood running through them is visible, making them bright red. Because the gills are so delicate, bony fishes have a hard gill cover or operculum to protect them.

Fishes have all the senses we do: touch, vision, taste, smell, and hearing - plus one more. Thanks to a lateral line made up of tiny pits with sensory nerves they have a sense of "distant touch," and are able to sense water movement nearby. The lateral line helps schooling fishes to keep together, predators to find prey, and prey to avoid predators. Other protective features of fishes are scales and slime.

The color of fishes reflects where they live. Fishes living on the bottom often are camouflaged to look like their surroundings.

More specific information on fish adaptations is located in the following script and in the MARE activity "It Takes All Kinds."

SCIENCE PROCESS SKILLS: observing, inferring

SOCIAL SKILLS: communicating, cooperating

VOCABULARY: adaptation, camouflage, caudal fin, chromatophore, counter shading, gills, lateral line, pectoral fin, pelvic fin, predator, prey

MATERIALS:
- Fish body parts (see Fish-Formation Pattern Sheet)
- Fish-Formation dress up script
- balloon
- butcher paper (about 8 ft.) or 1/2" foam rubber
- permanent color markers
- elastic (2 ft. of 1/2" width; 2 ft. of 1" width)
- saran wrap
- red felt or red construction paper
- white poster board (railroad board)
- overhead projector and transparency of pattern sheet
- scissors

PREPARATION: Construct the fish body parts as instructed on the pattern sheet. Conceal the parts in a box or bag until each is needed. Be sure the pieces are stacked in anticipation of the order in which you'll probably retrieve them.

INTO

(Note: This activity is a great way to create interest in thinking and learning about fishes. For this reason, consider surprising your students with the Fish-Formation without much initial discussion. Encourage lively class participation during the dress-up, and students will be stimulated to further discussion and study afterwards. Consider using this activity before "It Takes All Kinds.")

THROUGH

The following script is one of many possible ways the dress-up can go. It can be different each time, depending on student responses to your questions. Be sure to credit all responses, even unexpected ones. The right leading questions help insure usable responses. Write new terms (in bold type) on the board as they are introduced. Use this script as a stimulus to get you started, and "Go with the flow." Enthusiasm and flexiblity are the keys to success. Surprise will stimulate extra fun and learning, so be sure to keep the fish parts hidden until needed.

FISH-FORMATION SCRIPT:

Teacher: Today we're going to get to know fishes better. There are thousands of different kinds of fishes, so it may seem difficult to learn about them. Fortunately, since fishes are all adapted to life in water, they have a lot in common. I'll need an assistant to help us begin our study of fish adaptations. *Select an eager student, and have them come to the front of the class. Be sure they aren't too big or small for the fish costume.*

Thank you, Toni, for volunteering to help us learn about fish today. Class, take your last look at Toni, the student. In the next few minutes, we're going to turn Toni into a fish, before your very eyes! Hmm, where should we start? *The dress-up is most fun if the student starts looking like a fish right away, so we suggest getting the fish body/skin and head on first.* Let's think about some adaptations Toni would need if she were going to start living her whole life underwater, like a fish. Have you ever stayed in a pool or the tub too long and gotten all wrinkled? Human skin isn't made for life in water, so maybe the first thing we should give Toni is some waterproof fish skin. *Pull out the fish body tunic and put it on the student as you would a jacket; then tape the front closed.* Now Toni's skin won't wrinkle, and her body shape is smooth and streamlined to move through the water with little resistance. But . . . while this is a very fine human head, it's not really streamlined for easy swimming. Maybe we should give Toni a fish head. *Pull out the fish head and slip it over the student's head as shown in the illustration.*

Let's see. . . How do fishes sense their environment? *(Students will probably respond with "eyes," but fishes have all the other senses we do, plus one extra!)* Toni, you've got beautiful eyes, but I'm afraid bony fishes don't have much use for eyelids and eye lashes - their eyes stay open all the time, and they have a much sharper focus underwater than ours do. So let's give you some fish eyes. *Pull out the fish eyes and tape them to the sides of the head.* A fish's eyes tell us a lot about its habits. Toni's eyes are quite large, so she's probably a visual predator - one that finds its prey by sight. Others depend mostly on their sense of smell and don't need large eyes. Fishes have pits with nerves that sense different smells. Point to nostrils on snout. Other fishes have long whiskers or barbels with taste receptors to sense their prey - like the catfish. Fishes can even feel nearby movements without actually

being touched, so they have one sense that we don't - a sense of "distant touch." The organ providing distant touch is the **lateral line**. *Pull out the dotted ribbon, and tape it just below the student's arm pit, so it hangs down the side.* Have you ever seen the line running down the side of a fish? That's the lateral line. It's made of a series of tiny pits, each with a little hair-like sensor that detects nearby water movement. So Toni, now you can sense a predator's approach, even in murky water. Lateral lines also help schooling fishes stay in touch.

Teacher: Now Toni-fish has a streamlined fish body, and smooth fish skin, but what if another fish decides to take a little bite of this nice unprotected skin? Don't fishes often have a kind of armor?

Class: She needs scales!

Teacher: Of course! Most (but not all) fishes have overlapping **scales**, covering most of the body, that protect them from bites and scrapes. *Pull out a patch of scales and tape them to the fish skin.*

Hey, what color should our fish be? *Accept all possibilities, and acknowledge that fishes come in all colors.* The color and pattern of a fish depend on where and how it lives. Fishes near the bottom often are camouflaged to match their surroundings. *Pull out a patch of camouflage pattern, and tape it to one side of the fish's body. Turn the student so the camouflaged side is visible.*

But, what if Toni was an open ocean fish, like a tuna? How do fishes in the open water hide? *Acknowledge various responses.* Did you ever notice that some fishes are dark blue on the back and light on the belly? That's common in open water fishes. *Pull out the blue back strip and tape it on the other side of the fish body. Turn the student so the counter shaded side shows.* When viewed from above, they blend in with the dark water below, and when viewed from below, they blend in with the light from above. This method of camouflage is called **counter-shading**. Shall we have Toni be a bottom dwelling fish, or an open ocean fish? *Turn the student so the appropriate coloring shows.*

Fishes have another protective coating that helps them avoid bacterial infections. If you've ever been fishing or handled a fresh fish, what's that slippery stuff that gets all over your hands?

Class: Slime!

Teacher: Right, you've been slimed by the fish's protective **mucus** coating. *Pull out some saran wrap to represent slime and drape it around the students shoulders like a shawl.* In addition to helping a fish avoid infection, the mucus helps reduce drag as the fish swims, and in some fishes, the mucus is poisonous, so predators avoid them.

So now Toni has a well protected body, but how's she going to swim? These human legs work great on land, but underwater they won't help much. Any ideas?

Class: She needs fins!

Teacher: Fins would sure help Tony move more efficiently through the water. Hmm, what fin do most fishes use as their main power thruster?

Class: The tail fin. *Other answers are OK, since some fishes use other fins for main swimming power.*

Teacher: Ah, the tail fin! It's also called the **caudal fin**. *Pull the rounded tail fin out and show it to the class. Write the words "caudal fin" on the board.* Will she move her tail side to side or up and down to swim? *Fish move their tails side to side; whales move their tails up and down. Demonstrate this as you hold the tail fin, then tape it to the bottom of the fish skin tunic (so it hangs down hiding the student's feet).* This rounded caudal fin is common to slow-swimming fishes that live on or near the seafloor. They often lay still and ambush their prey. Other slow-swimming fishes have squared off tails like this. *Pull out the squared tail to demonstrate.* The fastest swimmers (tuna, etc.) have crescent-shaped tails. *Pull out the crescent shaped tail.* Slowest of all are the long skinny fishes with no caudal fin (e.g. moray eel). Which tail should we give Toni-fish? *Tape on the most popular tail fin.*
So now if Tony sees a tasty sardine swim by, she can beat her tail to chase it. But when her tail beats one direction, her body will tend to move in the other. A sail boat has a board in the center of the hull, called a keel, to help keep it going straight. What can we give Toni that would work like a boat's keel?

Class: More fins?

Teacher: Right! Fishes have a fin right on the middle of their back called a **dorsal fin**. *Pull out the dorsal fin and tape it along the back of the costume.* And they have a similar fin on the middle of their underside, called the **anal fin**. *Pull out the anal fin and tape it to the front of the costume just above the tail.* So our Toni-fish has two keels to keep her going straight when her tail beats side to side. But what if the sardine she's chasing turns suddenly, and all she can do is swim in a straight line?

Class: More fins!

Teacher: Right again! Our fish have side fins called **pectoral fins** on each side of their body that help to turn and stop. *Pull out the pectoral fins and attach*

one to each bicept with the elastic band. Now, Toni, if the sardine turns left, you can put out your left pectoral fin to turn that way, too. Some fishes swim mainly with their pectoral fins, instead of their caudal fin. Now, to make Toni-fish even more agile, she has two other fins, called **pelvic fins**, that help her turn and stop. The pelvic fins are near the mid-line on the fish's belly. *Take out the pelvic fins and tape them on.* Some fishes use their pevlic fins like legs to walk on the bottom.

Now Toni-fish can find prey and detect predators with her eyes and lateral line. She can chase prey or escape predators with her caudal fin, turn and stop with her pectoral and pelvic fins. But even if she catches a squid, how's she going to eat it?

Class: Jaws! (or "teeth," or "a mouth")

Teacher: Let me see if we have some fish jaws for Toni. *Get the class to make the suspense-building sound effects from the movie "Jaws," - **da na da na da na da na da da da da!**, as you pull out a set of jaws.* The jaws of a fish can tell us a lot about the food it eats. A fish with a big mouth and very small teeth (like a grouper) probably swallows other fishes whole. *Pull out another set of jaws.* A fish with lots of big sharp teeth (like a barracuda) may slash its prey before swallowing. Which jaws shall we give Toni? *Tape the desired jaws onto the fish's head.*

Well, now, let's see if our transformation is complete. *Quickly recap the adaptations that have been added, having the class come up with either the name of the element (e.g. "lateral line"), or the function (e.g. "distant touch").*

Let's give a big hand for Toni-fish for helping us learn all about fish today! *Have the star take a bow, and have another student help to carefully remove the costume parts.*

BEYOND

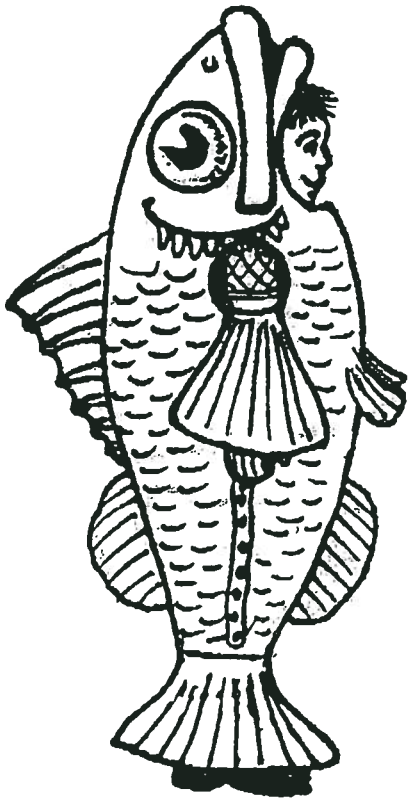
• Have students draw an imaginary fish and label its adaptations for a particular habitat and life style (using the new terms you wrote on the board). Then have them describe their creation to the class.

• The MARE activities in "It Takes All Kinds" are an ideal follow-up to "Fish-Formation."

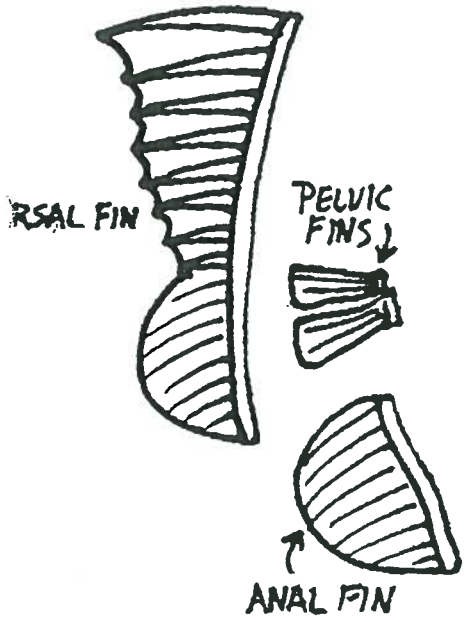
Written by Bruce Stewart; Revised 5/25/94

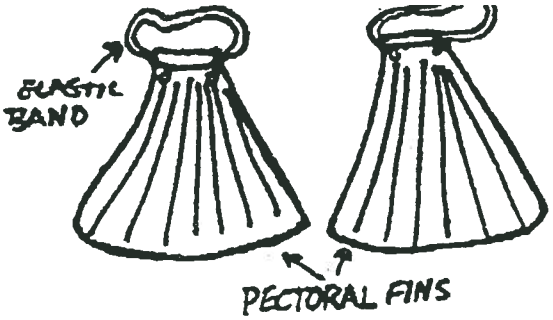
FISH FORMATION

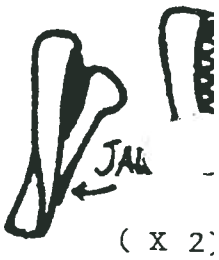
Pattern Sheet



Instructions: Make a transparency of the patterns. Using an overhead projector, adjust the patterns so that they are at the appropriate size (arms should fit through the holes on the costume's side; feet should be visible just below the tail), then using a colored marker, trace the patterns onto butcher paper. Remember to make two each of the eyes, gills, gill covers, jaws, lateral lines, and tails so that there is one each for both the left and right sides of the costume. You can now use your creativity and make the fish costume with various types of materials. For instance, scale patches can be drawn on any white sheet of paper, gills can be made of red construction paper, felt, or posterboard, and dots can be drawn on a cloth or paper ribbon for the lateral line. Attach elastic bands onto the pectoral fins so that the fins can be slipped on like sleeves. After the costumes' parts are cut out and made, laminating or taping the edges is advised to prevent rips. All parts can be affixed with adhesive tape during the dress-up. (Note: Feel free to improve on the pattern. Once you've got a design you really like, consider constructing the costume out of 1/2" foam rubber.)







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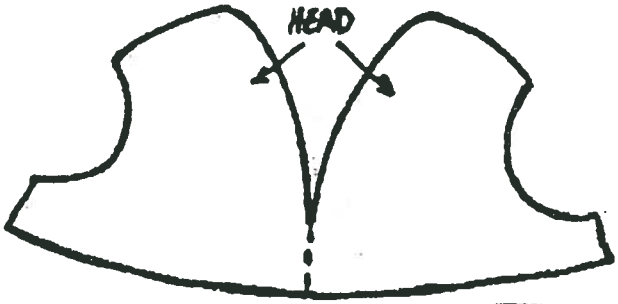

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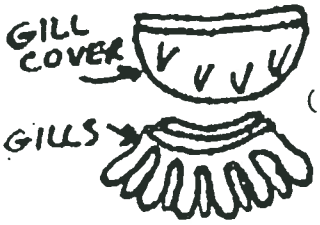

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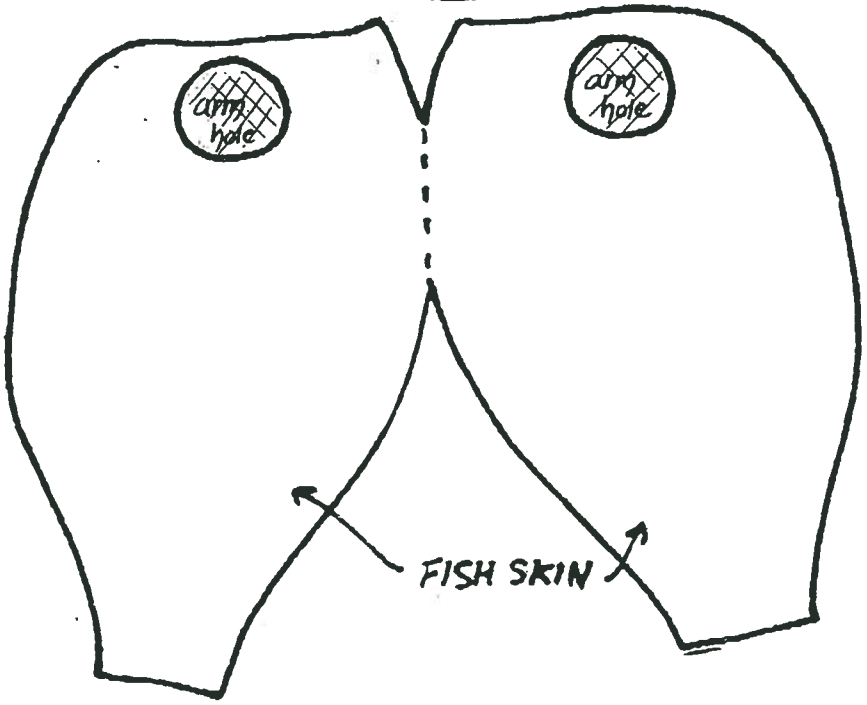

TAILS

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