

# LIFE CYCLE OF A FRESHWATER MUSSEL

## OBJECTIVES

1. Students will read about and discuss the role of mussels in the historical industries of the Mississippi River.
2. Students will examine human impacts on Mississippi River freshwater mussel populations.
3. Students will list 2 reasons a mussel's life cycle makes them sensitive to human actions.

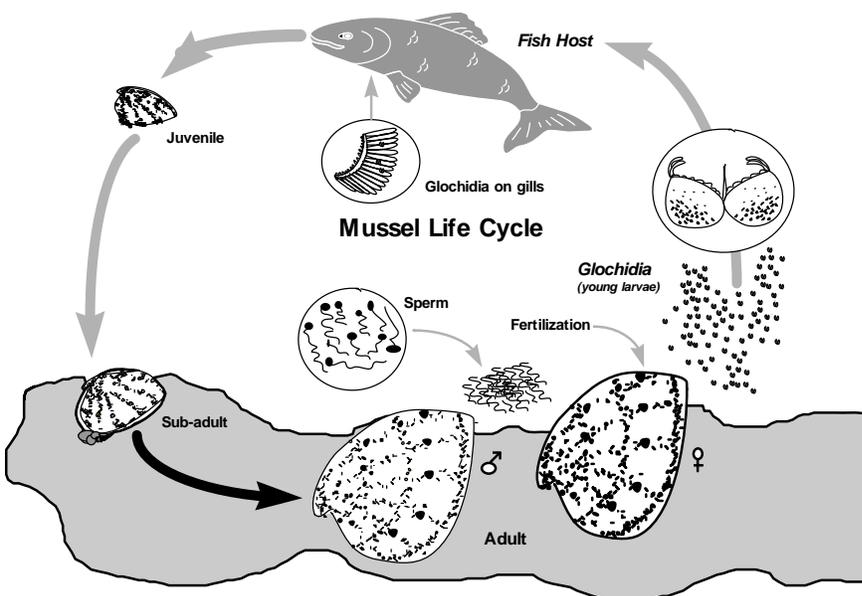
Many people ask about the difference between a mussel and a clam. In general (although there are exceptions) mussels require a host for glochidia development, while clams do not. More precise anatomical differences are also used to differentiate the two. The Mississippi River is home to 49 species of mussels and only 4 species of clams. Therefore, the majority of the "clams" found in the river are actually mussels.

## METHODS

Students are guided through the life cycle of a freshwater mussel. Each phase is introduced by a student reading an excerpt from *The Story of My Life by Billie Button*. Then the students view that stage or anatomical part by looking at overheads of the mussel or it's life cycle. Additionally, two demonstrations involving students role playing mussels are performed: 1. mussel reproduction demonstration and; 2. fish host/substrate needs demonstration.

## BACKGROUND

A generalized life cycle of a mussel:



**Grade Level:** 4 - 12

**Subjects:** Math, Social Studies, Science, History, Phy. Ed., Language Arts

**Duration:** 60 minutes

**Group Size:** Any

**Setting:** Classroom, outdoors, or gym

**Key Vocabulary:** Glochidia, endangered, host specific, host, life cycle, mussel, marsupium, larvae, mussel bed, anthropomorphism, substrate

**Materials:**

- confetti
- fan
- fish pictures
- substrate cards
- *Billie Button Story*
- overheads or copies of mussel life cycle, mussel internal anatomy, mussel external anatomy



Glochidia of a freshwater mussel

The life cycle of a freshwater mussel is quite complex. Fertilized eggs (most species of mussels reproduce sexually) develop into **larvae**, called **glochidia**, in the **marsupium** of the female mussels.

Glochidia, when released from the female, must come in contact with a passing fish and attach to the gills, fins, or body of that fish. During this parasitic stage, the mussel glochidia are harmless to their fish host. The mussel-host fish relationship helps disperse a basically immobile creature (the mussel), within and between aquatic systems.

Many mussels are "host specific" in that their glochidia can only survive on a specific species of fish. If a glochidium attaches to a fish that is not the species it is looking for, it will not survive.

After a few days to several weeks, the glochidia free themselves from the host, drift to the **substrate** and begin their lives as juvenile mussels. Quite often, mussels are concentrated in certain areas of the river bottom called **mussel beds**. Mussel beds are often located in areas inhabited by a wide variety of fish species. The areas frequented by fish tend to accumulate higher number of glochidia and eventually a mussel bed develops.

It may take several years (2-9) before juveniles mature and can reproduce as an adult. Adults may live 60 - 70 years if conditions are right. However, studies have documented that it is not uncommon for some species of mussels to successfully reproduce only once out of seven or more years.

**Being host specific can make a mussel extremely sensitive to human impacts. For example, the construction of Lock and Dam 19 near Keokuk, Iowa, blocked the migration of skipjack herring up the Mississippi River. The skipjack herring is the only host for the ebony shell and elephant ear mussels. These two mussels are no longer found in the Mississippi River watershed above Keokuk, Iowa, since their host, the skipjack herring, can no longer migrate above Lock and Dam 19.**

## MATERIALS

<p>Billie Button Life History:          -- Overheads or copies of:              mussel life cycle              mussel internal anatomy              mussel external anatomy          -- One copy per student of chapters I - III of the Billie Button Story</p>	<p>Genetic Contribution Demonstration:              Fan              Confetti</p> <p>Host and Substrate Demonstration:              Host Cards              Substrate Cards</p>
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## PROCEDURE

### BILLIE BUTTON LIFE HISTORY:

Hand out copies of *The Story of My Life by Billie Button* (located in the appendix) and assign one student reader to each of the excerpts marked.

**Introduction:** Tell the students that this story was published as a promotional advertisement for the Wisconsin Pearl Button Company of La Crosse sometime between 1914 and 1920. The language used was standard for that period of history. Also explain that the story is told from the perspective of a button. This is an example of **anthropomorphism** (attributing human characteristics to something not human).

Following are comments and/or demonstrations/simulations that can be used after each excerpt is read to enhance understanding (referenced by excerpt number). The students could also be provided a copy of the mussel's life cycle to keep track of which stage of the mussel's life cycle is being discussed.

1 – This is the introduction to the life cycle. On overheads, point out siphons and foot.

2 -- Describe a “crow foot” (pictured on Page M-3) and point out the brood pouch on overhead. (The brood pouch is not visible on the graphic. Rather, the brood pouch is located within the gills of a female mussel that is labeled).

3 -- Do “Genetic Contribution Demonstration” described below.

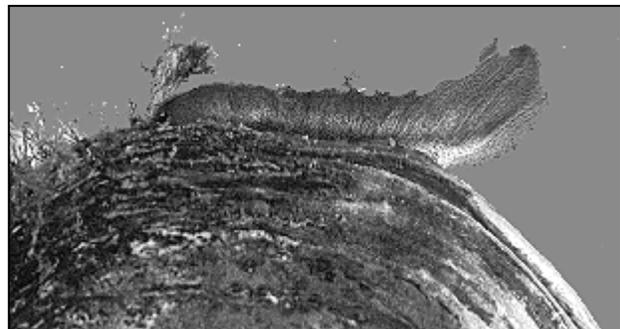
4 -- Note the “hooks” on the picture of the glochidium in story or refer to the life cycle diagram for an enlargement of a glochidium. These hooks are what enable a glochidium to attach to its host.

5 -- Just read

6 – Just read

7 -- Describe importance of fish host in the life cycle of a mussel.

8 -- Point out that some mussels (Higgin's Eye and pocketbooks for example) have special adaptations of their mantle flap which resembles the appearance and movement a small fish. They use this adaptation to “lure” fish in close. When the fish try to eat the “lure,” the mussel shoots its glochidia at the fish, thereby increasing the chances that it will infect the fish.



Higgins' Eye displaying special adaptation of its' mantle flap which resembles the appearance and movement a small fish.

9 -- The mussel is now considered a juvenile and will have to grow up before reproducing. At this point, do the “Host and Substrate Demonstration” described below.

### GENETIC CONTRIBUTION DEMONSTRATION:

This demonstration simulates how mussels reproduce. Mussel reproduction is dependent on the presence of a current to carry sperm from a male to a siphoning female mussel. Therefore, mussels can only reproduce if the female is downstream of the male mussel; the sperm cannot swim upstream. Somehow, the female mussel can differentiate between food, sperm from a different species of mussel (which is ingested or passes through her) and the sperm from a male of her species.

1. Ask for 2 volunteers. One will play a female mussel, the other a male.
2. Have the male mussel stand with his back to the female mussel. Give the male mussel a handful of confetti. The confetti represents his genetic contribution, or sperm. Instruct the male mussel that when you tell him it is time to spawn he will throw the confetti into the current (represented by the breeze created by the fan).
3. Have the female mussel stand about 5 feet behind the male mussel facing his back. Point out that the breeze coming from the fan represents the current and ask where the female mussel should be (upstream or downstream) in order to successfully reproduce. Instruct the female mussel that she will use her hands to “siphon” the sperm released by the male mussel. She cannot move her feet, but can move her hands to try and catch the males genetic contribution. She cannot pick up confetti from the floor.
4. Turn on the fan using the high setting for maximum breeze and tell the male to spawn.
5. Count the number of confetti pieces caught by the female mussel. Inform the female mussel that only the sperm caught is usable for reproduction. **Point out that of the large number of sperm released by the male, only a very small percentage are actually successful in fertilizing an egg.**

### HOST AND SUBSTRATE DEMONSTRATION:

This demonstration simulates the need for the proper host and appropriate substrate for the survival of a freshwater mussel. The simulation will be done twice. Once as the glochidia of a common mussel, the giant floater, and again as glochidia of the endangered Higgin’s Eye Pearly mussel.

The glochidia of a **giant floater** can develop to maturity on a variety of fish host species. It can also live on many different substrates.

The **Higgins’ Eye Pearly mussel** is host-specific. This means that as a glochidium it can only develop on walleye, sauger or smallmouth bass. Higgins’ eye also survive best when living in strong current areas of the Mississippi. Current is one factor that determines what type of substrate is found in an area. In the case of Higgins’ Eyes, they survive best on the following substrates: gravel, sand and gravel, and sand.

Following are playing cards which will need to be made (number of cards needed is indicated in parentheses if more than one). The cards should be at least 6 X 9 inches in size.

(Pictures or text can be used to identify these cards):

Fish Cards:

<b>Fish Cards</b>	
<b>Species Name</b>	<b># of Cards</b>
- Freshwater Drum (also called Sheepshead)	1
- Paddlefish	2
- Carp	1
- Catfish	1
- Largemouth Bass	1
- Crappie	1
- Walleye	2
- Sauger	2
- Rock Bass	2
- Bluegill	1
- Largemouth Bass	1

Substrate Cards:

<b>Substrate Cards</b>	<b># of Cards</b>
- Gravel	2
- Sand and Gravel	2
- Sand	4
- Backwater Muck	4
- Sandbar that dries up in summer	4
- Riprap	4

(Riprap is large rock used to stabilize or protect eroding shoreline. The chances of a mussel surviving on riprap are slim due to the size of the rock, and numerous crevices among the rocks.)

Place the cards face down in a large play area with host cards at one end and substrate cards at the other.

1. Have students line up behind the end with the substrate cards and tell them that they are glochidia of giant floaters, a common species of mussel (during the second round, they will be Higgins' Eye). Instruct them that they will now find out what species of fish they have infected by walking to the other end of the playing field and stepping on one of the fish host cards. More than one student can be on a card at once. Tell them to wait until told to turn over the host cards.
2. After each student has placed a foot on the host card, have them pick up that card to see which species of fish they have attached to. Since giant floaters can successfully develop to maturity on a variety of species, all students will "survive."
3. Have them place the cards face down on the ground.
4. Now find out what type of substrate their fish is over when they detach from their host. Instruct the students to walk to the other end of the playing field and step on one of the substrate cards. More than one student can be on a card at once. Tell them to wait until told to turn over the substrate cards.
5. Inform the students who have landed on a "sand bar that dries up in the summer" or "riprap" that they did not survive. All other students will survive. Students that landed on a sand bar that dries up in the summer they did not survive because mussels, especially very small mussels, will not be able to move into deeper water as the sandbar is exposed. Students that landed on riprap did not survive because chances of a mussel surviving on riprap are slim due to the size of the rock, and numerous crevices among the rocks. This limits their growth and feeding potential and usually results in mortality.

6. Repeat the simulation; this time have the students be Higgins' Eye mussels. Make the following changes to reflect limiting factors for Higgins' Eye mussels.

In **Step 3**, only students that chose walleye, sauger or largemouth bass will survive and proceed to the substrate stage. All other students have infected a fish species on which they cannot survive.

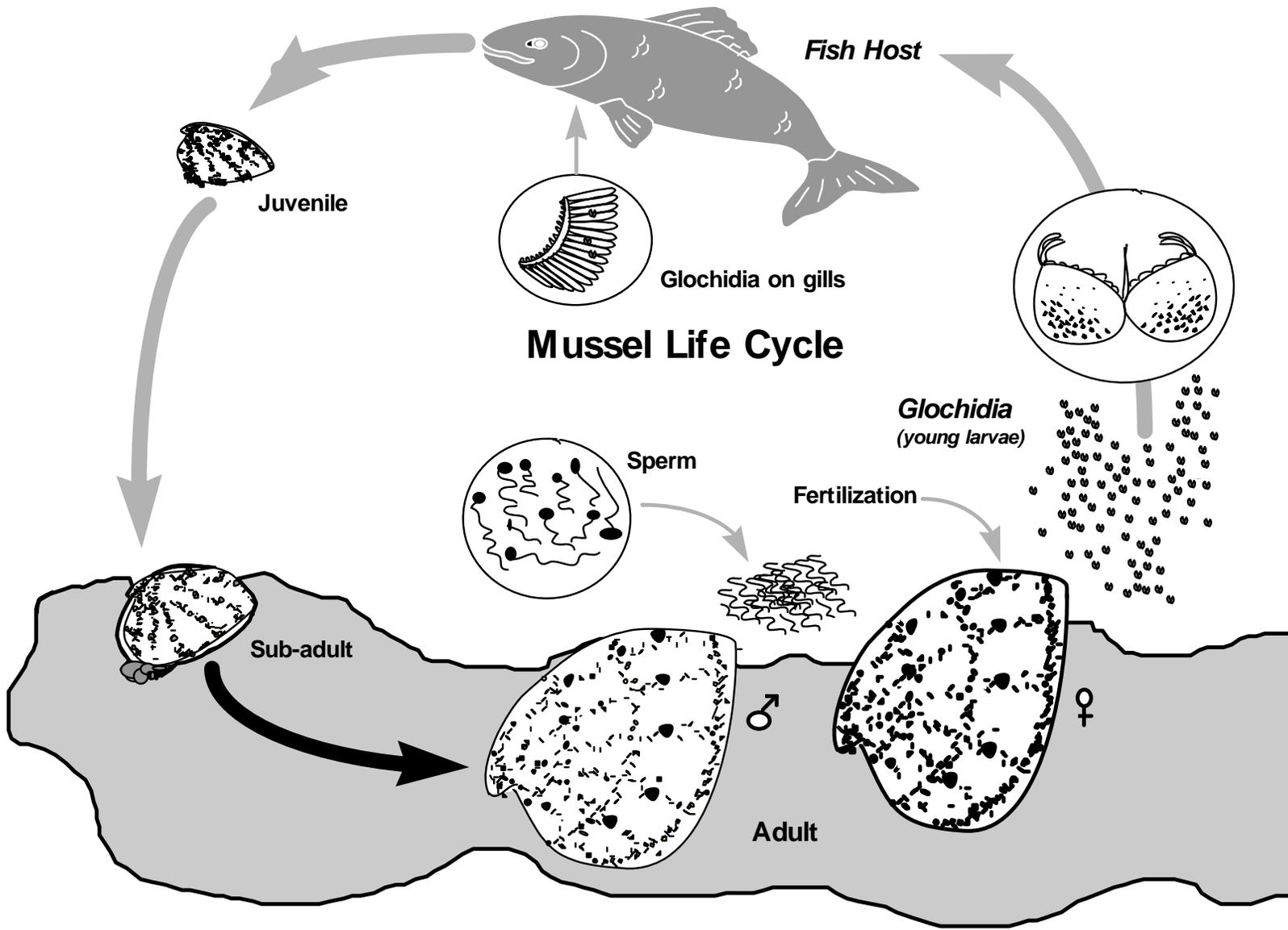
In **Step 6**, students that land on a "sand bar that dries up in the summer" or "riprap" **do not** survive for the same reasons previously stated. Additionally, Higgins' Eye glochidia which land on "**backwater muck**" **do not survive**. Higgins' Eye survive best in areas of the Mississippi having strong currents. "Backwater muck" is found in areas lacking current. Current is one factor that determines what type of substrate is found in an area. In the case of Higgins' Eyes, they survive best on the following substrates: gravel, sand and gravel, and sand.

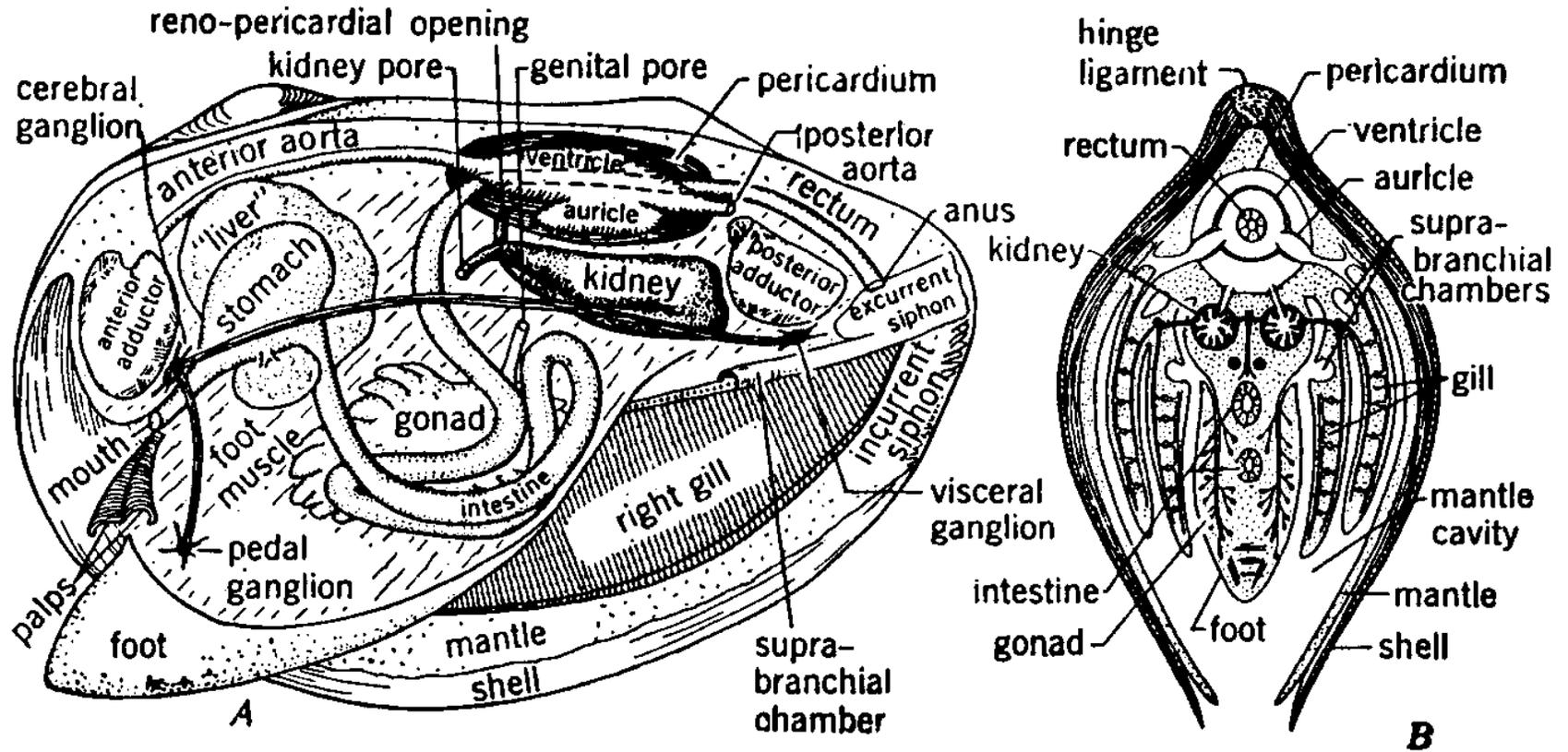
## ASSESSMENT

Have student write 2 reasons why the freshwater mussel's life cycle or feeding habits make them sensitive to changes in their habitats caused by humans.

## EXTENSIONS

1. Have the students research the fish species listed above and determine their habitat requirements. Then have them make the fish and substrate cards as part of the preparation for this activity.
2. Share with the students how buttons were manufactured from mussel shells.





Freshwater Mussel Internal Anatomy

# The Story of My Life by "Billie Button"

CHAPTER I. The author tells of his ancestry and pedigree, with side-lights on the habits of the care-free clam.

1

IN telling my story, I, Billie Button, must go back to the time long before I was I at all. Come with me, kind reader, to the Mississippi River, somewhere between Iowa and Wisconsin. Take a peep beneath its waters a little way off shore. Clams—Clams—Clams—millions of them, waiting in a "bed" a mile or more long, with their faces turned upstream and their mouths open, for the clam "toils not, neither does he spin," but waits for the big river to bring his food right down into his jaws. Not the clams that make your mouth water at the famous Clam Bakes of Long Island Sound, but their cousins, the Fresh-Water-Clams.

High-sounding names they have in the mouths of the scientific gentlemen who write Fisheries Bulletins and Zoologies. Take a long breath before you tackle them: *Lampsilis Adontonoides*, *Anodonta Corpulenta*, *Plagiola Donaciformis*, *Quadrula Pustulata*, and a lot of others that sound like the combatants in a Sicilian vendetta. Your clammer and longshore urchin, though, don't bother with scientific terminology, but dub them Slop Bucket, Nigger Head, Mucket, Pig Toe and other expressive if inelegant nicknames.

2

Ask that clammer over there to show you what his "crow foot" has brought up. Look carefully at the dozen or so specimens he dumps into your boat. Maybe they'll be all of one family, or just as likely every one will be different in appearance and name.



2,  
Cont.

Pick up one and rip off its shell ruthlessly. (What's a clam's feelings to the pursuit of knowledge?) If it's breeding time and you have chanced on a mother clam, you will find the gills doing double duty, for besides performing their natural breathing functions they will be distended (wholly or in part) with a jelly-like mass containing thousands of tiny eggs, becoming what the scientists call the "marsupium" or brood pouch. If your specimen answers to the name of Paper Shell or *Lampsilis Laevissima*, these eggs will be pale or colorless. If it chances to be a *Quadrula Ebena*, they will be pink or bright red.



# The Story of My Life by "Billie Button"

CHAPTER II. Here you meet the Glochidium.

Don't be afraid of his name.

He is harmless

MAYBE the next clam you investigate will have no eggs at all—then you can gamble that it is a father clam, useful, but with a history that, as Kipling says, "is another story."

3

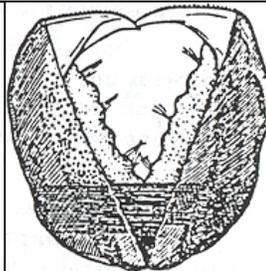
Number three opens up differently. The brood pouch is full, but not of eggs. Instead you'll see, if you look closely, myriads of little embryo clams or glochidia (how these professors do love to parade their Latin). These glochidia are hatched from the eggs in the brood pouch, but remain there, packed snug and tight, for periods of from a few weeks to several months, according to the particular kind of clam from which they spring. The glochidium is tiny, of course, and its shell is soft, but it has all the essential features of the adult clam, and in the brood pouch of the old mother clam its organs develop and it grows up toward perfect clamhood.

4

Now drop the rest of your clams into the bottom of your boat, row off down stream and try your luck as an angler. If fate is kind and bait attractive, you'll land a brace of rock bass or a sheepshead—at worst you can count on pulling in a few sunfish.

5

What has that to do with clams? Let's see.



A GLOCHIDIUM

Take a close look at that fish you caught last. Along its fins and gills you will find little rough humps and bunches—all closed over with "skin." Don't be suspicious. Mr. Fish isn't diseased—these are not boils or bunions, but another step in the life history of the clam, and a shining example of Dame Nature's way of caring for her helpless children.

6



When you open these bunches you will find that each contains a glochidium just like one of those you saw in the clam's brood pouch a half hour back, only a little better developed. You have stumbled on the clam in its "parasitic" stage.

7

# The Story of My Life by "Billie Button"

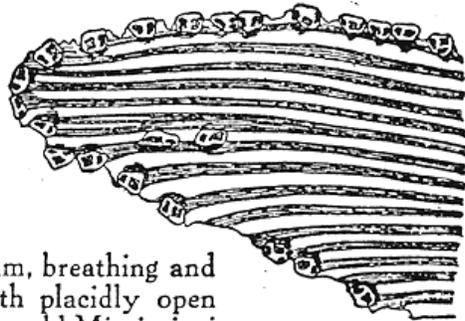
## CHAPTER III. *The clam's halcyon days—with a forewarning of trouble.*

8

THE glochidium, when thrust out by the mother clam into the cold and cruel world, closes its embryo shell on the fins or gills of the first fish that comes along, a sac or cyst forms about it, and it lives in this state for a few weeks, during which time it develops into a full fledged mussel. This doesn't hurt the fish at all, and is mighty beneficial to His Clamlets. The time spent as a parasite differs from two to six weeks, depending upon the particular kind of clam that is making its way in the world.

9

Bye and bye the glochidium gets tired of being dependent upon other folk, opens up the door of its house on the fish's fin and drops off to the bottom of the stream, where it takes its place in the clam bed as a fully developed, (although not fully grown), clam, breathing and sleeping, and keeping its mouth placidly open for the generous food supply the old Mississippi brings along. If the water is pure and runs rapidly, all's well and the clam thrives, but if a sewage system or factory pours its polluting waste into the stream, its existence is likely to be cut prematurely short.



"Very well," you say, "but is this the life story of a Clam or of a Pearl-Button?" Be patient, I'm coming to that, but first I must tell you how the clam's lot nowadays isn't such a soft snap after all, how it's worried and flurried, hunted and harried, and finally dragged forth from its bed to a slaughter of the innocents.

Here's how: For many years the clam from whose shell I sprang lay in a Mississippi clam-bed, with millions of its relatives.

There it staid, eating its fill and growing in Summer, in Winter lying dormant; each year of its life marked by lines and grooves on its shell. For the first few years it grew rapidly, then slower and slower until—

**ONE DAY SOMETHING HAPPENED.**

