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ABSTRACT

This interdisciplinary unit is intended for use in the fourth grade. Through discussion of the American Lobster, its economics, history, literature, and biology, the unit describes the effects of the marine environment on human history and culture. Sections deal with how marine organisms have evolved. Detailed descriptions are provided of lobster fishing procedures and equipment and discussion covers the development of cultures that depend on the resources of the sea for income or food. (RE)

FINESTKIND: THE AMERICAN LOBSTER

A Learning Experience for

Marine Education

Produced By

Northern New England Marine Education Project

Supported in Part by

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Northern New England Marine Education Project

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Acknowledgements

This unit was prepared and trial tested in schools in Maine and New Hampshire during spring 1978. Each of the units in this Marine Education Program were trial tested in a minimum of five classrooms and were revised as a result of suggestions by the cooperating teachers. Parts of these units and much of our working philosophy was derived from project C.O.A.S.T. developed at the University of Delaware and we gratefully acknowledge the leadership of Dr. Robert Stegner, director of project C.O.A.S.T. These materials were trial tested under the supervision of former assistant director Dr. [illegible]es Picker and were written by graduate students in education at the University of Maine (Orono) and cooperating teachers in the schools of Union, Maine; Freeport, Maine; and Hampton, New Hampshire. We call these units - trial units - because we hope you will try them in your classroom and modify them to suit your situation.

John W. Butzow
Project Director
January 1979

NORTHERN NEW ENGLAND MARINE EDUCATION PROJECT

ANNOTATED LIST OF INFUSION UNITS: K-8

Trial Edition A

K — Clams and Other Critters: a unit on shells (living and non-living), includes crafts, science, language arts, home economics, math and other areas. (Butzow and Jones)

K + 1 — Marine Art: art and craft activities to be used in many subject areas. (Picker)

2 — The Aquarium: revolves around a freshwater aquarium setup. Language arts, math, science, art and others. (Kilfoyle)

3 — The Beaver: study of the history, economics and natural history of the beaver. Social studies, language arts, music, arts, crafts, science, math. (DiSilvestro)

4 — The Lobster: explores the economics, history, biology, literature of the lobster. Home economics, art, crafts, science, social studies, literature. (Eiseman, Dresser, Kilfoyle)

5 — Whales and Whaling: a complete study of the history, biology and economics of whales and whaling. Language arts, music, math, science, social studies, arts, crafts, industrial arts. (Picker, Carkin)

6 — Our Heritage of Ships: surveys the development of ships, with emphasis on New England. Science, art, music, crafts, literature, language arts, social studies. (Glueck, Butzow)

7 — Ships, Shipping and Waterways: explores ships and seaways today; with emphasis on New England. Social studies with excursions into science, arts. (Glueck, Butzow)

8 — Coastal Indians of Northern New England: three part approach to Indian studies, culminating in an "Indian Day or livening." Independent study suggested for Part II. Language arts, library science, music, art, crafts, social studies, marine science, industrial arts. (Picker, DiSilvestro)

Units are available from:
Northern New England Marine Education Project
Shibles Hall, College of Education
University of Maine at Orono
Orono, Maine 04469

TITLE: Finest Kind: The American Lobster

*MARINE CONCEPT: 3.2 Marine organisms are adapted to their environments in different ways.

3.21 Marine organisms are adapted developmentally, structurally, functionally and behaviorally to their environments.

4.1 The marine environment has affected the course of history and the development of human cultures.

4.11 Proximity to the oceans and the availability of marine resources have influenced the cultures of many societies.

GRADE LEVEL: 4

CLASS PERIODS: Various

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*The conceptual scheme is from A Conceptual Scheme For Marine & Coastal Environmental Studies, 1973. Available from Dr. Robert Stegner, University of Delaware, Newark, De. 1971.

INSTRUCTIONAL OBJECTIVES

At the conclusion of this unit, each student should be able to:

1. Distinguish the American Lobster, HOMARUS AMERICANUS, from other crustaceans.
2. Identify five parts on a lobster.
3. Describe the life cycle of the lobster.
4. Describe how the lobsterman "fishes" for the lobster.
5. Describe the required skills of at least two types of jobs related to lobstering.
6. Construct a craft item having to do with lobstering.
7. Cook a lobster or other crustacean using various recipes.

THE AMERICAN LOBSTER

Teacher Background:

Introduction

The largest phylum in the animal kingdom is Arthropoda, which contains animals with jointed legs.

The American Lobster belongs to a group of arthropods called Crustaceans.

The American Lobster is distinguished from other crustaceans, such as the crabs, by the large abdomen. It has five pairs of legs. The first pair end in pincers and are larger than the rest. The lobster is usually right handed; that is, the large crusher claw is on the right while the pincher claw is on the left.

How Does the Lobster Move About?

While moving along the bottom, the lobster moves easily on the tips of its slender crawling legs. During this process, it keeps its large claws extended forward to reduce resistance as it moves through the water. It must be remembered that the lobster weighs less in the water than in air; so, its movement in the water is much more graceful than the strained crawling we observe in the sink or on the table. While leisurely surveying its territory, the lobster maintains forward motion primarily through the rhythmic beating of its swimmerets.

If startled, or in danger, the lobster can swim rapidly by flexing its powerful abdomen, or tail. This flexing results in a fast, backward movement of the lobster with its legs streaming behind.

Where does the American Lobster live?

The lobster is found in the Atlantic coastal waters and in estuaries from eastern Canada to the middle Atlantic coast--from Belle Isle in Labrador to North Carolina. It is commonly found in the waters of the New England coast where it is most abundant. The lobster is a bottom dweller. It lives among rocks and in mud burrows seeking the protection of seaweed, kelp, and other marine growths. The lobster, as far as is presently known, is relatively non-migratory, moving off-shore into deeper waters during the cold months, and returning to the coastal shoals during the spring and summer months.

Reproduction in the American Lobster

All lobsters reproduce by the physical union of two sexes. The female can only mate shortly after molting. The female has a special organ called a sperm receptacle, where she stores the sperm from the male until the eggs are ready to be extruded. The sperm remains vital within the female's receptacle for periods in excess of a year. When the female is ready to lay her eggs, she turns on her back and flexes her abdomen. The eggs then flow from her genital openings at the bases of the second pair of walking legs over the receptacle where the eggs are fertilized by the previously stored sperms. The fertilized eggs become attached by a natural adhesive to the female's swimmerets. The female carries these eggs until they are hatched. She is called a "berried," "seeder," or "spawn lobster" during this period. The eggs usually are cemented in bunches to the swimmerets and one female may carry from 9,000 to 100,000 eggs.

The young go through a change and after hatching bear very little resemblance to the adult. The little lobster has a tiny, rounded body.

The length of time required for a typical young lobster to grow to maturity is about 208 days. It is estimated that during that period a lobster will grow from a width of one twenty-fifth (1/25) of an inch to several inches. The life of a lobster usually ranges from three to fifty years or more, attaining a one pound size in four to seven years.

How does the American Lobster Grow?

The lobster is completely enclosed in a more or less continuous hard-shelled covering, hinged like a suit of armor. This hard shell is incapable of expansion; so, in order to accommodate increased size due to growth, the lobster has to shed its shell from time to time. It does this by backing out of its shell.

The lobster gives warning of an approaching molt several days in advance. A black line appears just within the back margins of the outermost segments of the swimming legs. This line changes to white then to red two or three days before the molt. Fishermen call the lobster in this condition a "shedder."

At the moment of molting the top shell (carapace) begins to move away from the abdomen and a crack appears in each side of the shell going almost to the mouth. The back part of the body begins to stick out through the gap. At this time, the lobster usually lies motionless, but it can swim quite actively if disturbed. The remainder of the molting process requires about fifteen minutes. The carapace is lifted higher and the rear walking legs begin to be withdrawn.

The only time the female lobster can be impregnated is when she has freed herself completely from her old shell. The lobster remains soft for a short time only, for within 48 hours the new shell has hardened.

Molting is an exhausting process and dangerous as well because the lobster is defenseless at this time.

How Does the American Lobster Locate Food and Eat It?

The American Lobster has two kinds of organs of special sense: a pair of eyes and two pair of antennae covered with sensory hairs. Though the eyes are prominent because of their size, the lobster's vision may not be very keen and not very useful in bright light. Like the eyes of insects, those of the lobster are compound, with perhaps as many as 14,000 lenses. There are suggestions, however, that different facets on the lobster's compound eye are sensitive to different light intensities. This might mean that the lobster's sight is more effective than previously thought.

The function of smelling is performed by the olfactory hairs, which are found all over the lobster's body with concentrations on the first antennae and mouth parts. These hairs are sensitive to chemical and tactile stimuli. As the currents send fine particles from live prey or from decaying organic matter, these olfactory hairs catch the scent and lead the lobster to its food. The lobster uses its pincers to rip and tear its food and push it into its mouth.

Regrowth of Limbs

A lobster can cast off a limb and grow a new one in its place. This seryes as a means of escape from its enemies. The growth of a

new limb begins at once with the formation of a bud beneath the scar left by the breaking off of the old limb. The bud takes on the shape of a limb, indistinguishable from the former limb after a few molts.

The American Lobster as Food For People

The lobster fisheries of Maine yielded a catch of over 21.4 million pounds in 1964. These are exclusively lobsters called "selects" which are lobsters caught inshore and which weigh under three pounds. The most abundant size in this group is the "chicken" lobster which has just molted into the legal minimum size. "Chickens" weight one pound, or less. Some states allow the taking of large lobsters from offshore waters by draggers. Maine prohibits this.

Lobsters caught inshore are caught in lobster traps set on the ocean floor from 50 feet to miles apart in from 5 to 50 fathoms of water (1 fathom = 6 feet). The traps are usually baited with fish cuttings to attract the lobster. A new pelleted bait is currently being developed which could be more convenient and less expensive. The 21.4 million lobsters caught in 1964 was the effort of 754,000 traps.

Lobsters may be placed in lobster cars or lobster floats to await sale. These are large, compartmentalized wooden boxes which lobstermen moor near their boats. The lobster car is divided into sections. The lobsters are checked for shell condition and size and put into appropriate compartments. Some lobsters are held in lobster pounds, which attempt to provide a "natural home," and fed until sent to market. Lobster pounds are sometimes dammed off coves along the coast of Maine. They have the advantage of being naturally cleansed by the changes in tide. The risk of disease among lobsters stored in

pounds is high, however; so, the lobsterman runs the constant risk of losing his catch while holding them awaiting the higher prices of winter.

Lobster Fishing (Lobstering)

Along the Maine and New Hampshire coasts, people fish for lobsters in the continental shelf waters. Although most of this fishing takes place during the spring, summer, and early fall months, some lobstermen tend traps throughout the cold, Maine winter months. The lobstermen on Monhegan Island, for example, have established a closed season for the Monhegan Island area. That closed season extends from July 1 to December 31, meaning that lobsters can only be caught in those exposed waters from January 1 to June 30 each year. That certainly discourages the occasional lobsterman.

Lobstermen set and tend traps from boats that range from 12' skiffs with outboard motors to hearty "Jonesport" and "Novi" boats 40' or more in length, generally powered by large, V-8 gasoline engines. These fishermen and boats work from a handful of traps for the part-time lobsterman to 300, or more, for the full-time fisherman with a large boat and a sternman. The wooden traps, which are often home-made, are usually set out in the early to late spring after the danger of destructive winter storms has passed. These traps are often lowered into the water surrounding ledges and shoals where the lobsterman feels lobsters are living. The wooden trap is ballasted with concrete in which the fisherman has qritten his name and his license number. The trap has an opening hatch on the top which permits the lobsterman to bait and empty his trap. It has a large opening at one end which is filled with the funnel-shaped headnet. This net permits lobsters to

crawl in, but not out. And, effective January 1, 1979, this trap must have either two circular escape vents 2 1/4" in diameter, or one 1 3/4" X 6" rectangular vent. These vents, or holes, will permit small lobsters to escape from the trap while retaining those of "keeping" size. This new measure may help reduce the cannabalizing of smaller lobsters by larger lobsters in the trap; it will reduce the exposure of small lobsters to predation by eliminating the long drop to the bottom after being thrown from the trap. During this drop, small lobsters were often eaten, or injured, by dogfish and cod.

The trap's position is marked by a color-coded buoy attached to the trap with pot-warp, rope usually of hemp or polypropylene. The pot-warp is kept more or less vertical in the water by a toggle-buoy attached between the marker buoy and the trap. The toggle is often an empty bottle, or a small net float.

Before putting the trap overboard, the lobsterman baits the trap. The bait will vary depending upon the lobsterman's preferences, the season, and the availability of bait. In Eastern Maine, the bait is usually placed in small net bait bags and tied into the traps. In Western Maine, when redfish racks (carcasses) are available, these fish carcasses are tied into the traps with a line running through the eye sockets.

After the trap has been set for a day, or sometimes more, the lobsterman hauls the trap onto his boat. This is usually done using a winch head powered by the boat's engine, but some lobstermen with smaller boats and fewer traps haul them up by hand. The "keepers" get their claws pegged, or banded with large rubber bands to prevent damaging fights in the lobster car, or pound; while, the "shorts" are

thrown overboard to continue growing. Female lobsters which are "seeders" or "berried" are marked and returned to the sea. These are females with eggs attached to the undersides of their abdomens. The lobsterman cuts several V-shaped notches in the tail fins of the "seeder" with his knife. This alerts others who may catch her that she is a productive female and that she should be thrown back. There is a fine, or jail sentence as punishment for those found in possession of egg-bearing lobsters.

Crabs and urchins are removed from the traps and either returned to the sea, or kept depending on the available market. The lobsterman then rebaits the trap and sets it once again in the same location if he's happy with its production, or elsewhere if he isn't.

With fall and the increasing risk of severe winter storms, which dash traps against the rocks or wash them to sea, the lobsterman hauls his traps and takes them ashore for winter storage and repair.

Commercial Route of the Lobster

At the day's end, the lobsterman dumps his catch into his lobster car, or pound (most lobstermen do not have pounds, only 40 - 50 exist along the Maine and New Hampshire coasts). He keeps them there awaiting either a convenient time to sell them to the wholesaler, the lobstermen's cooperative, or awaiting a time when the price is slightly more favorable.

Lobstermen with pounds may even buy lobsters from other fishermen at the going wholesale price and store and feed them in anticipation of higher prices during the winter months when supply is low and prices high.

The wholesale buyer then transports and distributes lobsters to retail outlets, or to other wholesalers who transport lobsters even greater distances. With each ensuing sale, and with each additional mile to transportation, the price of the lobster to the consumer increases. For example, this author has seen live Maine lobsters on sale in Florida for $15.95/pound at the same time they were available for $1.89/pound from fishermen selling retail along the Maine coast.

This web of sales, transportation and preparation with its escalating costs provides interesting possibilities for arithmetic exercises as later suggested exercises will demonstrate.

The Lobsterman Off-Season

Late in the fall, after all the traps are hauled out, some lobstermen will rerig their boats to go scallop dragging, while others will haul their boats up for the winter. Those hauled up may be set in cradles at high tide and dragged up above the high water mark with tractors, or trucks after the tide has gone out, or they may be set on cradles and dragged up marine railways. While the boat is out for the winter, the lobsterman has a chance to clean her bottom, paint the boat, and overhaul the engine and running gear. During the winter months, the lobsterman also has to mend his traps. Rotten, or broken slats are replaced with new ones, and the pot-warp, toggles, and buoys are also checked and replaced as necessary.

Inevitably, traps have been lost in storms, or have been lost when the buoy and toggle were cut from the pot-warp, perhaps by a passing powerboat. The lobsterman must build new traps to replace these. He must also replace those which have outlived their usefulness.

as producing traps and may best be sold to tourists. The lobsterman often buys his trap stock from sawyers who specialize in producing lobster trap stock and then constructs his own traps. He pours the cement ballast into the trap bottom and writes his name and license number in it while it is still unset. The head nets must then be installed. These can be purchased, but many fishermen knit their own, or have members of their families knit them. New buoys are made from wood cut nearby, or purchased made of plastics. These buoys are painted with the lobsterman's own distinctive color code and branded with his license number. They are then affixed to the pot-warp along with the toggle.

With luck, and the many skills possessed by the lobsterman, the boat and gear are ready by spring for another season of fishing.

SUGGESTED ACTIVITIES

I. Read Finest Kind O'Day by Bruce McMillan to the class. (J. B. Lippincott Co., 1977)

II. Have students answer the following questions about Finest Kind O'Day:

1. What are the duties of a sternman in a lobster boat?
2. Why do the lobstermen usually only lobster during the summer?
3. What reason did Brett's father have for wanting Brett to be able to row 4 times around the island before he was allowed to row to town?
4. Why do lobstermen paint their buoys different colors?
5. What sort of things would make you say "Finestkind"?
6. What are the reasons for throwing back the notched and "berried" lobsters?
7. Why aren't there millions of lobsters, even though a female lobster may lay millions of eggs?

III. Show the slides included with the unit and discuss lobstering with the class.

A. Visit a lobster boat, or

B. Visit a lobster pound (see included list of suggested pounds), or

C. Arrange for a lobsterman or pound manager to visit your class. Be sure to ask questions of these resource people concerning prices, marketing, laws, overfishing, and lobstering as a career.

Lobster Pounds (East to West)

A. M. Look Canning Co.
Whiting, Maine (Holmes Bay)

Oscar Look
Jonesport, Maine

Arnold Francis
Pigeon Hill
Milbridge, Maine

Creamer's Pound
Sorrento, Maine

Herb Hodgkins
Tidal Falls
Hancock, Maine

Stonington Lobster Co-op
Stonington, Maine

Bickford (Baystate)
Vinalhaven, Maine

Graffam Bros. (H. W. Look)
Port Clyde, Maine

"Lefty Lobster"
Bremen, Maine

Maine Coast Seafood
Spruce Head, Maine

Bristol Lobster Sales
Boothbay, Maine

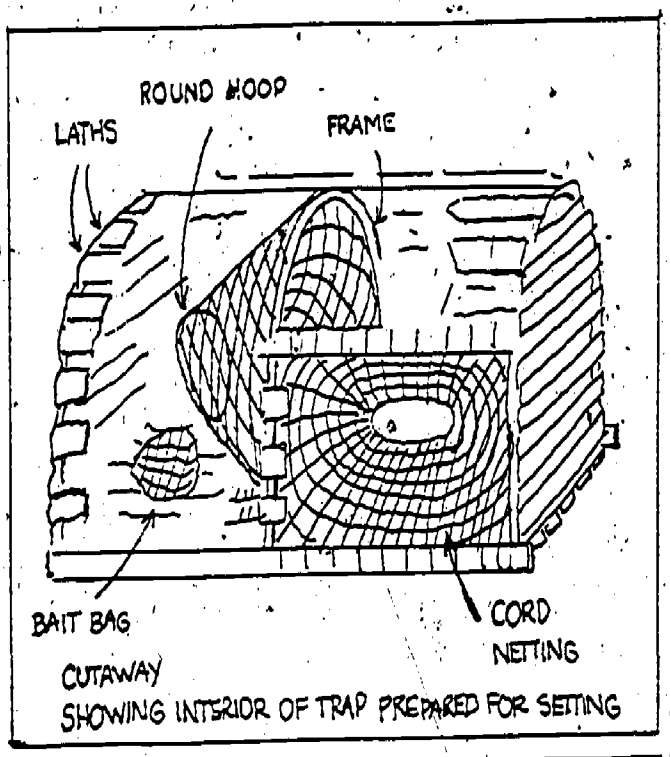
Churchill Lobster Products, Inc.
52 Browns Wharf, Portland

Bayley's Lobster Pound
East Grand Avenue Extension
Pine Point, Maine

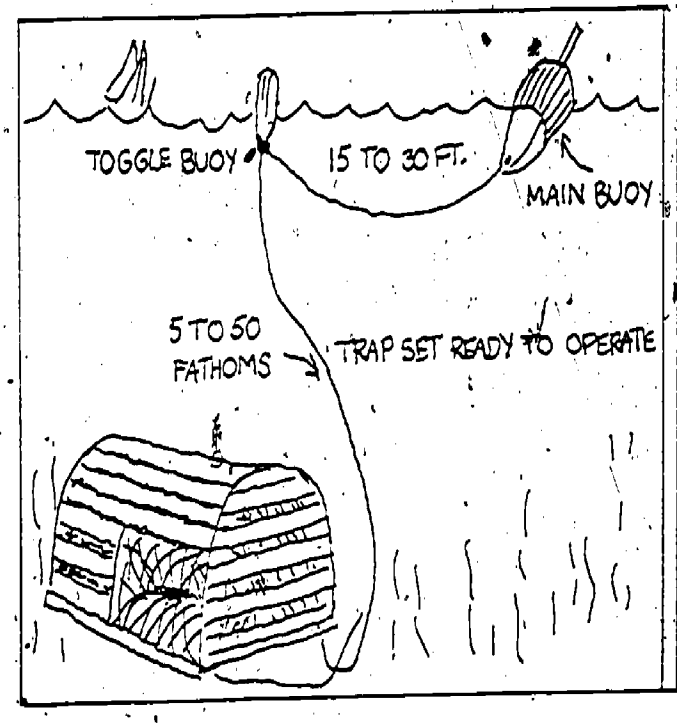
Sanders Lobster Co., Inc.
54 Pray Street
Portsmouth, N.H.

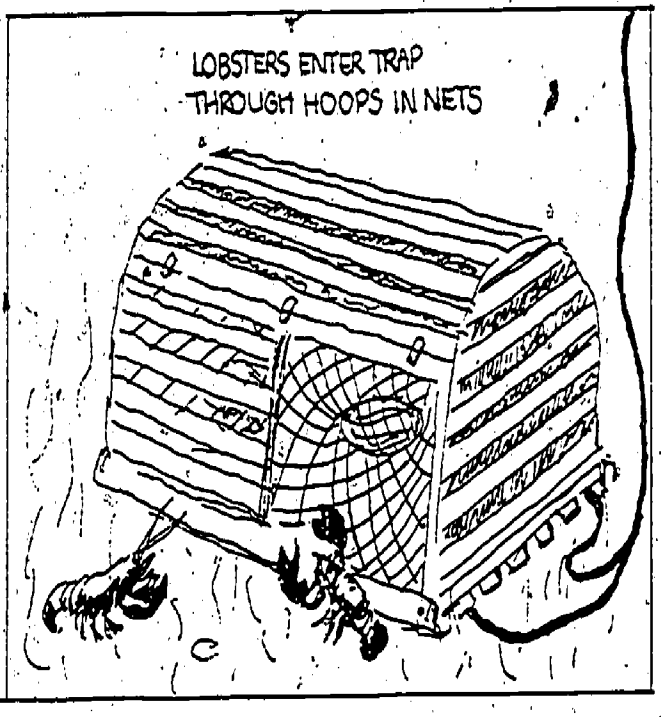
IV. Arrange for one or two lobsters to be donated for class study. Cook these and use the meat for a lobster salad, which should feed the entire class. Put a small amount on a cracker. Serve with other shellfish, if possible.

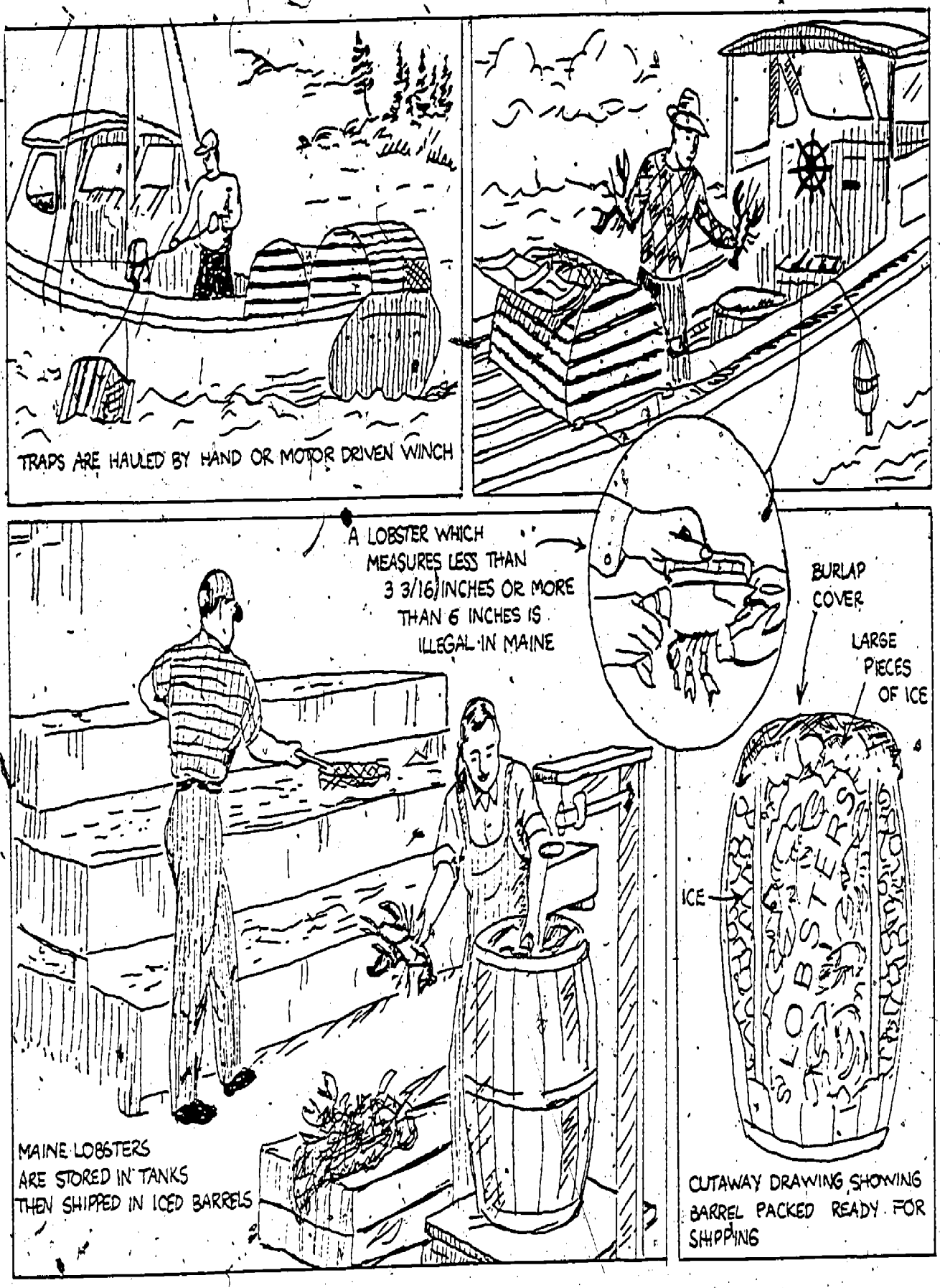
HOW A MAINE LOBSTER IS CAUGHT



CUTAWAY
SHOWING INTERIOR OF TRAP PREPARED FOR SETTING





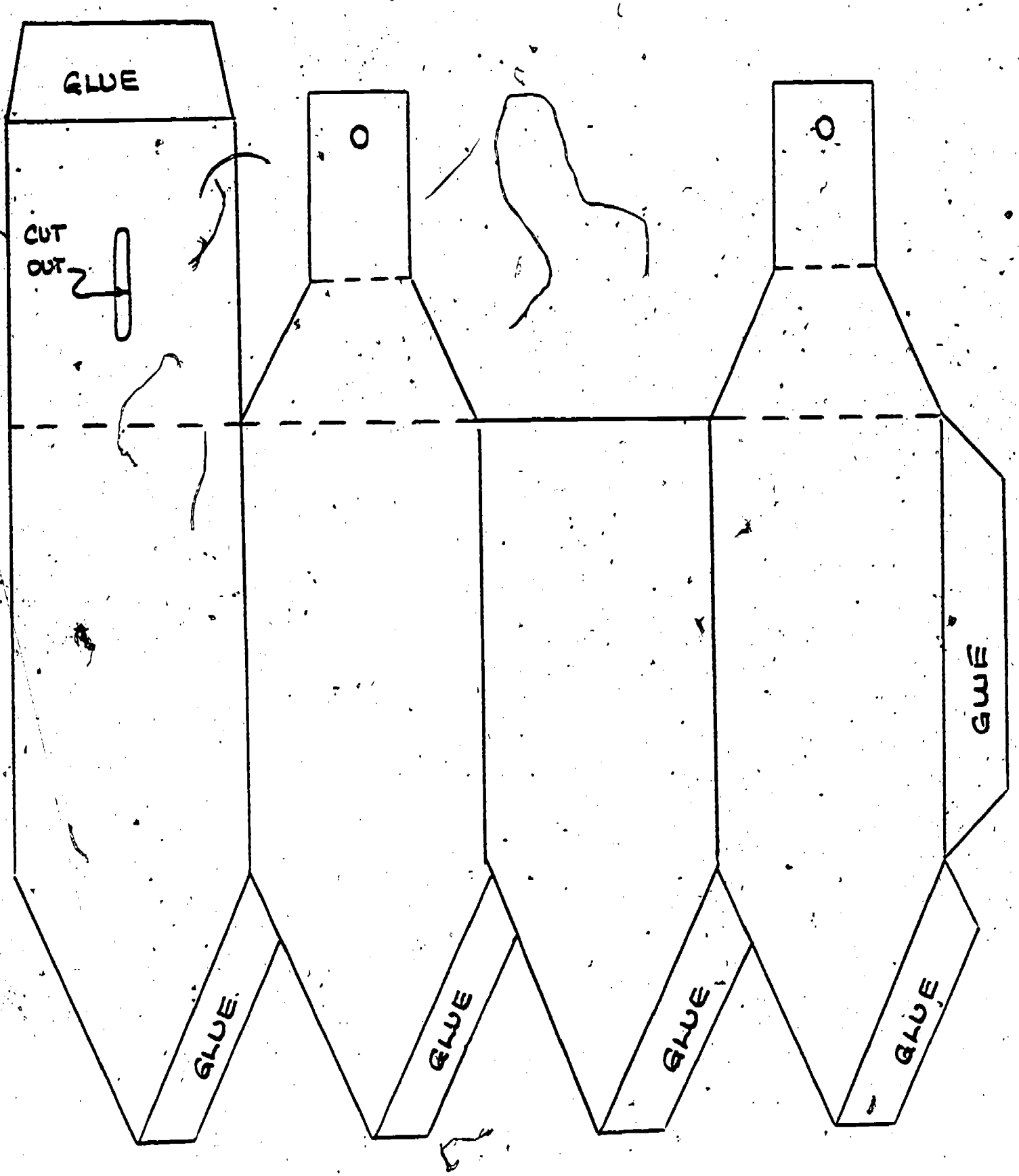

TRAPS ARE HAULED BY HAND OR MOTOR DRIVEN WINCH
A LOBSTER WHICH MEASURES LESS THAN 3 3/16 INCHES OR MORE THAN 6 INCHES IS ILLEGAL IN MAINE
BURLAP COVER
LARGE PIECES OF ICE
ICE
MAINE LOBSTERS ARE STORED IN TANKS THEN SHIPPED IN ICED BARRELS
CUTAWAY DRAWING SHOWING BARREL PACKED READY FOR SHIPPING

V. Have students construct a lobster buoy from the enclosed cut-out pattern. Have each student select his/her own color scheme such that no tow in the class are alike. This is a problem the fishermen must face in their areas. (These buoys could be used as Christmas tree ornaments by adding a yarn loop.)

VI. Make a wall chart with an outline of a lobster buoy for each student in the class. Have each student select a color scheme and paint one of the buoys and print his/her name next to the buoy.

VII. Make a collage of a lobster trap under the water. Use a page of construction paper, toothpicks, clay buoys, string, small drawings of lobsters (or small plastic lobsters, such as those found on swizzle sticks), tiny dried snails, starfish, and sea urchins, sand and pebbles. Glue these objects to the paper and make a picture showing the lobster's habitat on the bottom, the lobster, the lobster trap made by gluing toothpicks to the paper, and the pot-warp and buoy. Your students may wish to include a lobster boat model on the surface of the water.

VIII. Music often helps to introduce and reinforce topics studied. Following is a simple song by Malvina Reynolds that you might use. Perhaps your music teacher can suggest other appropriate pieces.



TEMPLATE FOR PAPER LOBSTER BUOY

PLACE TO BE

by Malvina Reynolds

D D D D D C# D E D
1. Everybody has a place to go,

F#F#F#F# F# E F# G F#
Everybody wants a place to be,

A A A A B A G F# E
When birds fly they're swimming in the sky,

D C# C# C# D E C# D
While fish are swimming in the sea.

D D D D D C# D E D
2. Everybody has a place to go,

F#F#F#F# F# E F# G F#
Everybody wants to be somewhere,

A A A A A B A G F# E D
Lobsters live at the bottom of the sea while

C# C# C# C# D E C# D
I'm at the bottom of the air.

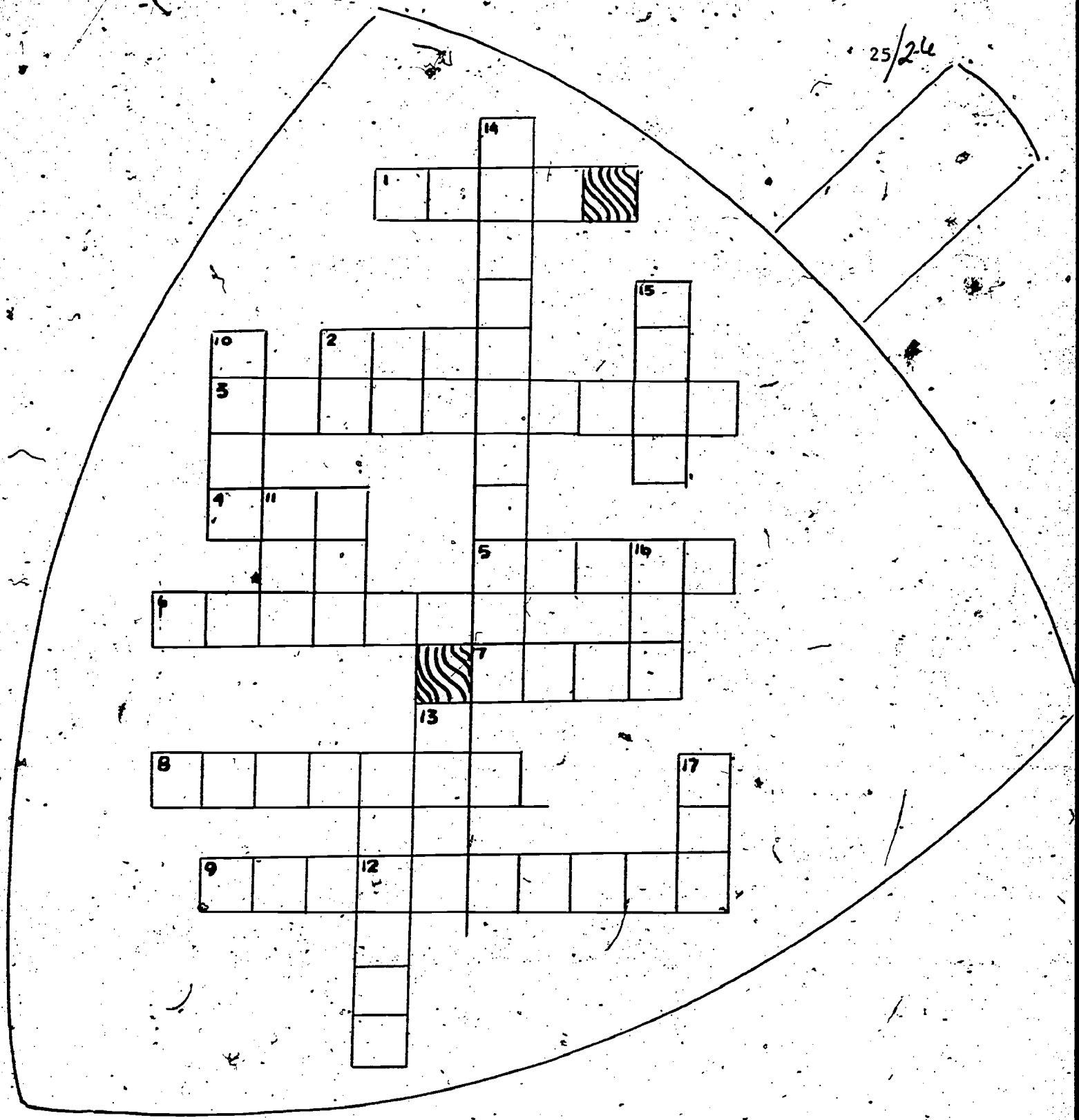
Our music teacher, Celia Jones, provided this song.

IX. Have your class write a paragraph, or paragraphs, about lobsters and lobstering using as many of the following words correctly as they can:

buoy
lobster
trap
lath
kitchen
warp
delicacy
notched
bait
shuttle
measure
counter
chicken
pistol
berried
head
coastal warden
environment
lobsterman
license

Note that some of the words are used quite differently by lobstermen then by people in everyday conversation. You might try awarding a certain number of points per word used appropriately (5 points, perhaps).

X. Have the students complete the following cross puzzles.


25/26
14
1
15
10
2
3
4
11
5
16
6
7
13
8
17
9
12

Across

1. A lobsterman knows where his traps are by the color of his _____. (buoy)
2. A lobster is attracted into a trap when he smells the _____. (bait)
3. A man who catches lobsters is called a _____ (lobsterman).
4. If he had fallen overboard he would have been quite _____ (wet).
5. Lobsters live in the _____ (ocean).
6. A lobster has two _____ (antennae) which stick out in front of his head.
7. The most meat in a lobster is in its _____ (tail).
8. A mother lobster which is carrying eggs is said to be _____ (berried).
9. When things are A-O.K., a lobsterman says _____ (finestkind).

Down

10. Before cooking a lobster, you should watch out for its crusher _____ (claw).
11. Lobsters are considered by most people as being quite good to _____ (eat).
12. On the front of a lobster's head are two _____ (eyes), which he sees with.
13. Lobsters and all decapods have ten _____ (legs).
14. Most people who catch lobsters have a _____ (lobster boat) to go out to sea in.
15. Lobsters are caught in a _____ (trap), sometimes called a pot.
16. A good lobsterman does not keep _____ (all) of the lobsters he catches.
17. When cooked a lobster is _____ (red).

Model Lobsterboat Hull Construction

XI. (It is recommended that the teacher perform this construction to show to the students, or that the teacher at least cut the keel and frames from the balsa wood for student assembly and planking.)

Cut out the included keel and stations patterns. Tape the two pieces of the keel together to form one smooth template. Now, carefully trace the patters on balsa wood approximately 1/8" thick. Using an X-acto type knife, carefully cut out each of the sections and the keel. Number each section as you cut it out, and draw the waterline (LWL) on each section using a straightedge. Draw the waterline on the keel as it is drawn on the pattern. Mark the station positions and numbers as they appear on the keel pattern onto the new balsa keel.

Next, cut a notch the thickness of the balsa wood in each of the sections from the bottom center up to the waterline. Note that section 0 has no waterline on it, since when the hull is afloat, that section should just touch the water. Cut a notch in section 0 about 1" deep and a similar depth notch in the keel at station 0. Insure that the tip of section 0 just touches the waterline on the keel.

At each of the other stations on the keel, cut a notch the thickness of the balsa down from the top of the keel to the waterline (LWL). Notice that there is no station T to correspond to section T; that is so since T is the transon. Using white glue, glue it to the after end of the keel with the section bottom flush with the bottom of the keel section which is above the propellor cut-out. Insure that the waterline on the transom intersects the waterline on the keel.

Now, apply white glue liberally to the notches in each section and to the notches in the keel and put the sections into the keel. Be sure to keep the sections perpendicular to the keel as the glue sets. Make sure that the waterline on each section intersects the waterline on the keel as you put them together. Set this "backbone" and "ribs" aside to dry.

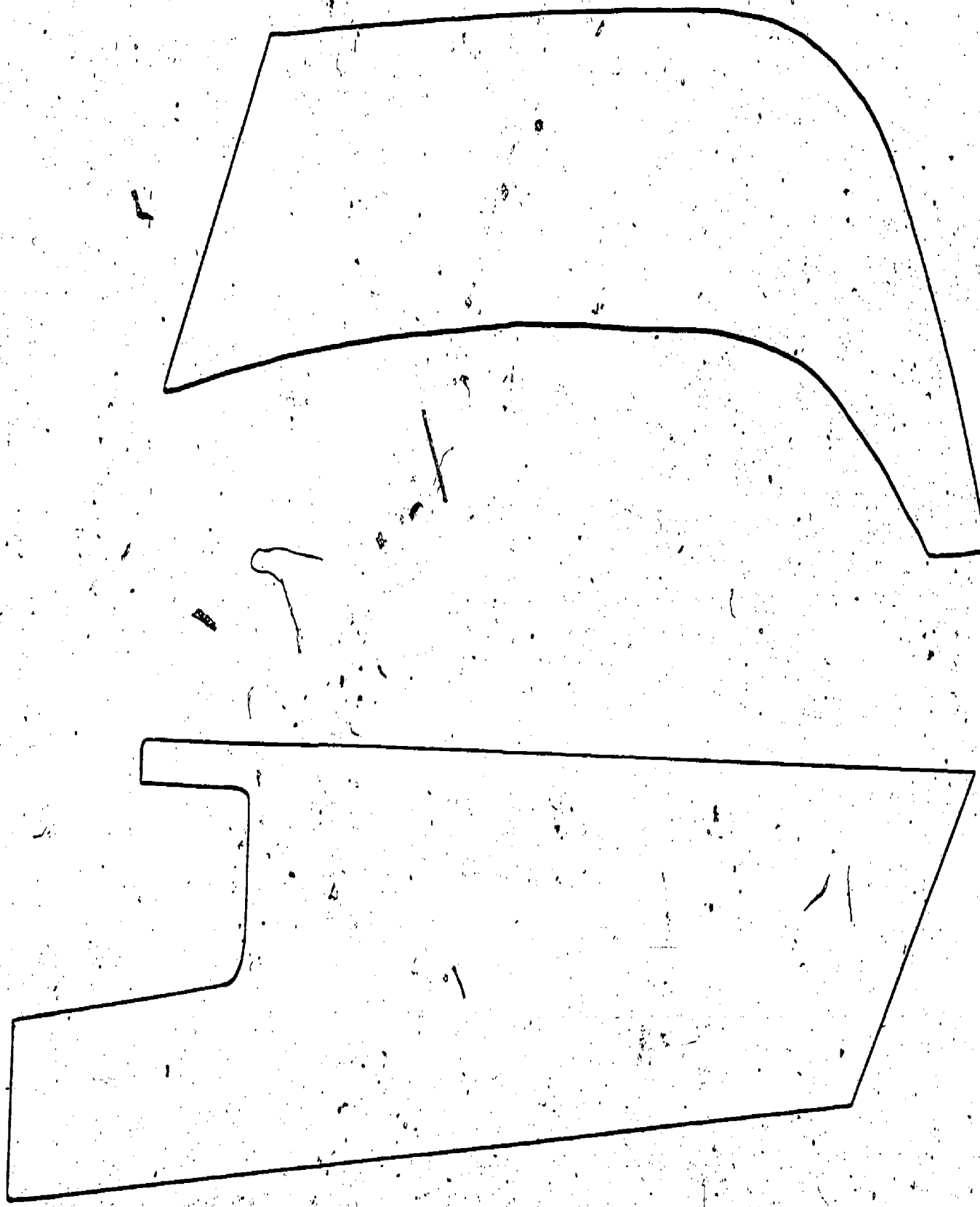
This process you have just gone through is not dissimilar to the manner in which boatbuilders actually construct framed boats. Of course, their sections are hollow ribs rather than our solid sections, and their keel is not nearly as deep as ours inside the boat, but the technique is similar.

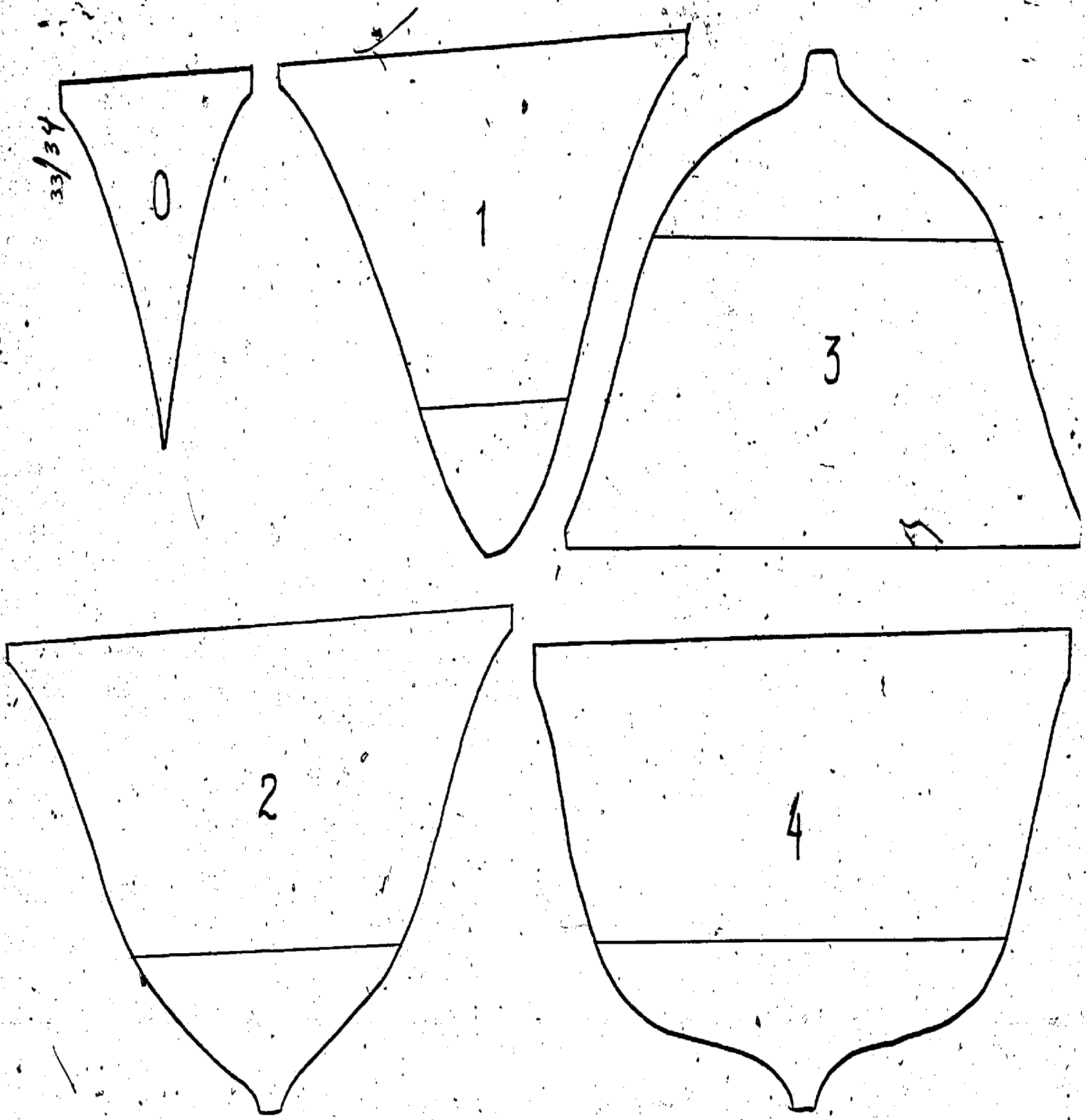
When your frame has dried, the hull is ready to be "planked." You, or your students, can see the shape of a real lobster boat hull by covering this frame. Strips of masking tape, or paper mache can be used to "plank" your hull. Turn it keel up and apply the planking.

The hull you have just completed will show your students the shape of the hull of many of today's active lobster boats. This model is actually of the Downeast 40, whose lines and profile are included in your unit courtesy of Webbers Cove Boat Yard, Inc., in East Blue Hill, Maine.

You'll notice that your sections have the shapes of the half-sections drawn in the body view in the middle of the lines drawing page, and that the profile of your keel comes from the profile drawing at the top of the page. Planking your hull will show the various contours depicted in the half-breadth drawing at the bottom of the lines drawing.

Try making a balsa cradle to display your hull, or hang it from the ceiling.

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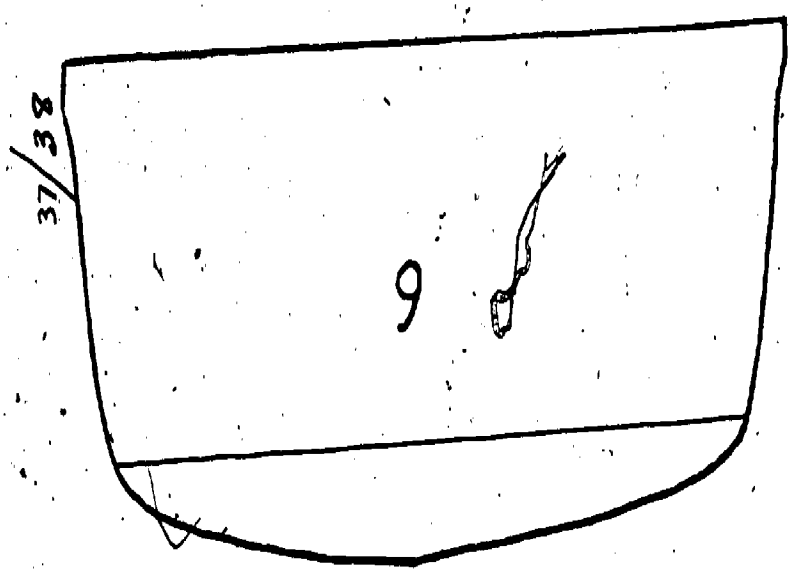
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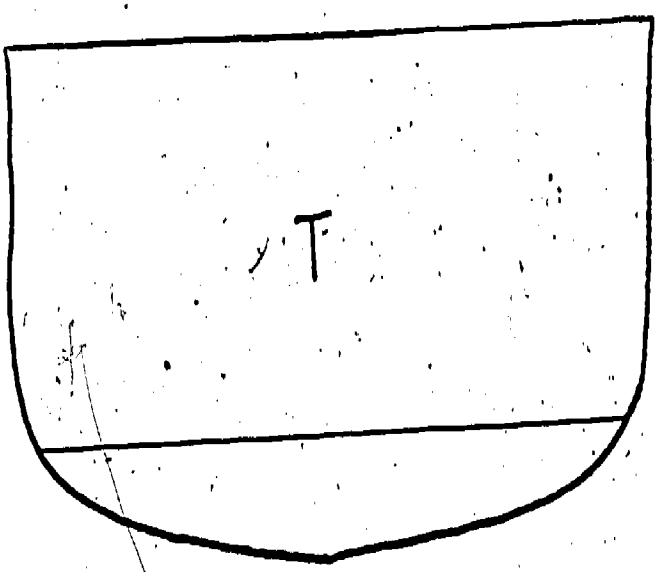
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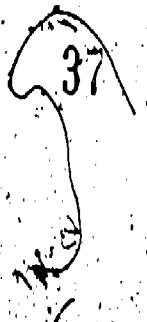
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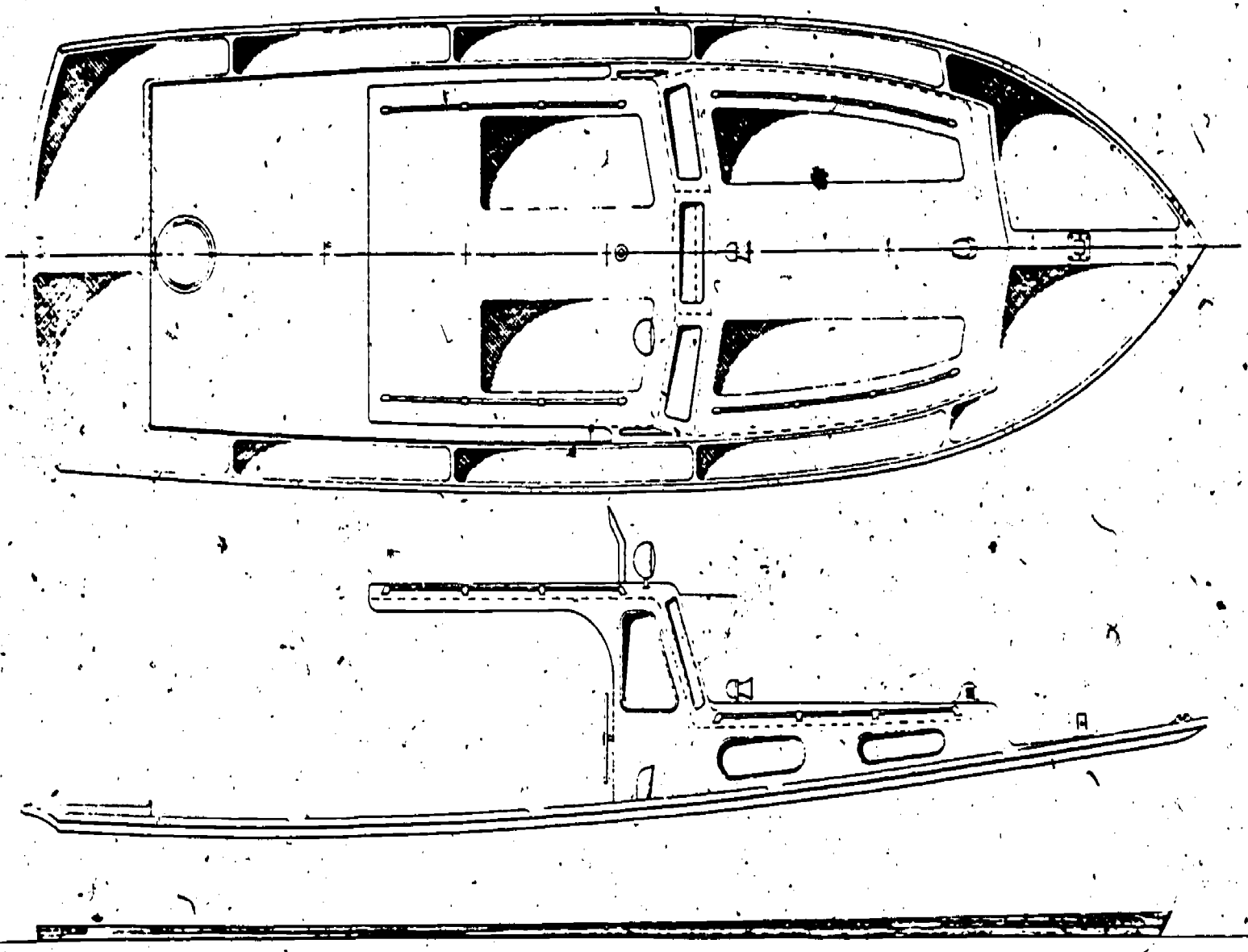
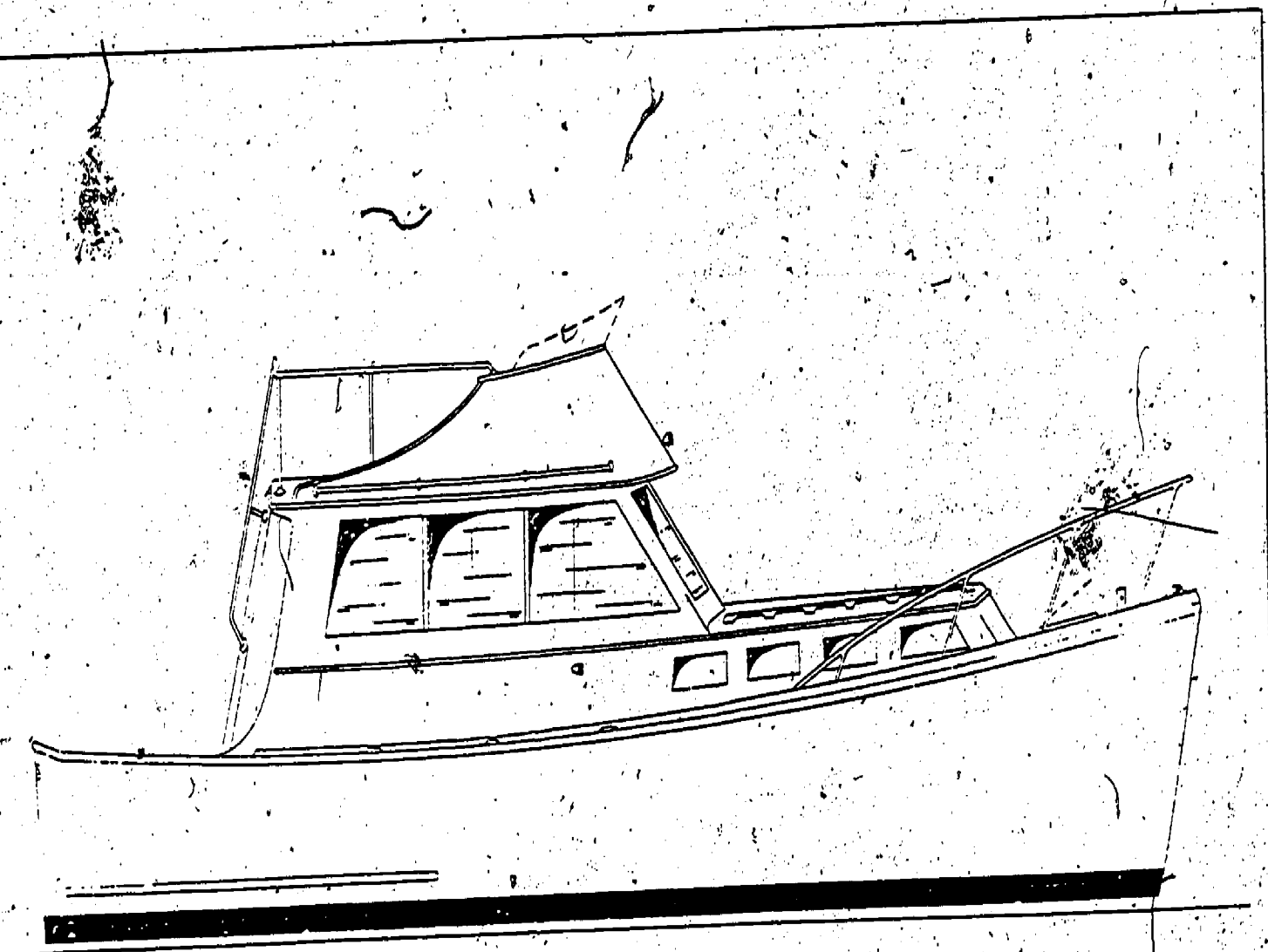
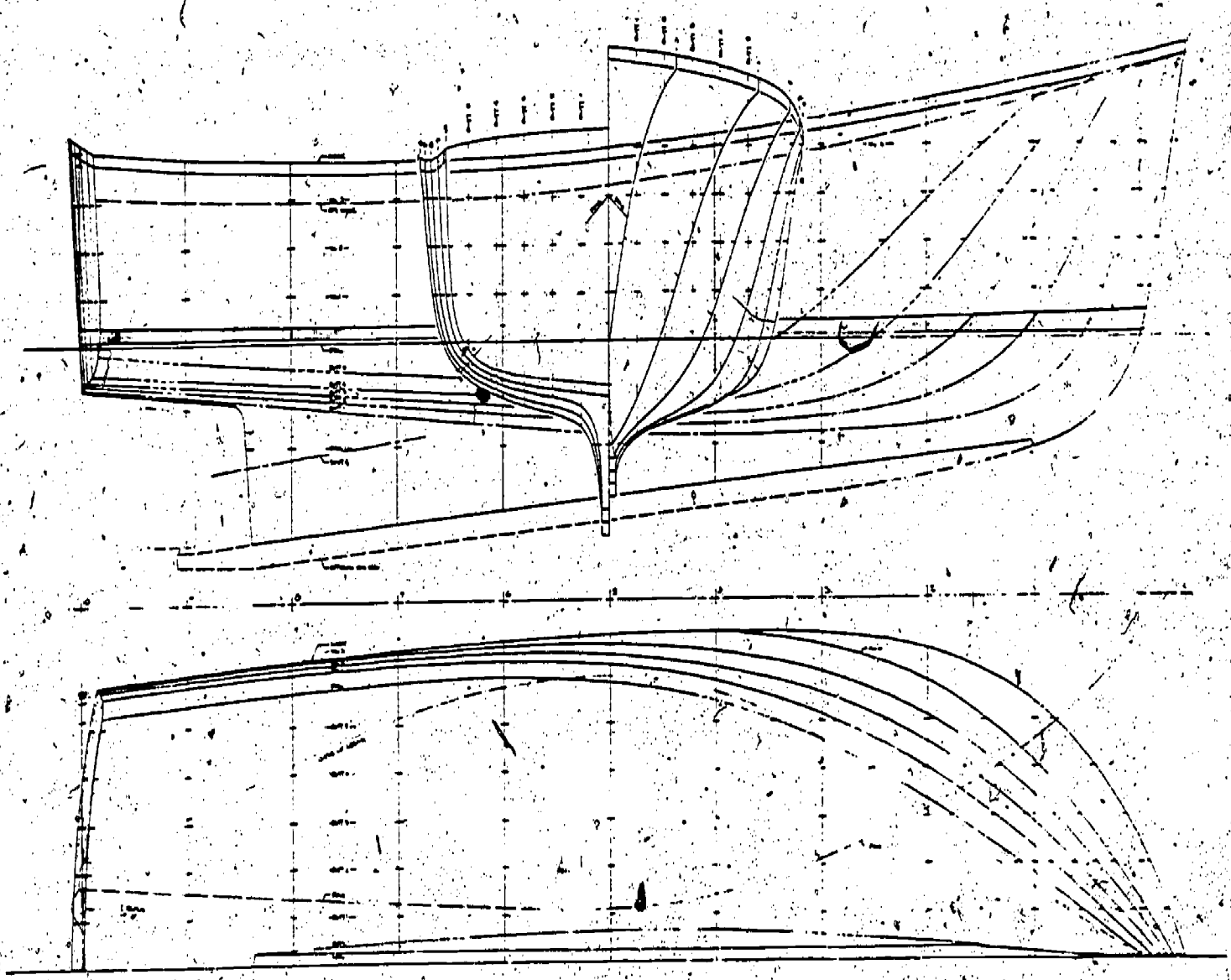


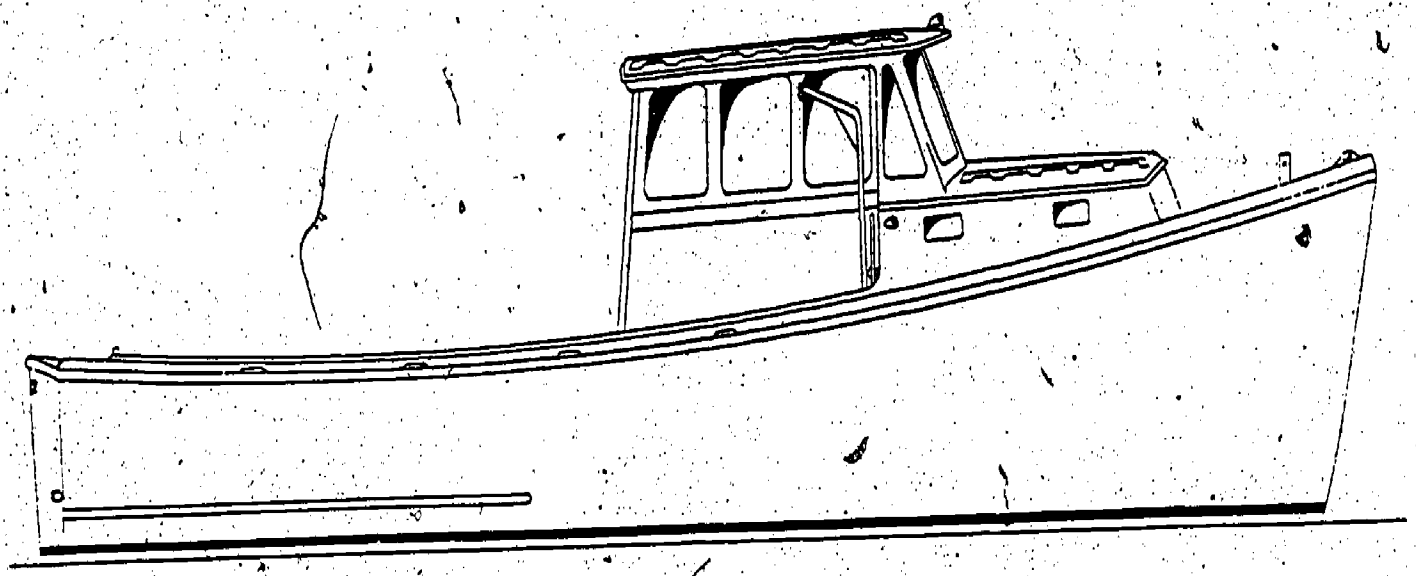


L. O. A. – 39'-11"
D. W. L. – 37'-11"
Beam – 14'-0"
Draft – 4'-4"
Scale: 3/8" = 1'

DOWN EAST 40
"SEDAN CRUISER"
WEBBERS COVE BOAT YARD INC.
EAST BLUE HILL, MAINE 04629
207-374-2841



DOWNEAST 43
Designed and Built by
WEBBERS COVE BOAT YARD, INC.
East Blue Hill, Maine 04629
Tel. (207) 374-2841
Scale 3/8" = 1'-0"



L. O. A. – 39'-11"
D. W. L. – 37'-11"
Beam – 14'-0"
Draft – 4'-4"
Scale: 3/8" = 1'

DOWN EAST 40
"LOBSTER BOAT"
WEBBERS COVE BOAT YARD INC.
EAST BLUE HILL, MAINE 04629
207-374-2841

XII. Establish an aquarium with crayfish in it so the class may observe the external anatomy and behavior of a decapod very similar to the lobster. Try the activities described.

Some of you may find that a line lobster is unattainable in your area. A crayfish is the common freshwater crustacean cousin of the American lobster. It is one of the 25,000 other species which belong to the crustaceans. If you live by a pond or stream you may find an abundant supply of them. These organisms are primarily nocturnal in their feeding and may be observed close to shore in the early evening hours if one were to look using a flashlight. Many times divers who might dive in the local lakes and ponds have observed their behavior and have picked them up quite readily. Perhaps you know of a diver who would be willing to collect them for you. The crayfish could also be taken with a trap which may be an interesting project for the class. It is constructed as follows: A rectangular box of any convenient size, 16 X 24 inches for example, is built of 1/4 inch mesh galvanized screen wire. A removable funnel should be made on one end of the trap. This is constructed of the same material and should extend about halfway into the trap and have a flattened opening about 4 inches wide and 1 1/2 inches deep. A minnow trap can be used too, if you elect not to build one. This can be purchased in a sporting goods store.

The trap should be set in shallow water along a sloping bank and buried partly with mud or sand. The opening should face the shore line with the bottom of the funnel even with the bottom of the stream or pond. Some of the trap will project out into the deeper water. Any type of dead fish or raw meat will attract the crayfish. Secure

this bait to the bottom of the trap with some flexible wire or string. This trap should be set in late afternoon or early evening and left overnight. If there are any crayfish in the pond, the trap should capture an abundance of them.[1]

Perhaps you may not want to do this part of the activity. Another option is to order these creatures from a biological supply house. They may be purchased living and the cost depends on their size. Small to medium crayfish are cheaper and easier to keep. They sell from around $5.00 to $7.00 for six to $8.00 to $10.00/dozen. This includes shipping. Some companies even have overnight delivery.

Connecticut Valley Biological Supply Co., Inc.
Valley Road, P.O. Box 326
South Hampton, Mass. 01073
Telephone Area Code 413-527-4030

Carolina Biological Supply Co.
Burlington, North Carolina
Order by Phone: Toll Free 800-334-5551

CENCO - 160 Washington Street
Somerville, Mass. 02143
Telephone: Prospect 6-1800 Area Code: 617

Turtox/Cambosco
MacMillan Science Co., Inc.
8200 South Hoyne Avenue
Chicago, Illinois 60620
Call Toll Free: 800-621-8980

Wards Natural Scientific Establishment, Inc.
P.O. Box 1712
Rochester, New York 14603

It is a good idea to plan for this activity several weeks in advance to allow set up time to take care of the crayfish.

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[1]Reprinted with slight changes from Science 55:677, 1922, by E. C. O'Roke, University of Michigan.

To start with, a 10 gallon aquarium is of sufficient size to hold 6-12 crayfish. First collect fresh, clean pond, stream, or lake water in covered containers. When you collect make sure you keep mud and other sediments out of the containers. Pond water will keep for an indefinite period of time and will be a source throughout the time you keep the crayfish. If there is no easy access to this type of water, you may use ordinary tap water. You must age this, though, by taking an air pump (available from pet shop) and an air stone (bubbler) and allowing the water in the containers to stand overnight or for several days. This gives sufficient time for the chlorine to escape from the water and not harm our friends.

The next step is to set up the aquarium: (see the diagram for details) You can collect the suggested materials from your local pet shop dealer or order them from one of the biological supply houses. If you cannot obtain all the materials, you may have to improvise.

Begin by washing the coarse angular gravel to remove all dust and dirt. Clean all equipment including the aquarium itself with baking soda. Never use a detergent. Set up the tank as pictured in the diagram. A plastic cover is suggested to help keep evaporation down and to keep out things that do not belong in the aquarium. This can be bought and cut to size from a local glass dealer. The same can be done for a divider if they are not available at the pet store. Place the aquarium in a naturally well lighted area but never in direct sunlight.

After setting the aquarium up, pour the angular gravel over the filter bed. This should be level and about 2" deep. Then place a

small dish or plate on one side of the aquarium and slowly pour the water into this to avoid disturbing the gravel. The water should come up to about 1" from the top of the aquarium.

Plug in all your equipment and check all your connections. The set-up should be left operating several days so you can monitor the temperature (should be kept at 60°F) and clarity. You may then add one little fish or any freshwater animal to it. This is to allow the necessary helpful bacteria to become established on your filter bed. Bacteria help break down any bad chemicals like ammonia from animal wastes. These chemicals would eventually cause harm to your crayfish if you added them too early. Allow at least two weeks time after adding one organism before you order your crayfish.

When you obtain your crayfish, clean them off by rinsing them separately in a bucket of water before adding them to the aquarium. Give the crayfish a couple of days to familiarize themselves with their new home before feeding them.

The crayfish may be fed dried dog food which has been broken up slightly, or raw hamburger. The size of the food should be around $\frac{1}{4}$ -$\frac{1}{2}$" balls. It is best to feed them on a regular time basis like in the morning on Tuesdays and Fridays. This will carry them through the weekend. They do not need feeding every day! Leave the food until they finish eating most of it - one day is sufficient. Remove any floating food or uneaten food after this or it will contaminate the water. You may even feed them separately from the aquarium. This can be an enjoyable activity for your students to watch:

ACTIVITY A

Feeding Observations Grades 4-6

1. How do crayfish react when they are hungry? (Drop a little food in front of them.) Do not disturb them as they eat - just observe them.
2. How do they use their claws and mouth parts when they eat? Are they right handed or left handed?
3. Are they very defensive when they eat? (like a dog with a new bone)
4. If one piece of food is dropped around several crayfish, which one eats first?

ACTIVITY B

Locomotion and Navigation Grades 4-6

1. Crayfish have two types of movement. What are t[illegible]
2. Can crayfish climb very well? What legs do they use?
3. When are they most active? (morning, late afternoon, when they are hungry?)
4. On a day when crayfish are not being fed, wash off a few small rocks and set up an obstacle course in the aquarium. How do crayfish get around them? Do they climb over them?
5. On a feeding day, place a small plastic (cleaned) ladder against the wall of the aquarium. How do the crayfish around this. Place some food at the top of the ladder. Will the crayfish climb the ladder? Which legs do they use? Do they use their antennae?
6. In a darkened room, place a flash light on one side of the aquarium. Are they attracted to the light?

ACTIVITY C

Handling the Crayfish

A large fish net should be used to pick up the crayfish from the aquarium when first handling them. This avoids introducing contaminants from your hands and also protects your friends from injury. Have a white enameled, or drawer divider, tray with about an inch of water in it. You may want to slant them slightly. The crayfish will walk up the bottom of the pan. When you pick up the crayfish (with washed hands), approach them from the rear, behind their claws and pick them up by their backs gentlely but firmly. Crayfish do not bite. They do not sting. They are not poisonous. They only pinch with their two large claws. The small walking legs will not harm you. Crayfish are very active and move quickly - they are a lot of fun.

Out of Water Activities

Be sure not to leave our friends out of water too long. Five minutes at the most, once a day would not be too much.

ACTIVITY D

Math Activity Grades 4-6

1. How many legs do they have? Are they paired?
2. How many antenna?
3. Are there any exceptions to these numbers?
4. If you have access to balances, you may want to keep a record of their weights. This is a good metric exercise. Record their weights in grams and keep a daily record

posted next to the aquarium. Do the crayfish gain or lose weight? You may want to carry this one step further and identify which ones gain or lose weight. This means you will have to label them.

5. Measure their claws, back, abdomen, etc. in millimeters

ACTIVITY E

Labeling

Handle the crayfish carefully. After removing from the aquarium, wipe off the crayfish with a soft towel. Also use the towel to cover the claws and head. Then mark them with white nail polish. They may be numbered on their backs. It is too difficult to write names with the brush so stick to a number system.

ACTIVITY F

Creative Writing

Objective: To have the pupil look more closely at the life of the crayfish in the aquarium and to have them put themselves in another animals place. You may add some interest by placing a cleaned bird cage mirror (made of plastic, not metal) in front of one of the crayfish and testing its reactions.

Materials: paper, pencils

Procedure: Give the pupils a list of topics related to the crayfish's life and discuss these topics to stimulate their imaginations.

1. If I were a crayfish in the tank . . .
2. Why I like my new home . . .
3. How I make my shelter . . .

4. What do I look like in the mirror?
5. My eyes are very different from other animal's eyes. . .
6. Where I used to live . . .
7. Who are my friends . . .
8. The strange things that observe me in my new home . . .

These questions can be reworded to suit the vocabulary of each group. After writing their stories, have the pupils illustrate them.

There are many activities that could be centered around the crayfish and its life cycle. You may want to separate the male from the females. They can be sexed like a lobster. The first pair of swimmerets are elongated in the male and shorter in the female. If the crayfish do reproduce the female will become berried (carrying eggs) around February or March. The young will hatch out after about a month on the female's tail. After leaving the tail they will have to be separated or they will be cannabalized. Have the students devise a way to raise them.

Another critical time is in the spring. The crayfish undergo molting. The pupils may watch this process and want to report on it. The crayfish is very weak after this and may be eaten by the others. Remove any others but do not disturb the newly molted one as its new shell is very soft. (It will harden in about two weeks.)

Their life cycles are very similar to the lobster. You may substitute the anatomy and many of the activities in the unit on the lobster for the crayfish. You will quickly find that the aquarium and the crayfish will be a center of attraction in your classroom. Have fun!

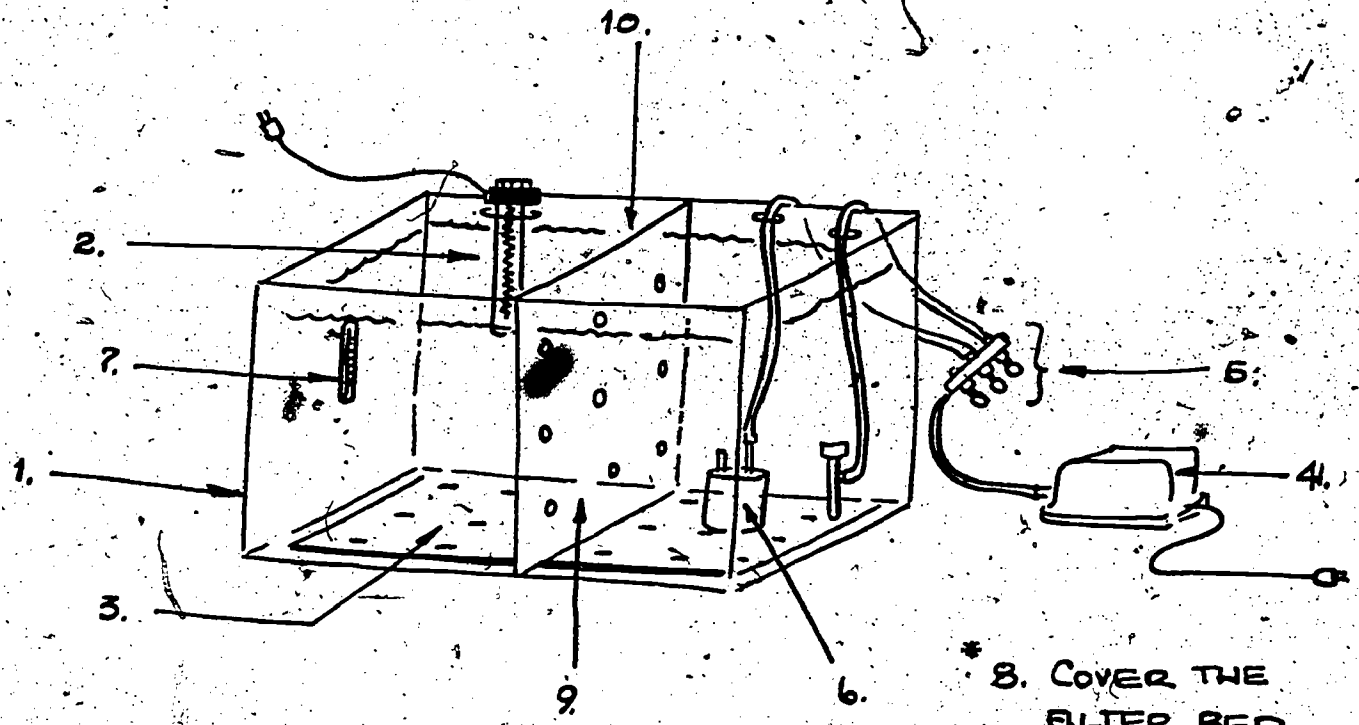
Spotle, S. H. Fish and Invertebrate Culture: Water Management in Closed Systems. New York: Wiley, 1970. 145 pp.

Spotle, S. H. Marine Aquarium Keeping - The Science, Animals, and Art. New York: John Wiley & Sons, 1973. 171 pp.

MATERIALS NEEDED:

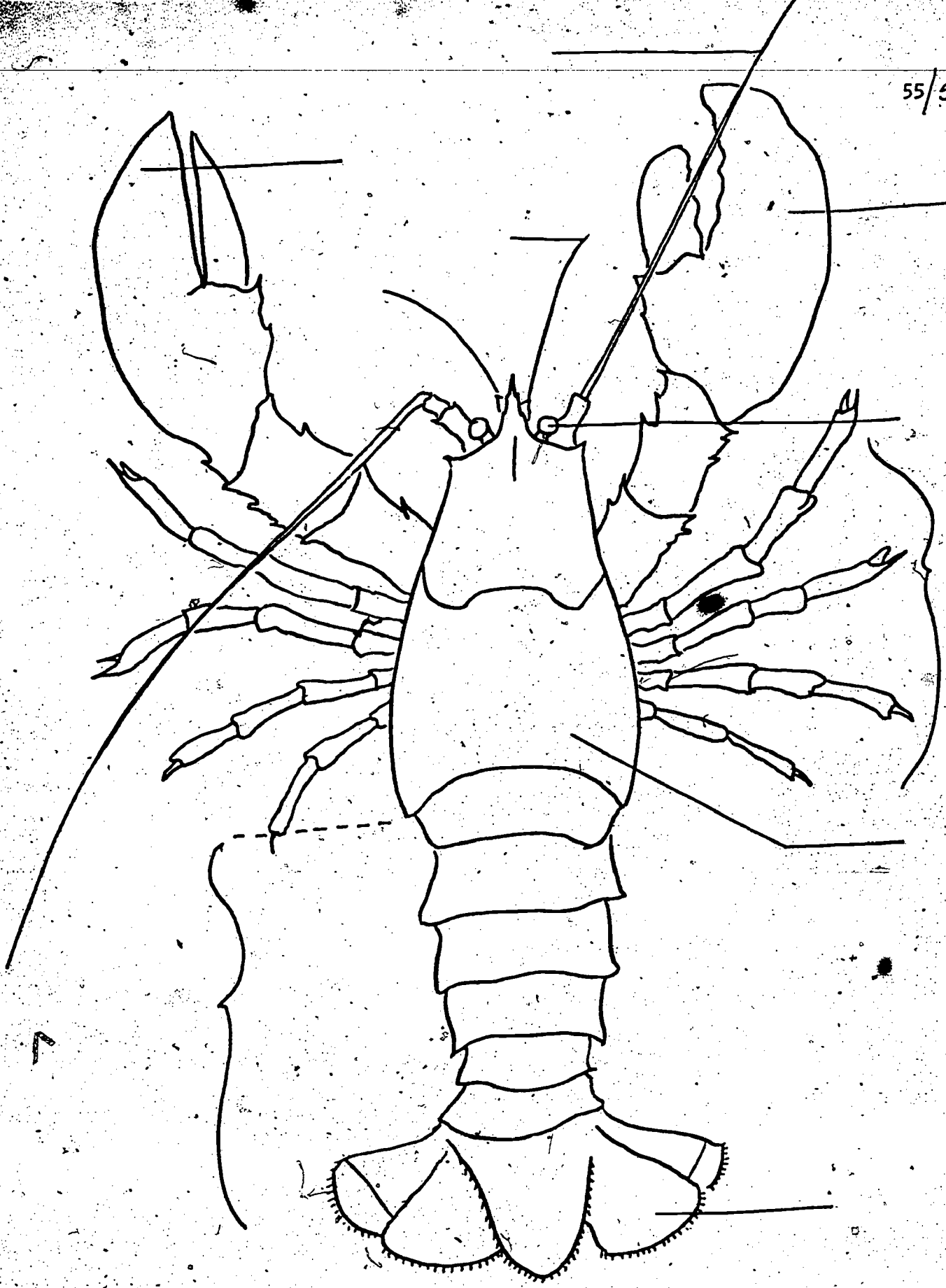
1. 10 GAL. AQUARIUM
2. HEATER
3. UNDERGRAVEL FILTER BED
4. AIR PUMP WITH TUBING
5. GANG VALVE
6. SUBMERSIBLE FILTER
7. FLOATING THERMOMETER
8. 20 LBS. OF LIGHT-COLORED GRAVEL (#5 SIZE)
9. DIVIDER WITH HOLES.
10. PLASTIC TOP WITH HOLES

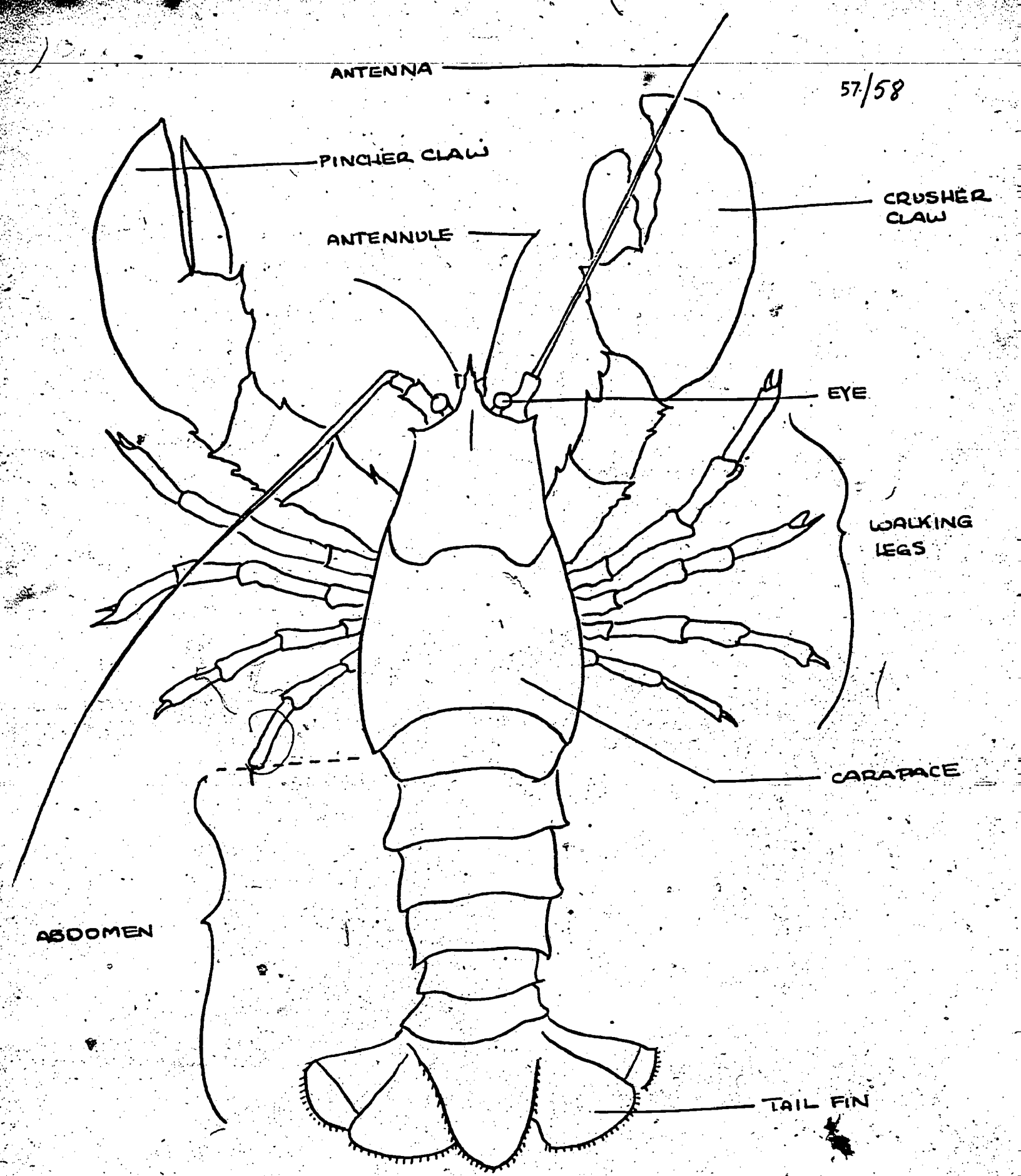
AQUARIUM SET-UP



8. COVER THE FILTER BED WITH ABOUT 2" OF GRAVEL

XIII. Prepare overheads, or handouts, from the lobster deagrams which follow. (You'll notice these same external features on your crayfish.) Explain the functions of the various parts, and point them out on your crayfish, if you have set up the aquarium. A copy of the dorsal view of the lobster is left with the parts unlabelled so that you may use it for a student exercise.

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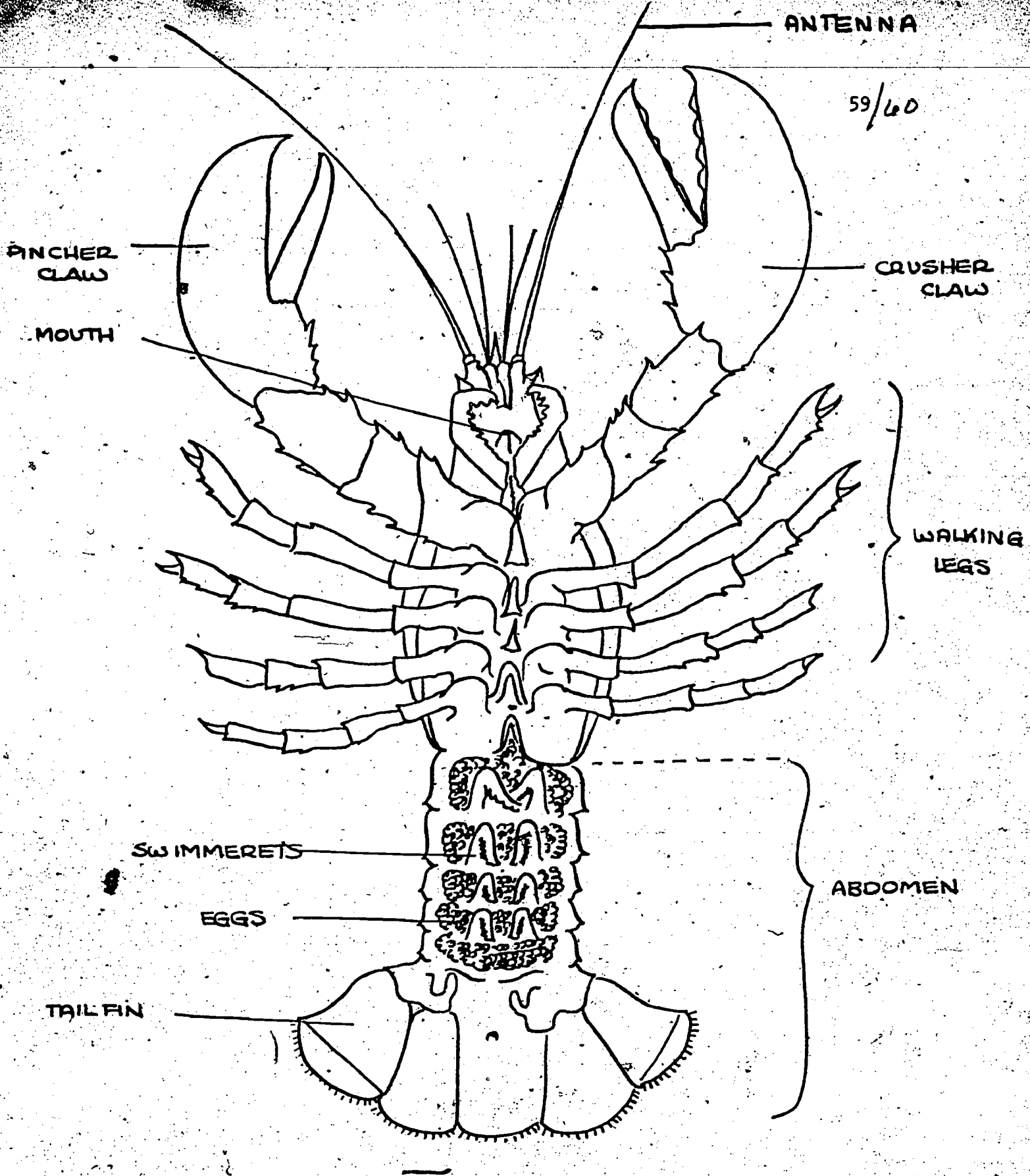
CRUSHER CLAW
ANTENNULE
EYE
WALKING LEGS
CARAPACE
ABDOMEN
TAIL FIN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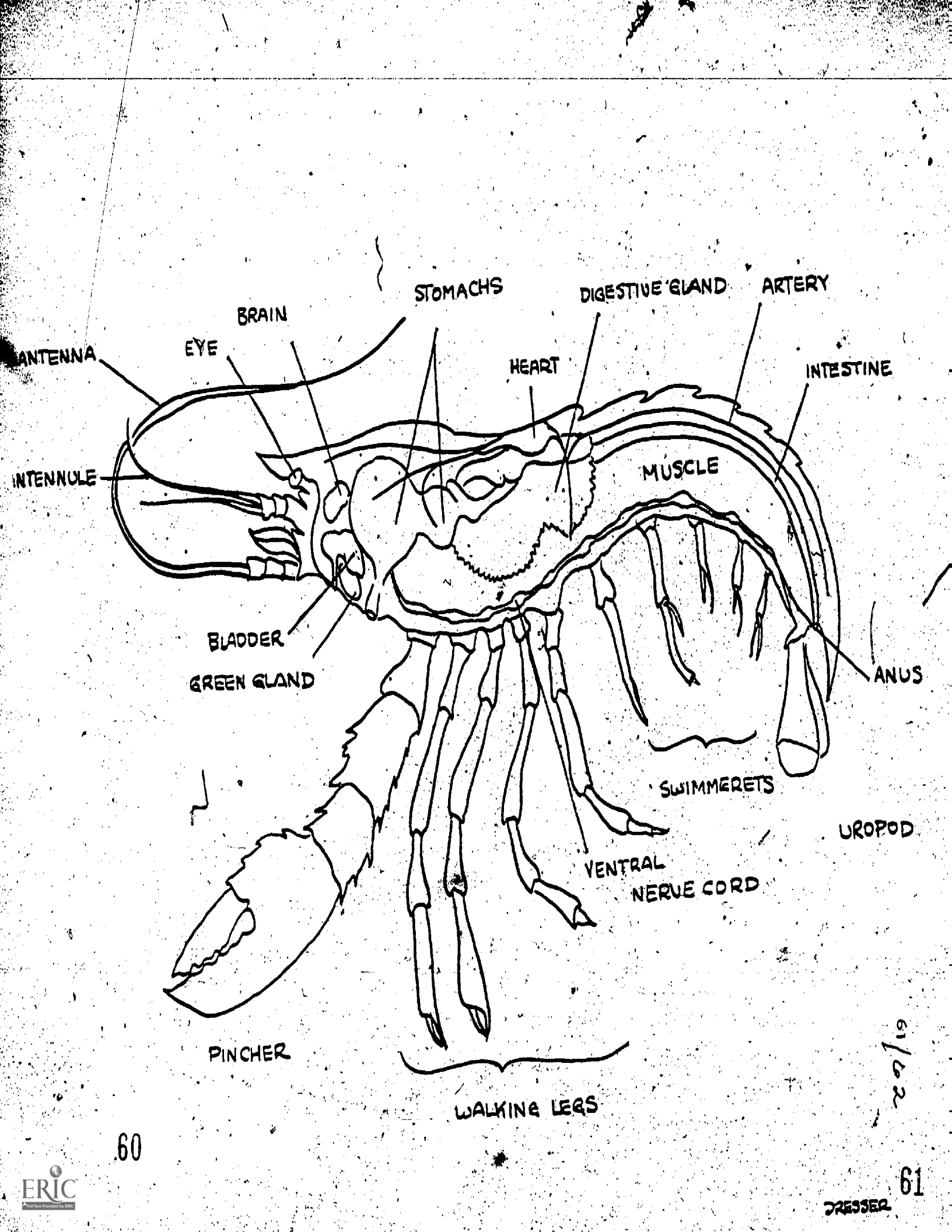
TAIL FIN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ARTERY
BRAIN
EYE
ANTENNA
HEART
INTESTINE
INTENNULE
MUSCLE
BLADDER
GREEN GLAND
ANUS
SWIMMERETS
UROPOD
VENTRAL
NERVE CORD
PINCHER
WALKING LEGS

XIV. Have the students solve the following problems. Similar problems can be designed around the mark-ups on lobsters from lobsterman to pound to consumer, or restaurant.

1. Paint for the lobsterman's boat costs $25.00 per gallon, and three gallons are needed to paint his boat. How much will the paint cost him?

2. If a lobsterman spends $257.34 for paint and hull repairs on his boats, $538.50 for an engine overhaul and a new propellor, $1106.00 for new traps, $428.16 for new warp, and $50.00 for new slickers, how much money has he spent getting ready for the lobstering season?

3. If the lobsterman sets out 270 traps and catches one one pound lobster in one third of the traps each day, how many pounds of lobster does he catch each day? (Of course, we know that some days he catches more and some days less.)

4. If the lobsterman gets paid $1.90 a pound for his lobsters, how much money does he receive on a day like the one in question 3? (We know that sometimes he gets paid more for his lobsters and sometimes he gets paid less.)

5. If fuel to run his boat costs $11.00 a day, and he must pay a helper (sternman) $20.00 a day, how much money does he have left?

6. At this rate, how many days must he work just to pay the total bills in problem 1?

7. If the lobsterman received the following amounts for the six days of one week for the lobsters he caught, how much money did he take in that week?

$167.50
132.45
79.80
180.32
100.49
98.76

8. If the lobsterman's expenses for each of the same days were as follows, how much money did he spend during the week?

$31.00
52.60
33.45
31.00
48.90
100.50

9. How much profit did the lobsterman have left at the end of the week?

10. If the lobsterman can make that amount for 26 weeks of the year, how much money would he earn for the year?

SUGGESTED REFERENCES

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National Wildlife Federation, Ranger Rick, "A Living Fossil: The Lobster," J.E. Hartman, Aug.-Sept, 1970, pp. 31-34.