The Great Lakes Triangle

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TEACHER GUIDE
OEAGLS Investigation #17

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TEACHER GUIDE

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TEACHER GUIDE
The Great Lakes Triangle

By Rosanne W. Forney and Daniel W. Jax
Ohio Sea Grant Education Program

OVERVIEW

This investigation includes three activities leading to a consideration of fact and fiction about the disappearances of planes and ships in the Great Lakes Area. The entire module is an example of how scientists work, and it can serve as a practical application of earth science skills as well.

The first activity involves studying the locations of missing craft and personnel. Students examine concentrations of the disappearances and speculate on their causes.

Activity B is actually three activities which are to be performed by different classroom groups simultaneously. If time permits, all three activities can be done by the entire class. This would increase the general level of student understanding of the three topics. The activities treat the wreck of the Edmund Fitzgerald as an example of a Great Lakes Triangle tragedy. One topic involves plotting bathymetric contours in eastern Lake Superior and pointing out locations where hidden ships could exist. A second topic uses a model of the Fitzgerald to illustrate how ship design could have contributed to the disaster. When all three topics have been considered the teacher will lead a discussion to consider whether the wreck of the Edmund Fitzgerald was an accident resulting from natural causes or whether other supernatural or extraterrestrial forces were at work.

Finally, Activity C focuses on how an art form can convey emotions as well as provide information. The class will listen to the ballad The Wreck of the Edmund Fitzgerald and tell how the song conveys its mood. Each student will then write a short letter or diary entry explaining "what really happened" when the Fitzgerald went down.

Within this Teacher Guide comments directed specifically to the teacher will appear in boxes in smaller print.

PREREQUISITE STUDENT BACKGROUND: None

MATERIALS:

Overhead projector, four transparent sheets, wax pencils or washable fine-point markers, cardboard tube 45-55 cm long, tape, aquarium gravel or plastic ESCP beads, bathymetric chart of eastern Lake Superior, and recording of Gordon Lightfoot’s The Wreck of the Edmund Fitzgerald.

The bathymetric chart of "St. Mary’s to Au Sable Point" (Nautical Chart No. 14862) for Activity B can be obtained from:
Distribution Division, C44
National Ocean Survey
Riverdale, MD 20840

The 1986 price for the map is $3.25.

OBJECTIVES:

Students who have completed this investigation will be able to:

1. Explain what is meant by the Great Lakes Triangle.
2. Describe how bathymetric charts are constructed.
3. Explain how weather information is mapped.
4. Describe the characteristics of a Great Lakes bulk carrier.
5. Discuss at least two possible explanations for the sinking of the Edmund Fitzgerald.

SUGGESTED APPROACH

Activity A should be done together by the entire class as an introduction to the topic.

Assign students to one of three teams for Activity B, or have them read all three topics if the class is to work as a unit. Activities A and B can usually be completed in two class periods.

Additional class time will be needed if all students do all parts of Activity B. Plan to lead a discussion based on the three topics when work on them is completed. A recommended question sequence is included in this guide.

As a follow-up and means of evaluating the impact of the entire investigation, Activity C can be assigned for completion outside of class once the recording has been played.
INTRODUCTION

In 1974, Charles Berlitz wrote in his famous best seller, The Bermuda Triangle:

There is a section of the western Atlantic, off the southeast coast of the United States, forming what has been termed a triangle, extending from Bermuda in the north to southern Florida, and then east to a point through the Bahamas past Puerto Rico to about 40 degrees west longitude and then back again to Bermuda. This area occupies a disturbing and almost unbelievable place in the world’s catalogue of unexplained mysteries. This is usually referred to as the Bermuda Triangle, where more than 100 planes and ships have literally vanished into thin air, most of them since 1945, and where more than 1,000 lives have been lost in the past twenty-six years, without a single body or even a piece of wreckage from the vanishing planes or ships having been found.

Former aviator Jay Gourley has since written a book called The Great Lakes Triangle (1977), which claims that the Great Lakes account for more unexplained disappearances than the Bermuda Triangle. This is no small comparison, considering that the Bermuda Triangle is sixteen times larger than the Great Lakes area. Gourley says:

Because of the irregular shape of the Great Lakes, pilots — aware of the dangers within — ordinarily circumnavigate the lakes, even when overflying might be shorter. It is almost impossible for even the slowest aircraft to be more than 20 minutes from land. Today’s airliner can cross Lake Erie through the middle in ten minutes. Faster aircraft can do it in much less than four minutes. Over any point on any of the Great Lakes it is possible for the pilot of any jet airliner to shut down all his engines and literally glide to land. There are hundreds of ground-based, sea-based and air-based radars constantly monitoring emergency frequencies for any sign of trouble.

Aware of the curious incidents over the Great Lakes, the Federal Aviation Administration several years ago instituted a special “Lake Reporting Service;” pilots on Great Lakes overflights make continuous reports to ground stations. A ten-minute delay in such a report automatically launches search-and-rescue operations. This service has saved many lives that would have been lost to ordinary accidents, but the high incidence of inexplicable disasters has remained unaffected.

Figure 1: One of the last photographs taken of the Edmund Fitzgerald.
ACTIVITY A: WHAT IS THE GREAT LAKES TRIANGLE?

MATERIALS

Map of vessel and aircraft disappearances in the Great Lakes area (Figure 2). Table I from the Teacher's Guide.

PROCEDURE

Table 1 (shown on pages 5-7 of the Teacher Guide) lists the disappearances or wrecks of ships and planes which are plotted in Figure 2 of the Student Guide. Please post the table where students can refer to it.

Figure 2 shows the last position of disappearing ships and planes in the area of the Great Lakes Triangle. Look at the map symbols and their locations to answer the questions on the next page.

- Planes from which the people were never found
- Ships from which the people were never found
- Planes with people found
- Ships with people found

Figure 2: Estimated locations of disappearances described in Gourley's The Great Lakes Triangle.
1. Are there some areas where large numbers of losses have occurred? If so, where? (Answer on your worksheet.)

2. Are there logical explanations for large numbers of losses having occurred at these particular areas? What explanation?

3. Do most of the losses include missing people?

4. Why do you think some of the planes, ships and people have never been found?

If you are interested in learning more about the planes and ships in Figure 2, your teacher can post a copy of the list from which the map was made.

T1. Yes, there are some areas with many disappearances. These include eastern Lake Superior, western Lake Erie, and areas around Milwaukee and Chicago.

T2. Allow for guessing on this question. The areas in Lake Michigan are around busy airports. Eastern Lake Superior is full of islands and has a narrow approach route into St. Mary's River.

T3. Yes, most losses included missing people.

T4. This question calls for speculation. All answers should be accepted.
### TABLE T1: GREAT LAKES TRIANGLE DISAPPEARANCES

<table>
<thead>
<tr>
<th>Date</th>
<th>Craft</th>
<th>Location at Time of Disappearance</th>
<th>People Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/28/92</td>
<td>Octopus</td>
<td>Off Manitou Islands, Lake Superior</td>
<td>all</td>
</tr>
<tr>
<td>10/28/92</td>
<td>W. H. Glapier</td>
<td>West Straits of Mackinac, Lake Superior</td>
<td>all</td>
</tr>
<tr>
<td>8/20/99</td>
<td>Huron Savidge</td>
<td>Lake Huron, near Alpena, Michigan</td>
<td>5</td>
</tr>
<tr>
<td>11/21/02</td>
<td>Briscoeburn</td>
<td>Middle of Lake Superior</td>
<td>all</td>
</tr>
<tr>
<td>10/09/07</td>
<td>Cypress</td>
<td>Off Coppermine Point, Lake Superior</td>
<td>all but 1</td>
</tr>
<tr>
<td>12/01/08</td>
<td>D. M. Clemson</td>
<td>Lake Superior, near Soo Locks</td>
<td>all</td>
</tr>
<tr>
<td>11/12/13</td>
<td>The Price</td>
<td>Southern tip of Lake Huron</td>
<td>all (some bodies recovered)</td>
</tr>
<tr>
<td>11/26/13</td>
<td>Rouse Simmons</td>
<td>Lake Michigan, just north of Chicago</td>
<td>17</td>
</tr>
<tr>
<td>11/24/18</td>
<td>Interlake</td>
<td>Lake Superior, near Soo Locks</td>
<td>all</td>
</tr>
<tr>
<td>11/24/18</td>
<td>Captain Andries</td>
<td>Lake Superior, near Soo Locks</td>
<td>all</td>
</tr>
<tr>
<td>12/07/27</td>
<td>Karmoona</td>
<td>Isle Royale</td>
<td>all</td>
</tr>
<tr>
<td>9/26/30</td>
<td>Our Son</td>
<td>Straits of Manitou, Lake Michigan</td>
<td>0</td>
</tr>
<tr>
<td>11/21/38</td>
<td>Hibou</td>
<td>Georgian Bay</td>
<td>7</td>
</tr>
<tr>
<td>12/02/42</td>
<td>Admiral</td>
<td>Lake Erie, 8 miles from Avon Point and 11 miles west of Cleveland</td>
<td>14</td>
</tr>
<tr>
<td>12/02/42</td>
<td>Stout</td>
<td>Lake Erie, 8 miles from Avon Point and 11 miles west of Cleveland</td>
<td>32 (some bodies recovered)</td>
</tr>
<tr>
<td>6/23/50</td>
<td>Northwest Airlines</td>
<td>Flight 2501</td>
<td>70 miles east of South Haven, Michigan</td>
</tr>
<tr>
<td>12/18/50</td>
<td>Sahem</td>
<td>11 north of Dunkirk</td>
<td>0</td>
</tr>
<tr>
<td>10/28/52</td>
<td>Small plane</td>
<td>35 miles northeast of Marquette, Michigan</td>
<td>4</td>
</tr>
<tr>
<td>11/28/52</td>
<td>CF-FU plane</td>
<td>Lake Superior, between Keweenaw Point and Whitefish Point</td>
<td>All</td>
</tr>
<tr>
<td>8/27/53</td>
<td>Jet</td>
<td>Over southern Lake Michigan</td>
<td>1</td>
</tr>
<tr>
<td>8/23/54</td>
<td>Twin Jet</td>
<td>North shore of Lake Ontario, near Ajax, Ontario</td>
<td>0</td>
</tr>
<tr>
<td>6/8/55</td>
<td>Light plane</td>
<td>North of Lake Superior, between Kapuskasing and Kenora, Ontario</td>
<td>0</td>
</tr>
<tr>
<td>5/15/56</td>
<td>Canadian twin jet</td>
<td>Just northeast of Lake Ontario</td>
<td>all</td>
</tr>
<tr>
<td>8/2/56</td>
<td>CF-100</td>
<td>Bruce Peninsula, near Georgian Bay</td>
<td>2</td>
</tr>
<tr>
<td>12/8/56</td>
<td>Aero Commander</td>
<td>North shore of Lake Erie, near Buffalo</td>
<td>0</td>
</tr>
</tbody>
</table>

*(continued)*

<table>
<thead>
<tr>
<th>Date</th>
<th>Craft</th>
<th>Location at Time of Disappearance</th>
<th>People Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/21/59</td>
<td>Piper PA-18</td>
<td>Lake Superior, near Teggan Lake, Ontario</td>
<td>2</td>
</tr>
<tr>
<td>12/16/59</td>
<td>Aero Design 560E</td>
<td>Lake St. Clair</td>
<td>2</td>
</tr>
<tr>
<td>9/23/60</td>
<td>Cessna 140</td>
<td>Over Lake Michigan, just south of Milwaukee</td>
<td>0</td>
</tr>
<tr>
<td>9/27/60</td>
<td>Twin Jet Interceptor</td>
<td>Lake Ontario</td>
<td>1</td>
</tr>
<tr>
<td>11/29/60</td>
<td>Piper plane</td>
<td>Lake Michigan, just off Chicago</td>
<td>3</td>
</tr>
<tr>
<td>3/26/61</td>
<td>Small plane</td>
<td>Wisconsin, just west of Lake Michigan</td>
<td>all</td>
</tr>
<tr>
<td>7/20/62</td>
<td>Light plane</td>
<td>Over western end of Lake Erie, between Alliance, Ohio and Detroit, Michigan</td>
<td>0</td>
</tr>
<tr>
<td>2/12/63</td>
<td>Small plane</td>
<td>Over Niagara Falls</td>
<td>0</td>
</tr>
<tr>
<td>9/9/63</td>
<td>Light plane</td>
<td>Sandusky, Ohio</td>
<td>0</td>
</tr>
<tr>
<td>2/15/64</td>
<td>Twin engine plane</td>
<td>Western Basin, Lake Erie, between Detroit, Michigan and Akron, Ohio</td>
<td>2</td>
</tr>
<tr>
<td>9/6/64</td>
<td>Twin engine Piper</td>
<td>Markham, Illinois</td>
<td>0</td>
</tr>
<tr>
<td>3/20/65</td>
<td>Cessna 170B</td>
<td>Lake Michigan, near Chicago</td>
<td>1</td>
</tr>
<tr>
<td>8/4/65</td>
<td>Mong sport plane</td>
<td>Lake Michigan</td>
<td>0</td>
</tr>
<tr>
<td>3/17/66</td>
<td>Twin engine Piper</td>
<td>Lake Huron, between Wiarton, Ontario and Alpena, Michigan</td>
<td>1</td>
</tr>
<tr>
<td>12/10/66</td>
<td>Light plane</td>
<td>Over water between Cleveland, Ohio and Erie, Pennsylvania</td>
<td>1</td>
</tr>
<tr>
<td>12/10/66</td>
<td>Cessna 172</td>
<td>Lake Erie, near Ashabula</td>
<td>all</td>
</tr>
<tr>
<td>1/14/67</td>
<td>Plane</td>
<td>Lake Michigan, near Muskegon</td>
<td>3</td>
</tr>
<tr>
<td>12/10/67</td>
<td>Multi-engine Beech 18</td>
<td>Lake Monona, near Madison, Wisconsin</td>
<td>0</td>
</tr>
<tr>
<td>5/21/69</td>
<td>Beech 35</td>
<td>Northwest shore of Lake Michigan, near Menominee, Michigan</td>
<td>4</td>
</tr>
<tr>
<td>6/17/69</td>
<td>Piper PA-28</td>
<td>Lake Michigan, just north of Chicago</td>
<td>0</td>
</tr>
<tr>
<td>11/6/69</td>
<td>Twin turbojet</td>
<td>Lake Michigan, 15 miles east of Milwaukee</td>
<td>7</td>
</tr>
<tr>
<td>4/4/70</td>
<td>Beech 36</td>
<td>Lake Michigan, near Gary, Indiana</td>
<td>0</td>
</tr>
<tr>
<td>6/12/71</td>
<td>Cessna 180</td>
<td>10 miles north of Whitmore Lake, Michigan</td>
<td>0</td>
</tr>
<tr>
<td>7/21/72</td>
<td>Twin Piper PA-31</td>
<td>Lake Michigan, 15 miles east of Milwaukee</td>
<td>1</td>
</tr>
<tr>
<td>7/21/72</td>
<td>Piper plane</td>
<td>Lake Michigan, just off Milwaukee</td>
<td>1</td>
</tr>
<tr>
<td>11/30/72</td>
<td>Beech Expeditor</td>
<td>Lake Michigan, between Detroit and Milwaukee</td>
<td>1</td>
</tr>
<tr>
<td>12/4/72</td>
<td>Cessna 320</td>
<td>Eastern shore of Lake Michigan</td>
<td>0</td>
</tr>
<tr>
<td>12/7/72</td>
<td>Plane</td>
<td>Lake Michigan, between Milwaukee and Chicago</td>
<td>1</td>
</tr>
<tr>
<td>12/15/72</td>
<td>Lear jet</td>
<td>Just south of Detroit, Michigan</td>
<td>0</td>
</tr>
<tr>
<td>Date</td>
<td>Craft</td>
<td>Location at Time of Disappearance</td>
<td>People Missing</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>3/20/73</td>
<td>Beach F18S</td>
<td>Lake Erie, between Cleveland and Detroit</td>
<td>1</td>
</tr>
<tr>
<td>4/20/73</td>
<td>Lake Seaplane</td>
<td>Lake Erie, just east of Howell, Michigan</td>
<td>1</td>
</tr>
<tr>
<td>4/19/74</td>
<td>Helicopter</td>
<td>Near northeast shore of Lake Ontario, between Ottawa and Greenville, Michigan</td>
<td>0</td>
</tr>
<tr>
<td>11/10/75</td>
<td>Edmund Fitzgerald</td>
<td>Lake Superior, off Coppermine Point</td>
<td>29</td>
</tr>
<tr>
<td>11/22/79</td>
<td>Weahbun steamers</td>
<td>Lake Huron, Georgian Bay</td>
<td>24</td>
</tr>
<tr>
<td>11/25/81</td>
<td>Jane Miller passenger steamer</td>
<td>Colpoys Bay, near Georgian Bay</td>
<td>28</td>
</tr>
</tbody>
</table>
ACTIVITY B: HOW CAN DISAPPEARANCES WITHIN THE TRIANGLE BE EXPLAINED?

Keywords: station model, scale model, draft, center of gravity, roll, pitch, contour lines, bathymetric, echo sounder.

MATERIALS

Navigational chart of eastern Lake Superior; cardboard tubes; plastic beads or aquarium gravel; outline maps of Lake Superior; weather data for November 10, 1975; pencil or pen; blank transparency; washable markers; tape.

PROCEDURE

You will be assigned to investigate and produce examples of one or all of the following topics:

1. Great Lakes bulk carrier design
2. Tracking a severe lake storm
3. Lake bottom characteristics

All the materials needed for your assignment are included in this booklet. If you have been assigned Topic 1, use pages 4–5. For Topic 2, use pages 6–10, and for Topic 3, use pages 11–12.

These numbers refer to pages in the Student Guide.

After your investigations have been completed your teacher will conduct a class discussion. Findings from all three topics will be brought together. The discussion will help you answer the questions below. It may be helpful to read the questions before you begin work, but do not try to answer them until all the investigations have been completed.

1. Could ship design be responsible for the loss of some vessels in the Triangle area?
2. How bad is a severe storm on the Great Lakes?
   a. Wind speeds?
   b. Wave heights?
   c. Duration (how long the storm lasts)?
   d. Visibility?
3. What kinds of areas in lakes and oceans may be safer when a storm is in progress?
4. How are bathymetric measurements made?
5. Is it possible that there are features on lake and ocean bottoms that mariners don’t know about?
6. What are the “Three Sisters” in the manner’s language?
7. Consider the Edmund Fitzgerald as an example of a Great Lakes Triangle disaster. Are there natural forces that could explain the sinking? What are some possible explanations?
8. Considering the storm, the water depth and temperature, and what possibly happened to the Fitzgerald, why do you think the bodies of the crewmen were never found?

TOPIC 1

GREAT LAKES BULK CARRIER DESIGN

INTRODUCTION

The Edmund Fitzgerald sank in the Great Lakes Triangle area on November 10, 1975. The Coast Guard and the National Transportation Safety Board both decided that the wreck was caused by a hatch cover which let water enter the hold. If you examine the general shape and parts of the Fitzgerald, you may be able to point out to your classmates some ways that ship design could have been at least a partial cause of the sinking.

The ships that carry iron ore (taconite pellets) on the Great Lakes are designed to haul huge loads with very little draft. Draft is the depth of water necessary to float a vessel. If a ship “draws” (has a draft of) 30 feet, it can only go in water that is more than 30 feet deep. Because of underwater rocks and the need to go through locks from one lake to another, most lake vessels draw 25 feet or less when fully loaded. This means that a large load must be spread out in a “thin layer.” If a ship is designed for use on one lake only, it can have a larger draft because it doesn’t have to go through any locks.
A bulk carrier is a ship that carries a large amount of unpackaged material like grain or minerals. Great Lakes bulk carriers are usually about ten times as long as they are wide, and about half as deep as they are wide. The *Edmund Fitzgerald* was the biggest ore carrier on the lakes when she entered service in 1958. The *Fitzgerald* was 727 feet long, 75 feet wide, and drew 25 feet of water.

**MATERIALS:** Cardboard tube at least 45 cm long; tape; small plastic beads or aquarium gravel; marking pen.

**PROCEDURE**

A scale model is a small version of anything, with all sizes cut down by the same proportion. Architects, car designers and such make scale models to see how a product is going to look before they invest in the real thing. The model of an 80 x 50 foot house might be 80 x 60 inches, or 8 x 6 inches, or 4 x 3 inches. For each of the model sizes given, the original measurements have both been divided by a certain number.

1. Build a scale model of the *Edmund Fitzgerald* using the dimensions given in paragraph 1 above. Use a cardboard tube which you flatten on one side to form the deck. Draw hatch covers on the deck and outline the positions of other deck structures.

2. Seal one end of the "hull" with tape and pour small plastic beads or aquarium gravel into the hold until it is about 3/4 full. Seal the open end so that none of the "ore" can get out.

This simulates the cargo of an ore carrier like the *Fitzgerald*. The hold of the ship is not really a single open chamber. It has dividers or "bulkheads" to separate one section from another. The *Fitzgerald* had three compartments for cargo inside its hold. Ore pellets were loaded through the hatches on deck.

3. Experiment with your model to find the answers to the following questions:

A. Balance the model on the side of a pencil. What do you have to do to find the balancing point (center of gravity)?

B. Suppose the ore is loaded and the ship is balanced for its trip across the lake. A storm comes up. Wind and high waves cause the ship to roll (rock from side to side) and pitch (rock from end to end). Which motion, roll or pitch, is more likely to shift the cargo out of balance?

C. Waves break over the ship one after another. The water from one wave doesn’t even clear the deck before more water piles on. How could this affect the ship’s balance?

D. A hatchway caves in or comes unsealed, letting water enter the hold. How could this affect the ship’s balance?

E. A series of waves raises up the stern and rolls under the ship toward the bow. If the cargo shifted strongly toward the bow, what could happen to the ship?

F. The *Fitzgerald* was 727 feet long. She sank in 330 feet of water. What could happen to the ship if it suddenly took a nosedive to the bottom?

4. Prepare to explain to the class how the ship design could be at least partly responsible for the loss of some vessels.

5. Share with the class the meaning of these terms: draft, scale model, hull, bulkheads, center of gravity, pitch, and roll.
TOPIC 2

STORM TRACKING

INTRODUCTION

Weather conditions on the water can sometimes create freak accidents that appear to be more supernatural than natural. Sightings of “ghost ships,” sea monsters and the like often occur during periods of unusual weather. Natural forces and a good imagination are probably responsible for many of the “unexplained” phenomena of the Great Lakes and Bermuda Triangles.

The mariners of the world’s oceans and the Great Lakes are always watchful of the weather. Their lives depend on how prepared they are for conditions on the water. Regardless of their preparedness, however, accidents happen. A storm may build up far more strength than weather predictions forecast, and the tremendous force of a raging sea may be more than a ship can take. Such an accident occurred on November 10, 1975, with the sinking of the ore freighter Edmund Fitzgerald.

MATERIALS: Transparencies of Lake Superior, wax pencils or washable markers, overhead projector.

PROCEDURE

Every six hours, at 1 and 7 p.m. and 1 and 7 a.m. Eastern Standard Time, observers all over the world report weather conditions at their location. Wind speed and direction are noted. Precipitation for the previous six hours is measured. Temperature, visibility and any other weather conditions are also recorded. The information is then put into an international code, sent to collection centers within each country, and exchanged internationally. In this country, the information is collected and analyzed by the U.S. Weather Bureau.

At the centers receiving the coded weather information, weather maps are prepared. The messages are decoded and the conditions reported are translated into figures and symbols. These are grouped around a small circle drawn on a map at the position of the station reporting the information. The circle on the map, with the figures and symbols describing the weather conditions at that location is called a station model. The method of construction of a station model and an interpretation of its information are shown in Figures 3-5.

Figure 3. Method for showing wind direction. Circle is placed at location of station, and bar points to where wind is coming from.
You are to examine and report data (information) on weather conditions during the storm that caused the Fitzgerald's sinking.

Figures 6 and 7 show the weather data for 1 and 7 a.m. (Eastern Standard Time) on November 10, 1975. The abbreviations used stand for ships that reported in as weather stations. This information was taken from the actual transcripts of hearings following the sinking of the Fitzgerald. Look carefully at Figures 6 and 7. Notice how the low pressure center is moving and where the Fitzgerald is at each time.

From your teacher get transparencies of Lake Superior numbered 3-4 and record on them the following information as was done for you in Figures 6 and 7:

A. Date and time (plot a new map for each different time).

B. Wind, wave, precipitation and visibility data for the stations listed. (Some stations are on land; others are reports from ships at the positions given.) The information to be plotted is in Table 1.
Figure 6. Weather data from 1 a.m., November 10, 1975
Figure 7. Weather data from 7 a.m., November 10, 1975
Table 1
Weather Data for Maps 3 and 4 (transparencies)

<table>
<thead>
<tr>
<th>Location</th>
<th>Wind</th>
<th>Wave</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Speed</td>
<td>Height</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(knots)</td>
<td>(feet)</td>
<td>(miles)</td>
</tr>
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<td>AND</td>
<td>20</td>
<td>SE</td>
<td>10 Clouds forming 10.24</td>
</tr>
<tr>
<td>Duluth</td>
<td>25</td>
<td>NW</td>
<td>5 Clds. dissolving 10.24</td>
</tr>
<tr>
<td>Silver Bay</td>
<td>20</td>
<td>NW</td>
<td>5 Clds. dissolving 10.24</td>
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<tr>
<td>SW of Isle Royale</td>
<td>40</td>
<td>WNW</td>
<td>10 Moderate snow 1.2</td>
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<tr>
<td>BEE</td>
<td>49</td>
<td>NW</td>
<td>7 Moderate snow 1.2</td>
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<td>TAD</td>
<td>53</td>
<td>NW</td>
<td>15 Heavy snow 1.2</td>
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<td>Copper Harbor</td>
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<td>Slate Island</td>
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<td>Caribou Island</td>
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<td>CLK</td>
<td>41</td>
<td>S</td>
<td>13 Moderate TSTM 5-9</td>
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<tr>
<td>Whitfish Point</td>
<td>20</td>
<td>SW</td>
<td>15 Light snow 2.4</td>
</tr>
</tbody>
</table>

Map 3
Date: 11/10/75
Time: 1300E

Map 4
Date: 11/10/75
Time: 1900E

Answer the following questions based on your maps:

1. In what direction was the storm moving? (Note the movement of the low pressure center.)

2. Do the winds around a low pressure center blow clockwise or counter-clockwise?
   Toward or away from the center?
   Are wind speeds greater or less as they get closer to the low pressure center?

3. On weather maps 1-4, check the station models for coastal weather and mid-lake weather. Which areas, coastal or mid-lake, had higher wind and waves?

4. Which areas had higher wind and waves, island areas or mid-lake areas?

5. Which side of the lake, Canadian or U.S., had more severe weather conditions?

6. The map below shows the courses taken by the Fitzgerald and a following ship, the Anderson.
   Was this the best possible course in view of the weather conditions?

7. Plot a recommended course for the Fitzgerald on a third transparency. You will want to consider the storm’s path, the wave heights and wind speeds along the way. Be prepared to defend your choices for the rest of the class.

Figure 8. Courses steered by the Arthur M. Anderson and the Edmund Fitzgerald on the night of November 10, 1975.
TOPIC 3

LAKE BOTTOM CHARACTERISTICS

INTRODUCTION

How deep is the water? Every mariner must be aware of water depth in order to know if his vessel will float without bumping the bottom.

Exploring water depths began with crude lead-weighted ropes on wires lowered from ships. Knots or marks on these sounding lines were recorded as depth measurements. “Mark twain,” for example, meant that the water came up to the second mark on the line and was two fathoms (about 4 meters) deep.

In World War I the echo sounder was developed. A sound sent out from an instrument aboard a ship bounces off the sea floor or lake bottom. When the echo returns to the ship, depth is calculated. Sound waves travel through water at a speed of 5,000 feet per second. If the sound takes one second to reach the bottom, its echo takes one second to return and the water is 5,000 feet deep. Using the results of echo sounding, scientists can draw a benthic chart. (“Bathy” means deep, and “metric” means measured.) Such a chart shows the characteristics of the sea floor or lake bottom.

1. The numbers on the nautical chart on your worksheet are the soundings at various locations in a small lake. The larger the numbers are, the deeper the water. The zeroes indicate shoreline areas, where the water depth becomes zero. All the zeroes around the edge of the map have been connected to show the shape of the lake.

Are there other zeroes besides the lakeshore ones? What kind of a feature has been drawn at Point A?

2. Now find a line that roughly shows where the water is 50 feet deep. (Mariners do not use the metric system yet.) The line goes between the numbers greater than 50 and the numbers less than 50. Contour lines do not end unless they go off the edge of the map, so the ends of the 50-foot line are connected.

There are two 50-foot bathymetric contours for this map. One surrounds the feature at A and another is around the inside of the entire lake. Be sure you understand why these lines were drawn where they are.

3. Put a Y on a part of the lake that has some very shallow areas close to the 50-foot line. This is a place where there is a rocky area or a shoal underwater. Sailors would have to be very careful not to bump their boats into this.

4. Draw a 100-foot contour line in the lake. Put an X on the deepest point in the lake.

Figure 2. A ship using an echo sounder

MATERIALS: Nautical chart of eastern Lake Superior (St. Mary’s to Au Sable Point), transparent sheet, wax pencil or washable marker.

PROCEDURE

A contour line is a line connecting points of equal elevation or depth. We can construct bathymetric contours in the following way:

Practice Map: Soundings in a Small Lake
5. On the large map showing the eastern end of Lake Superior, place a transparent sheet so that its short bottom edge is on the line labeled 46250' and the long left hand edge is on the 8520' line of longitude. Trace the shoreline onto your paper.

6. In the area covered by the tracing paper, draw 50-foot bathymetric contours. Be sure to look around for the depths far out in the water that may need to be enclosed in such lines.

7. Also draw a 75-foot contour. Your map should now show places of shallow water that are surrounded by very deep water.

8. Label the town of Coppermine Point on your transparency. On November 10, 1975, the Edmund Fitzgerald sank off Coppermine Point in 532 feet of water. The ship was coming from the northwest. Put an X on the place where the sinking probably occurred.

9. The Fitzgerald's hull was 37 feet deep. In a storm with large waves the hull might dip down to a depth of about 50 feet. Locate areas where hidden shoals might be (depths of 50 feet or less, and areas where few depth measurements have been made). Be prepared to show the class the areas where the Fitzgerald should have sunk bottom.

The following sequence is recommended for bringing out the major points (topics are addressed as if they were done by separate teams).

Teacher:

We have noted that many ships and planes have disappeared in the Great Lakes area. Does this indicate that some unusual forces are at work in the area, causing vessels and people to vanish into thin air, or could natural causes explain the losses? (No pause for answer.) Let's examine some things that might cause a ship to sink in the Great Lakes. Team 1, show us how a Great Lakes bulk carrier is built and loaded.

Team 1:

Presents a model of the Fitzgerald. Be sure they explain what a scale model is and tell what is meant by draft of a ship.

Teacher:

When you experimented with your model, Team 1, show us what you discovered about the balance of such a ship.

Team 1:

Tells what was done with the model and how they answered questions A to F.

A. Cargo must be positioned exactly right to balance the ship.

B. Pitch will shift the cargo out of balance more.

C. Waves pile up water on deck and weight the ship down more. (They could also cause it to have a greater draft temporarily, so it could strike an obstacle underwater.)

D. Water sloshes as the ship rolls and pitches. The water makes cargo shifting even more likely.

E. The ship could dive to the bottom.

F. It could snap into pieces or the front part could be buried in the lake bottom.

Teacher:

(Show picture of Fitzgerald wreck. Figure 1G) Could this have happened in the way you described? (Answer depends on Team 1's previous answers. If E and F were correct, answers here should be 'yes'.)

Teacher:

Team 2 has investigated the weather conditions on the day the Fitzgerald sank. Team 2, please explain when and how a station is constructed.

Team 2:

Gives the requested information from Student Guide.

Teacher:

What was the weather like on November 10, 1975?

Team 2:

Shows Figures 5 and 7, then two transparencies, pointing out the general direction in which the storm was moving (toward the northeast, as shown by maps 1-3). Figures 1G and 2 show correct station models for Maps 2 and 4.

Teacher:

When a low pressure center is on the map, it generally means unsettled weather. How do winds blow around a low pressure center?

Team 2:

Gives answer to question 2 (Counter-clockwise flow toward the center, with stronger winds near the center.)

Teacher:

On your transparencies, show us what types of areas have higher winds and waves.

Team 2:

Gives answers to questions 3-5 and shows transparency sections to illustrate:

Higher in coastal areas than mid-lake (Map 1, Figure 6)
Mid-lake and islands about the same (Map 1)
Canadian and U.S. sides about the same (Map 3)
Teacher:
Team 2, do you think the Fitzgerald chose the safest route, or could you plot a safer one?

Team 2:
Shows the transparency with the Fitzgerald route and explains the reasons for choosing the route. General discussion of Team 2's choice. There are no correct answers.

Teacher:
Team 3 has information about the bottom of Lake Superior and how the underwater features could cause ships to wreck. Team 3, how do we know what's on the floor of a lake or ocean?

Team 3:
Responds according to the introduction to its activity. Shows map done as practice. (See Figure TG 4.)

Teacher:
Let's look at the area where the Fitzgerald sank. Team 3, what do the bathymetric contours tell us about the lake bottom in this area?

Team 3:
Shows tracing of contours and points out shallow areas. (Figure TG 5.)

Teacher:
Tells about the "Three Sisters" waves described in article on pages 00 (a fourth explanation of what might have happened).

At this point the teacher should pull together the information from all teams and emphasize the following:

1. A combination of natural forces and possible human error could account for the sinking of the Fitzgerald.

2. Many disappearances within the lakes triangle are in heavy traffic areas (narrow stretches of water, busy airports, etc.). Compare this with the accident rate on the busiest street in your community and the accident rate on a less-travelled route.

3. There is probably no single explanation for all the accidents in the Great Lakes triangle, but it is likely that logical reasons for the losses could be found.

4. This investigation has been a piece of scientific detective work — the putting together of pieces of information to reach a logical conclusion.

Figure TG1. The Edmund Fitzgerald as it appears on the bottom of Lake Superior. (Artist's conception based on Coast Guard data, Northern New England Marine Education Project, 1978.)
Figure T02. Correct station models for students' Map 3.

Figure T03. Correct station models for students' Map 4.
Figure TG4. Key to practice map of soundings in a small lake.
ACTIVITY C: WHAT HAPPENED ABOARD THE EDMUND FITZGERALD?

On November 10, 1975, the Great Lakes ore carrier Edmund Fitzgerald sank in the area of the Great Lakes Triangle. Though its wreckage was found, no members of the ship’s crew were ever recovered. The sinking thus became not only a new piece of the triangle’s mystery; it became a human story as well.

Strong emotions are often expressed more effectively through an artistic creation than through spoken words. A violent painting or a joyful dance can communicate feelings that anyone can understand. The deep sorrow felt in the lakes country when the Edmund Fitzgerald sank was expressed in a haunting ballad by a Canadian singer, Gordon Lightfoot.

MATERIALS: Recording of Gordon Lightfoot’s “The Wreck of the Edmund Fitzgerald,” words to that song, pencil or pen.

THE WRECK OF THE EDMUND FITZGERALD

The legend lives on from the Chippewa on down of the big lake they call “Gitche Gumee.”
The lake, it is said, never gives up her dead
when the skies of November turn gloomy.
With a load of iron ore twenty-six thousand tons more
than the Edmund Fitzgerald weighed empty,
That good ship and true was a bone to be chewed
when the “Gales of November” came early.

The ship was the pride of the American side
coming back from some mill in Wisconsin.
As the big freighters go it was bigger than most
with a crew and good captain well seasoned,
Concluding some terms with a couple of steel firms
when they left fully loaded for Cleveland.
And later that night when the ship’s bell rang
could it be the north wind they’d been feelin’?

The wind in the wires made a tattle-tale sound
and a wave broke over the railing.
And ev’ry man knew as the captain did too
‘twas the witch of November came stealin’.
The dawn came late and the breakfast had to wait
when the Gales of November came slaslin’.
When afternoon came it was freezin’ rain
in the face of a hurricane west wind.

When suppertime came the old cook came on deck
sayin’, “Fellas, it’s too rough t’ feed ya.”
At 7 p.m. a main hatchway caved in;
said, “Fellas, it’s been good t’ know ya.”
The captain wired in he had water comin’ in
and the good ship and crew was in peril.
And later that night when ‘is lights went outa sight
came the wreck of the Edmund Fitzgerald.

Does anyone know where the love of God goes
when the words turn the minutes to hours?
The searchers all say they’d have made Whitefish Bay
if they’d put fifteen more miles behind ’er.
They might have split up or they might have capsized;
they may have broke deep and took water.
And all that remains is the faces and the names
of the wives and the sons and the daughters.

Lake Huron rolls, Superior sings
in the rooms of her ice water mansion.
Old Michigan steams like a young man’s dreams;
the islands and bays are for sportsmen.
And farther below Lake Ontario
takes in what Lake Erie can send her.
And the iron boats go as the mariners all know
with the Gales of November remembered.

In a musty old hall in Detroit they prayed,
in the “Maritime Sailors’ Cathedral.”
The church bell chimed ‘till it rang twenty-nine times
for each man on the Edmund Fitzgerald.
The legend lives on from the Chippewa on down
of the big lake they call “Gitche Gumee.”
“Superior,” they said, “never gives up her dead
when the Gales of November come early!”

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PROCEDURE
1. Listen to the recording. How does it make you feel?

For each of the following things about the song, tell how it helps to produce this general feeling:

A. the singer’s voice.
B. the tempo (how fast the song is).
C. the instrument being played.

D. sounds in the background.

E. the words (list words or phrases that help create
the feeling.

T1. Student feelings will differ but will probably be expressed
as worried feelings followed by sadness.

A. The singer’s voice is low and clear. “He sounds sad,”
many students say.

B. The tempo is very slow and rhythmic. It seems to roll
and number song.

C. The instrument is a steel guitar. The rhythmic rise and
fall is created with a “bottle slide.”

D. Background sounds are like storm waves rising and
breaking against the ship. After the ship sinks, storm
waves are no longer heard.

E. Lyrics that create a mood include: never gives up her
dead, gloomy, a bone to be chewed, the witch of Novem-
ber, sleshan, pen, the words turn the minutes to hours;
etc.

2. Imagine that you are aboard the Fitzgerald on the
night of the storm. The darkness and the cold rain
are uncomfortable, but until now no one has
doubted that you will reach your destination.

The song reports that “at 7 p.m. a main hatchway
caved in.” Write a one-page description of what
you might have witnessed aboard the ship as it
sank. This can be done as if you are recording
events in a diary or writing a last letter to a friend.
Since you have probably decided for yourself what
must have happened that night, this is a way of
providing the world with an “eyewitness” account
of the events.

T2. This is an exercise in creative writing. Students imagine
what actually happened aboard the Fitzgerald as it sank
and write a first-person account as if they had been there.

REFERENCES

Berlitz, Charles. The Bermuda Triangle. New York: Doubleday and


Some people have survived “close encounters”
with the Bermuda Triangle, others have not. The last
messages from ships and planes that have disap-
peared are examined in Berlitz’s book, Without A
Trace, a follow-up to The Bermuda Triangle. The book
also includes the testimony of witnesses and survivors.
It serves to enlarge the mystery of the Triangle as it
searches for the natural or supernatural causes for
happenings there.

As you read these accounts, search for ways to
explain the happenings naturally. Both Berlitz’s and
Gourley’s books imply that forces from outer space
are responsible for triangle disappearances. Though
this idea is an interesting one, most scientists would
tell us that science fact is stranger than science
fiction. It is very likely that some natural factors such
as those you investigated in this activity have been
responsible for disappearances in both the Great
Lakes and Bermuda Triangles.

There are more things in heaven and earth
than are dreamt of in our philosophy.

Shakespeare
Survival Of Supersonic Dive Called Miracle

DETROIT (AP) — The 80 passengers aboard the TWA flight from New York to Minneapolis had just eaten a midair snack when they felt the craft begin to vibrate.

Suddenly, the plane swerved to the right, completed a 360-degree barrel roll and nose-dived from 39,000 to 12,000 feet — in a matter of seconds at a speed apparently exceeding that of sound.

"YOU COULD FEEL your face pressed back and the blood rush to your head," said Chell Roberts, 32, a University of Utah student who was aboard. "Everyone was screaming. I thought it was over."

"We were just through eating when it happened ... people started to scream and a flight attendant started to cry," he said. "It's really a funny feeling to see what everybody does before they think they are going to die."

But nobody died Wednesday night. Only three people aboard suffered minor injuries.

FEDERAL AVIATION Administration (FAA) inspectors said it was "miraculous" and "unprecedented" that the Boeing 727 jetliner survived such midair trauma before being brought under control in a desperation maneuver. Langborne Bond, head of the FAA, commended the pilot, identified only as H. Gibson of Chicago.

"I can't think of any other incident where a commercial, passenger plane has done a complete 360-degree rollover and survived," Bond said Thursday. "The miracle is that it held together under such extraordinary speed and circumstances."

Preliminary evidence, Bond said, indicated that the flight was "very routine in clear weather" when the plane "began to vibrate, went out of cruise control, rolled to the right, did a complete turnover, and dived to the ground."

"WE DON'T KNOW what caused it at this time," Bond said.

At that point, the pilot tried to slow the descent by deploying devices on the plane designed to increase drag. But the wing flaps, spoilers and leading-edge slats proved ineffective at the speed the plane was traveling and were torn off.

The pilot then lowered the landing gear.

"It is clear that that is the event that allowed the crew to regain control of the plane," Bond said.

"THERE IS NOTHING in the manual to tell you what to do," he said, commending the pilot.

Bond and other FAA officials flew in from Washington to survey the damaged craft at Detroit Metropolitan Airport. The plane, with a seven-member crew, made an emergency landing at 10:30 p.m. Wednesday.

Propped up by jacks, the plane sat on an airport runway as mechanics, FAA officials and reporters examined the damage. Flaps on the right wing were ripped off during the descent. Pieces of metal hung from that wing and from the fuselage around the landing gear doors on both sides. Inside the airliner, newspapers and magazines were strewn on the floor. A large sack of used air sickness bags stood in the aisle.

TWO TAPES, ONE recording cockpit conversations and one recording radio conversations with the ground, were sent for study to the National Transportation Safety Board in Washington.

Chuck Foster, associate administrator of the FAA for aviation standards, said the plane was flying about 500 mph before the trouble hit, but in the dive apparently exceeded 650 mph — above the speed of sound at that altitude and temperature.

"I've been told that the airspeed indicator was pegged all the way over to the edge," Foster said. "If that proves to be the case, it will be the first time in FAA history that an airplane (not designed for it) had exceeded those speeds and survived."
EVALUATION ITEMS

1. The Great Lakes Triangle
   a. includes all of the Great Lakes and some surrounding areas.
   b. is smaller than the Bermuda Triangle.
   c. has more unexplained disappearances than the Bermuda Triangle.
   d. all of the above.

2. The draft of a ship is the
   a. amount of water it displaces.
   b. depth of its cargo.
   c. number of tons of cargo it can carry.
   d. depth of water it needs to float.

3. The “three sisters” are
   a. three freighters that sank together in Lake Superior in 1975.
   b. a series of three waves that are higher than average
   c. three lighthouses on the shore of Lake Michigan.
   d. Buffalo, Detroit, and Chicago.

4. Which statement is true concerning Great Lakes bulk carrier design?
   a. All freighters are more than 300 feet long.
   b. Most freighters have a draft in a small, concentrated area.
   c. Cargo holds keep cargo in a small, concentrated area.
   d. The freighter is often about 10 times longer than it is wide.

5. What factor(s) could throw a ship out of balance?
   a. A hatchway caves in, letting water into the hold.
   b. The ship pitches and rolls, causing the cargo to move around.
   c. A series of waves suddenly hits the ship.
   d. All of the above.

6. In the Great Lakes area the winds around a low pressure center blow
   a. toward the center and clockwise.
   b. toward the center and counterclockwise.
   c. away from the center and clockwise.
   d. away from the center and counterclockwise.

7. The depth of a lake is determined using
   a. scuba divers.
   b. echo sounding.
   c. weighted rope.
   d. light waves.

8. What is the mood of the song The Wreck of the Edmund Fitzgerald?
   a. Happy
   b. Hopeful
   c. Sorrowful
   d. Frightful
Did ‘three sisters’ pull it down?

Fitzgerald: Another theory

Throughout the years, the greatest battles with Lake Superior have been waged by commercial fishermen. Personality, individuality, and the Store have enabled me to resist this battle. But I did not submit my version of the tragedy. The Fitzgerald went to the bottom of Lake Superior by means of a submarine, due to excessive water weight on the deck of her forward section, immediately aft of the pilot house.

The absolute key to this tragedy lies in the Three Sisters—three big waves. I am assured that this phenomenon has not been considered.

Commercial fishermen, and all men who have spent considerable time on Lake Superior during storms, know that at irregular intervals, three big waves appear. Fishermen throughout the years, have tied and utilized these three big waves to successfully gain entrance to dangerous harbors when the wind is blowing off the lake.

To further understand this phenomenon, stand on the beach when the wind is blowing off the lake, and periodically, three waves will come higher on the sand than the others. This phenomenon of the three big waves is much more pronounced during a big storm, in the middle of Lake Superior, and in the fall and winter months.

Although the stormy seas were the key to the disaster, many other elements have to be precise to conquer this gigantic, magnificent ship. Some of these factors have to be considered: wind direction and velocity, speed of seas, distance between seas, direction of ship, speed of ship, weight of cargo, buoyancy displacement ratios, depth of water, course of ship bow and inertia.

We know the wind was blowing approximately 30 mph out of the northwest. The speed of the ship would have been approximately 16 mph. A look at the chart will show that the course to Sault Ste. Marie, at the point where the ship was found, would have been approximately southeast.
Had the captain realized the storm could sink his ship, he could have gained shelter on the south side of Michigan Island or, later in the day, sought shelter under the north shore, on the Canadian side of the lake.

Had he known the ship could sink, he could have reduced his speed or utilized the old sailboat tactic of “lacking” before the wind. Had his speed been half, that massive body of water would have dissipated twice as fast.

Those of us who operate ships, regardless of size, should have learned many things as the result of this tragedy in which Lake Superior was able to swallow a ship of the magnitude of the Fitzgerald. Books have been written, and probably should be revised because of the tremendous number of relatively small pleasure craft, on water safety.

The cardinal lesson to be learned from the Fitzgerald tragedy is that one should never underestimate the ferocity and power of Lake Superior. Conversely, never overestimate the capabilities of your craft. A good operator does not get caught in a storm greater than the capabilities of his boat. However, if it does happen, common sense should prevail.

Any ship will survive a storm much better if the speed is reduced. If the situation gets to a point where shelter cannot be reached, any ship will weather a storm much better if she is held into the wind, with just enough propulsion to maintain steerageway.

HEAVILY LADEN
She was laden with 53 million pounds of iron ore pellets. This additional 10 million pounds of water, for 20 seconds, and a travel distance of only 50 feet, caused the entire plane of the ship to depress from horizontal to from 5 to 15 degrees below horizontal. At this point, her decks were under or almost under the surface. Because her bow and sides were perpendicular to the water, her buoyancy-displacement factor became decreased to a point where inertia prevailed and she continued her course to the bottom.

With the terrific weight, speed and the forward force of the propellers, it is doubtful if the angle of descent would have increased much during the relatively short distance of 350 feet to the bottom. This angle would increase somewhat as the ship descended, because water pressure increases with depth. When the bow plowed into the clay bottom of the lake, the stern section would have been close enough to surface to permit time and space for the stern section to capsize after she snapped.

We are to believe the findings of the Coast Guard board of inquiry, whereby she sank because of seepage through the hatches, she would likely have seeped water through hatches both forward and aft, and would have settled to the bottom on a horizontal plane, and the aft section would not have had space or time to be upside down.

WHY IT HAPPENED
We have dealt with how this tragedy occurred, now let us consider why it happened, how it could have been prevented and what lessons it can teach people who put out to sea in boats.

The Edmund Fitzgerald lies on the bottom of Lake Superior today, with it’s full crew of 29 men trapped inside her, because the captain did not realize he was in danger. Prior to this tragedy, the Great Lakes ships had become so large, so well constructed, so fast and so completely equipped that the captains thought they were unsinkable.
Fitzgerald Hit Reef, Latest Report Says

DULUTH, Minn. (AP) — The Lake Carriers’ Association says the ore carrier Edmund J. Fitzgerald sank after striking a shoal, or underwater reef, nearly two years ago in storm-tossed eastern Lake Superior.

The association rejected the theory of the U.S. Coast Guard, which found that the “most probable cause” of the disaster was loss of buoyancy and stability resulting from massive flooding of the cargo hold through ineffective hatch closures.

The association, composed of 15 domestic bulk shipping companies operating 135 vessels on the Great Lakes, filed its position paper Wednesday with the National Transportation Safety Board, asking that it be considered in the board’s deliberations in the case.

The paper was written by Paul E. Trimble, a retired Coast Guard admiral who is association president.

Trimble cited 40 years’ experience with the type of hatch covers and closure clamps in use and said if they were ineffective there would have been many watery cargoes to unload.

“This would have been a “costly problem that vessel and cargo owners would not tolerate,” he said.

Testimony about improper hatch closure procedures on other vessels in other than heavy weather conditions “should under no circumstances be assumed to have been the case on the Fitzgerald in the weather she was experiencing,” Trimble said.

He cited testimony before the board about the Fitzgerald’s course shortly before it sank Nov. 10, 1975. Some of it was presented by the captain and a mate of the ore carrier Arthur Anderson, which was providing navigational assistance to the Fitzgerald after radar failure.

While no plot of the Fitzgerald was maintained, the captain of the Anderson said the Fitzgerald was close to Six Fathom Shoal north of Caribou Island.

Trimble’s other arguments in opposition to the Coast Guard’s findings included:

—MINUTES after passing Six Fathom Shoal, the Fitzgerald reported a list and said two tank vents had been carried away and that two ballast pumps were operating.

—THE CAPACITY of the ballast pumps—14,000 gallons per minute—was adequate to handle the volume of water that could enter through the eight-inch diameter vents.

—THERE SHOULD have been no list, particularly in 10 to 15 minutes, from water from this source.

—THE FITZGERALD’S report of listing in such a brief period “can only be readily explained by bolting of the vessel’s ballast tanks caused by striking Six Fathom Shoal.”

—THERE WAS NO REPORT of hatch damage or hatch covers opening.

—IT IS QUESTIONABLE that water in the cargo hold would have resulted in a list since it would not have been restricted to one side of the vessel.

—THE FITZGERALD’S MASTER reported the pumps were operating and “we are holding our own” minutes before the ship disappeared from view on the Anderson’s radar.

—THE QUANTITY of water needed to sink the Fitzgerald “could not have seeped through the hatch covers.”

Trimble said the Fitzgerald “labored in heavy, quartering seas for over three hours” after the initial damage caused by shoaling.

When buoyancy became marginal, a large wave or series of waves could have raised the stern, starting the bow’s drive under water, Trimble theorized.

He said hatch covers could have been blown off by compressed air in the cargo compartments as water entered from the sides or bottom, or they could have sprang from the weight of taconite pellets cargo as the vessel drove in 530 feet of water.

Underwater photographs of the wreck, he said, do not support a conclusion that the hatch clamps were not properly closed, he said.
Ohio Sea Grant Program

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The Great Lakes Triangle

by

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INTRODUCTION

In 1974, Charles Berlitz wrote in his famous best seller, The Bermuda Triangle:

There is a section of the western Atlantic, off the southeast coast of the United States, forming what has been termed a triangle, extending from Bermuda in the north to southern Florida, and then east to a point through the Bahamas past Puerto Rico to about 40 degrees west longitude and then back again to Bermuda. This area occupies a disturbing and almost unbelievable place in the world's catalogue of unexplained mysteries. This is usually referred to as the Bermuda Triangle, where more than 100 planes and ships have literally vanished into thin air, most of them since 1945, and where more than 1,000 lives have been lost in the past twenty-six years, without a single body or even a piece of wreckage from the vanishing planes or ships having been found.

Former aviator Jay Gourley has since written a book called The Great Lakes Triangle (1977), which claims that the Great Lakes account for more unexplained disappearances than the Bermuda Triangle. This is no small comparison, considering that the Bermuda Triangle is sixteen times larger than the Great Lakes area. Gourley says:

Because of the irregular shape of the Great Lakes, pilots — aware of the dangers within — ordinarily circumnavigate the lakes, even when overflying might be shorter. It is almost impossible for even the slowest aircraft to be more than 20 minutes from land. Today's airliner can cross Lake Erie through the middle in ten minutes. Faster aircraft can do it in much less than four minutes. Over any point on any of the Great Lakes it is possible for the pilot of any jet airliner to shut down all his engines and literally glide to land. There are hundreds of ground-based, sea-based and air-based radio stations constantly monitoring emergency frequencies for any sign of trouble.

Aware of the curious incidents over the Great Lakes, the Federal Aviation Administration several years ago instituted a special "Lake Reporting Service." pilots on Great Lakes overflights make continuous reports to ground stations. A ten-minute delay in such a report automatically launches search-and-rescue operations. This service has saved many lives that would have been lost to ordinary accidents, but the high incidence of inexplicable disasters has remained unaffected.

OBJECTIVES

When you have completed this investigation you will be able to:

1. Explain what is meant by the Great Lakes Triangle.
2. Describe how bathymetric charts are constructed.
3. Explain how weather information is mapped.
4. Describe the characteristics of a Great Lakes bulk carrier.
5. Discuss at least two possible explanations for the sinking of the Edmund Fitzgerald.
Figure 1: One of the last photographs taken of the *Edmund Fitzgerald*.

**ACTIVITY A: WHAT IS THE GREAT LAKES TRIANGLE?**

**MATERIALS**

Map of vessel and aircraft disappearances in the Great Lakes area. Table I from the Teacher's Guide.

**PROCEDURE**

Figure 2 shows the last position of disappearing ships and planes in the area of the Great Lakes Triangle. Look at the map symbols and their locations to answer the questions on the next page.
Figure 2: Estimated locations of disappearances described in Gourley's *The Great Lakes Triangle*.

1. Are there some areas where large numbers of losses have occurred? If so, where? (Answer on your worksheet.)

2. Are there logical explanations for large numbers of losses having occurred at these particular areas? What explanation?

3. Do most of the losses include missing people?

4. Why do you think some of the planes, ships and people have never been found?

If you are interested in learning more about the planes and ships in Figure 2, your teacher can post a copy of the list from which the map was made.
**ACTIVITY B: HOW CAN DISAPPEARANCES WITHIN THE TRIANGLE BE EXPLAINED?**

**MATERIALS**

Navigational chart of eastern Lake Superior; cardboard tubes; plastic beads or aquarium gravel; outline maps of Lake Superior; weather data for November 10, 1975; pencil or pen; blank transparency; washable markers; tape.

**PROCEDURE**

You will be assigned to investigate and produce examples of one or all of the following topics.

1. Great Lakes bulk carrier design
2. Tracking a severe lake storm
3. Lake bottom characteristics

All the materials needed for your assignment are included in this booklet. If you have been assigned Topic 1, use pages **. For Topic 2, use pages **, and for Topic 3, use pages **.

After your investigations have been completed your teacher will conduct a class discussion. Findings from all three topics will be brought together. The discussion will help you answer the questions below. It may be helpful to read the questions before you begin work, but do not try to answer them until all the investigations have been completed.

1. Could ship design be responsible for the loss of some vessels in the Triangle area?
2. How bad is a severe storm on the Great Lakes?
   a. Wind speeds?
   b. Wave heights?
   c. Duration (how long the storm lasts)?
   d. Visibility?
3. What kinds of areas in lakes and oceans may be safer when a storm is in progress?
4. How are bathymetric measurements made?
5. Is it possible that there are features on lake and ocean bottoms that mariners don’t know about?
6. What are the “Three Sisters” in the mariner’s language?
7. Consider the Edmund Fitzgerald as an example of a Great Lakes Triangle disaster. Are there natural forces that could explain the sinking? What are some possible explanations?
8. Considering the storm, the water depth and temperature, and what possibly happened to the Fitzgerald, why do you think the bodies of the crewmen were never found?

**TOPIC 1**

**GREAT LAKES BULK CARRIER DESIGN**

**INTRODUCTION**

The Edmund Fitzgerald sank in the Great Lakes Triangle area on November 10, 1975. The Coast Guard and the National Transportation Safety Board both decided that the wreck was caused by a hatch cover which let water enter the hold. If you examine the general shape and parts of the Fitzgerald, you may be able to point out to your classmates some ways that ship design could have been at least a partial cause of the sinking.

The ships that carry iron ore (taconite pellets) on the Great Lakes are designed to haul huge loads with very little draft. Draft is the depth of water necessary to float a vessel. If a ship “draws” (has a draft of) 30 feet, it can only go in water that is more than 30 feet deep. Because of underwater rocks and the need to go through locks from one lake to another, most lake vessels draw 25 feet or less when fully loaded. This means that a large load must be spread out in a “thin layer.” If a ship is designed for use on one lake only, it can have a larger draft because it doesn’t have to go through any locks.
A bulk carrier is a ship that carries a large amount of unpackaged material like grain or minerals. Great Lakes bulk carriers are usually about ten times as long as they are wide, and about half as deep as they are wide. The *Edmund Fitzgerald* was the biggest ore carrier on the lakes when she entered service in 1958. The *Fitzgerald* was 727 feet long, 75 feet wide, and drew 25 feet of water.

**MATERIALS:** Cardboard tube at least 45 cm long, tape, small plastic beads or aquarium gravel, marking pen.

**PROCEDURE**

A scale model is a small version of anything, with all sizes cut down by the same proportion. Architects, car designers, and such make scale models to see how a product is going to look before they invest in the real thing. The model of an 80 x 60 foot house might be 80 x 60 inches, or 8 x 6 inches, or 4 x 3 inches. For each of the model sizes given, the original measurements have both been divided by a certain number.

1. Build a scale model of the *Edmund Fitzgerald* using the dimensions given in paragraph 3 on page 7. Use a cardboard tube which you flatten on one side to form the deck. Draw hatch covers on the deck and outline the positions of other deck structures.

2. Seal one end of the "hull" with tape and pour small plastic beads or aquarium gravel into the hold until it is about 3/4 full. Seal the open end so that none of the "ore" can get out.

This simulates the cargo of an ore carrier like the *Fitzgerald*. The hold of the ship is not really a single open chamber. It has dividers or "bulkheads" to separate one section from another. The *Fitzgerald* had three compartments for cargo inside its hold. Ore pellets were loaded through the hatches on deck.

3. Experiment with your model to find the answers to the following questions:

   A. Balance the model on the side of a pencil. What do you have to do to find the balancing point (center of gravity)?

   B. Suppose the ore is loaded and the ship is balanced for its trip across the lake. A storm comes up. Wind and high waves cause the ship to roll (rock from side to side) and pitch (rock from end to end). Which motion, roll or pitch, is more likely to shift the cargo out of balance?

   C. Waves break over the ship one after another. The water from one wave doesn't even clear the deck before more water piles on. How could this affect the ship's balance?

   D. A hatchway caves in or comes unsealed, letting water enter the hold. How could this affect the ship's balance?

   E. A series of waves raises up the stern and rolls under the ship toward the bow. If the cargo shifted strongly toward the bow, what could happen to the ship?

   F. The *Fitzgerald* was 727 feet long. She sank in 530 feet of water. What could happen to the ship if it suddenly took a nosedive to the bottom?

4. Prepare to explain to the class how the ship design could be at least partly responsible for the loss of some vessels.

5. Share with the class the meaning of these terms: draft, scale model, hull, bulkheads, center of gravity, pitch, and roll.
TOPIC 2

STORM TRACKING

INTRODUCTION

Weather conditions on the water can sometimes create freak accidents that appear to be more supernatual than natural. Sightings of "ghost ships," sea monsters and the like often occur during periods of unusual weather. Natural forces and a good imagination are probably responsible for many of the "unexplained" phenomena of the Great Lakes and Bermuda Triangles.

The mariners of the world's oceans and the Great Lakes are always watchful of the weather. Their lives depend on how prepared they are for conditions on the water. Regardless of their preparedness, however, accidents happen. A storm may build up far more strength than weather predictions forecast, and the tremendous force of a raging sea may be more than a ship can take. Such an accident occurred on November 10, 1975, with the sinking of the ore freighter Edmund Fitzgerald.

PROCEDURE

Every six hours, at 1 and 7 p.m. and 1 and 7 a.m. Eastern Standard Time, observers all over the world report weather conditions at their location. Wind speed and direction are noted. Precipitation for the previous six hours is measured. Temperature, visibility and any other weather conditions are also recorded. The information is then put into an international code, sent to collection centers within each country, and exchanged internationally. In this country, the information is collected and analyzed by the U.S. Weather Bureau.

At the centers receiving the coded weather information, weather maps are prepared. The messages are decoded and the conditions reported are translated into figures and symbols. These are grouped around a small circle drawn on a map at the position of the station reporting the information. The circle on the map, with the figures and symbols describing the weather conditions at that location is called a station model. The method of construction of a station model and an interpretation of its information are shown in Figures 3-5.

MATERIALS: Transparencies of Lake Superior, wax pencils or washable markers, overhead projector.

![Diagram](image-url)

Figure 3. Method for showing wind direction. Circle is placed at location of station, and bar points to where wind is coming from.
Figure 4. Symbols used to indicate wind speed (in knots)

Figure 5. Interpretation of a Station Model

1. Force of wind = 25 knots
2. Wind direction: from northwest
3. Visibility 2-4 miles
4. Thunderstorm in progress
5. Waves

You are to examine and report data (information) on weather conditions during the storm that caused the Fitzgerald's sinking.

Figures 6 and 7 show the weather data for 1 and 7 a.m. (Eastern Standard Time) on November 10, 1975. The abbreviations used stand for ships that reported in as weather stations. This information was taken from the actual transcripts of hearings following the sinking of the Fitzgerald. Look carefully at Figures 6 and 7. Notice how the low pressure center is moving and where the Fitzgerald is at each time.

From your teacher get transparencies of Lake Superior numbered 3-4 and record on them the following information as was done for you in Figures 6 and 7:

A. Date and time (plot a new map for each different time).

B. Wind, wave, precipitation and visibility data for the stations listed. (Some stations are on land; others are reports from ships at the positions given.) The information to be plotted is in Table 1.
Date: 11/10/75  
Time: 0100E

![Map of a coastal area with weather information]

<table>
<thead>
<tr>
<th>Location</th>
<th>Wind Speed (knots)</th>
<th>Wind Direction</th>
<th>Wave Height (feet)</th>
<th>Precipitation</th>
<th>Visibility (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson (AND)</td>
<td>32</td>
<td>NE</td>
<td>10</td>
<td>Rain</td>
<td>5-9</td>
</tr>
<tr>
<td>Fitzgerald (FTZ)</td>
<td>52</td>
<td>NNE</td>
<td>10</td>
<td>Heavy rain</td>
<td>2-4</td>
</tr>
<tr>
<td>Duluth</td>
<td>15</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apostle isles</td>
<td>30</td>
<td>NNE</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thunder Bay</td>
<td>10</td>
<td>NE</td>
<td>7</td>
<td>Rain</td>
<td>5-9</td>
</tr>
<tr>
<td>BRE</td>
<td>38</td>
<td>NE</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLK</td>
<td>42</td>
<td>ENE</td>
<td>7</td>
<td>Clouds forming</td>
<td>10+</td>
</tr>
<tr>
<td>SWN</td>
<td>40</td>
<td>NE</td>
<td>7</td>
<td>Moderate rain</td>
<td></td>
</tr>
<tr>
<td>WEI</td>
<td>30</td>
<td>NE</td>
<td>10</td>
<td>Squalls</td>
<td>10+</td>
</tr>
<tr>
<td>BEE</td>
<td>30</td>
<td>SE</td>
<td></td>
<td>Fog</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 6.** Weather data from 1 a.m., November 10, 1975
Figure 7. Weather data from 7 a.m., November 10, 1975.
Table 1
Weather Data for Maps 3 and 4 (transparencies)

Map 3
Date: 11/10/75
Time: 1300E

<table>
<thead>
<tr>
<th>Location</th>
<th>Wind Speed (knots)</th>
<th>Wave Direction</th>
<th>Wave Height (feet)</th>
<th>Precipitation</th>
<th>Visibility (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AND</td>
<td>20</td>
<td>SE</td>
<td>10</td>
<td>Clouds forming</td>
<td>10-24</td>
</tr>
<tr>
<td>Duluth</td>
<td>25</td>
<td>NW</td>
<td>5</td>
<td>Clds dissolving</td>
<td></td>
</tr>
<tr>
<td>Silver Bay</td>
<td>20</td>
<td>NW</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW of Isle Royale</td>
<td>40</td>
<td>WNW</td>
<td>10</td>
<td>Moderate snow</td>
<td></td>
</tr>
<tr>
<td>BEE</td>
<td>49</td>
<td>NW</td>
<td>7</td>
<td>Light snow</td>
<td></td>
</tr>
<tr>
<td>TAD</td>
<td>53</td>
<td>NW</td>
<td>15</td>
<td>Heavy snow</td>
<td>1/2</td>
</tr>
<tr>
<td>Copper Harbor</td>
<td>60</td>
<td>WNW</td>
<td>8</td>
<td>MOD 10-24</td>
<td></td>
</tr>
<tr>
<td>Slate Island</td>
<td>25</td>
<td>NW</td>
<td>7</td>
<td>Moderate TSTM</td>
<td></td>
</tr>
<tr>
<td>SIM</td>
<td>44</td>
<td>W</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caribou Island</td>
<td>40</td>
<td>S</td>
<td>13</td>
<td></td>
<td>5-9</td>
</tr>
<tr>
<td>CLK</td>
<td>41</td>
<td>S</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whitefish Point</td>
<td>20</td>
<td>SW</td>
<td>15</td>
<td></td>
<td>2-4</td>
</tr>
</tbody>
</table>

Map 4
Date: 11/10/75
Time: 1900E

<table>
<thead>
<tr>
<th>Location</th>
<th>Wind Speed (knots)</th>
<th>Wave Direction</th>
<th>Wave Height (feet)</th>
<th>Precipitation</th>
<th>Visibility (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duluth</td>
<td>10</td>
<td>WNW</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper Harbor</td>
<td>40</td>
<td>NW</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Marais</td>
<td>35</td>
<td>W</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARM</td>
<td>25</td>
<td>NW</td>
<td>8</td>
<td>Clds dissolving</td>
<td>10+</td>
</tr>
<tr>
<td>NE of Isle Royale</td>
<td>40</td>
<td>NW</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>off Marathon</td>
<td>25</td>
<td>NW</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTZ (tank)</td>
<td>49</td>
<td>NW</td>
<td>16</td>
<td>Drizzle &amp; snow</td>
<td>10+</td>
</tr>
</tbody>
</table>

Answer the following questions based on your maps:

1. In what direction was the storm moving? (Note the movement of the low pressure center.)

2. Do the winds around a low pressure center blow clockwise or counter-clockwise? Toward or away from the center? Are wind speeds greater or less as they get closer to the low pressure center?

3. On weather maps 1-4, check the station models for coastal weather and mid-lake weather. Which areas, coastal or mid-lake, had higher wind and waves?

4. Which areas had higher wind and waves, island areas or mid-lake areas?

5. Which side of the lake, Canadian or U.S., had more severe weather conditions?

6. The map below shows the courses taken by the Fitzgerald and a following ship, the Anderson.

Was this the best possible course in view of the weather conditions?

7. Plot a recommended course for the Fitzgerald on a third transparency. You will want to consider the storm's path, the wave heights and wind speeds along the way. Be prepared to defend your choices for the rest of the class.

Figure 8. Courses steered by the Arthur M. Anderson and the Edmund Fitzgerald on the night of November 10, 1975.
TOPIC 3
LAKE BOTTOM CHARACTERISTICS

INTRODUCTION

How deep is the water? Every mariner must be aware of water depth in order to know if his vessel will float without bumping the bottom.

Exploring water depths began with crude lead-weighted ropes on wires lowered from ships. Knots or marks on these sounding lines were recorded as depth measurements. "Mark twain," for example, meant that the water came up to the second mark on the line and was two fathoms (about 4 meters) deep.

In World War I the echo sounder was developed. A sound sent out from an instrument aboard a ship bounces off the sea floor or lake bottom. When the echo returns to the ship, depth is calculated. Sound waves travel through water at a speed of 5,000 feet per second. If the sound takes one second to reach the bottom, its echo takes one second to return and the water is 5,000 feet deep. Using the results of echo sounding, scientists can draw a bathymetric chart. ("Bathy" means deep, and "metric" means measured.) Such a chart shows the characteristics of the sea floor or lake bottom.

1. The numbers on the nautical chart on your worksheet are the soundings at various locations in a small lake. The larger the numbers are, the deeper the water. The zeroes indicate shoreline areas, where the water depth becomes zero. All the zeroes around the edge of the map have been connected to show the shape of the lake.

Are there other zeroes besides the lakeshore ones? What kind of feature has been drawn at Point A?

2. Now find a line that roughly shows where the water is 50 feet deep. (Mariners do not use the metric system yet.) The line goes between the numbers greater than 50 and the numbers less than 50. Contour lines do not end unless they go off the edge of the map, so the ends of the 50-foot line are connected.

There are two 50-foot bathymetric contours for this map. One surrounds the feature at A and another is around the inside of the entire lake. Be sure you understand why these lines were drawn where they are.

3. Put a Y on a part of the lake that has some very shallow areas close to the 50-foot line. This is a place where there is a rocky area or a shoal underwater. Sailors would have to be very careful not to bump their boats into this.

4. Draw a 100-foot contour line in the lake. Put an X on the deepest point in the lake.

Figure 9. A ship using an echo sounder

MATERIALS: Nautical chart of eastern Lake Superior (St. Mary's to Au Sable Point), transparent sheet, wax pencil or washable marker.

PROCEDURE

A contour line is a line connecting points of equal elevation or depth. We can construct bathymetric contours in the following way:

Practice Map: Soundings in a Small Lake
5. On the large map showing the eastern end of Lake Superior, place a transparent sheet so that its short bottom edge is on the line labeled 46260' and the long left hand edge is on the 8520' line of longitude. Trace the shoreline onto your paper.

6. In the area covered by the tracing paper, draw 50-foot bathymetric contours. Be sure to look around for the depths far out in the water that may need to be enclosed in such lines.

7. Also draw a 75-foot contour. Your map should now show places of shallow water that are surrounded by very deep water.

8. Label the town of Coppermine Point on your transparency. On November 10, 1975, the Edmund Fitzgerald sank off Coppermine Point in 530 feet of water. The ship was coming from the northwest. Put an X on the place where the sinking probably occurred.

9. The Fitzgerald's hull was 37 feet deep. In a storm with large waves the hull might dip down to a depth of about 50 feet. Locate areas where hidden shoals might be (depths of 50 feet or less), and areas where few depth measurements have been made. Be prepared to show the class the areas where the Fitzgerald should have struck bottom.

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**ACTIVITY C: WHAT HAPPENED ABOARD THE EDMUND FITZGERALD?**

On November 10, 1975, the Great Lakes ore carrier **Edmund Fitzgerald** sank in the area of the Great Lakes Triangle. Though its wreckage was found, no members of the ship's crew were ever recovered. The sinking thus became not only a new piece of the triangle's mystery, it became a human story as well.

Strong emotions are often expressed more effectively through an artistic creation than through spoken words. A violent painting or a joyful dance can communicate feelings that anyone can understand. The deep sorrow felt in the lakes country when the **Edmund Fitzgerald** sank was expressed in a haunting ballad by a Canadian singer, Gordon Lightfoot.

**MATERIALS:** Recording of Gordon Lightfoot's "The Wreck of the Edmund Fitzgerald." Words to that song, pencil or pen.

**THE WRECK OF THE EDMUND FITZGERALD**

The legend lives on from the Chippewa on down of the big lake they call "Gitche Gumee." The lake, it is said, never gives up her dead when the skies of November turn gloomy.
With a load of iron ore twenty-six thousand tons more than the **Edmund Fitzgerald** weighed empty, That good ship and true was a bone to be chewed when the "Gales of November" came early.

The ship was the pride of the American side coming back from some mill in Wisconsin. As the big freighters go it was bigger than most with a crew and good captain well seasoned, Concluding some terms with a couple of steel firms when they left fully loaded for Cleveland.
And later that night when the ship's bell rang could it be the north wind they'd been feelin'?

The wind in the wires made a tattle-tale sound and a wave broke over the railing.
And ev'ry man knew as the captain did too 'twas the witch of November come stealin'.
The dawn came late and the breakfast had to wait when the Gales of November came stealin'.
When afternoon came it was freezin' rain in the face of a hurricane west wind.

When suppertime came the old cook came on deck sayin', "Fellas, it's too rough t' feed ya."
At 7 p.m. a man hatchway caved in;
he said, "Fellas, it's been good t' know ya."
The captain wired in he had water comin' in and the good ship and crew was in peril.
And later that night when "is lights went outta sight came the wreck of the **Edmund Fitzgerald**.

Does anyone know where the love of God goes when the words turn the minutes to hours? The searchers all say they'd have made Whitefish Bay if they'd put fifteen more miles behind 'er.
They might have split up or they might have capsized, they may have broke deep and took water.
And all that remains is the faces and the names of the wives and the sons and the daughters.

Lake Huron rolls, Superior sings in the rooms of her ice water mansion.
Old Michigan steamers like a young man's dreams, the islands and bays are like sportsmen.
And farther below Lake Ontario takes in what Lake Erie can send her.
And the iron boats go as the mariners all know with the Gales of November remembered.
In a musty old hall in Detroit they prayed,
in the “Maritime Sailors’ Cathedral.”
The church bell chimed ‘til it rang twenty-nine times
for each man on the Edmund Fitzgerald
The legend lives on from the Chippewa on down
of the big lake they call “Gitche Gumee.”
“Superior,” they said. “never gives up her dead
when the Gales of November come early!”

PROCEDURE

1. Listen to the recording. How does it make
   you feel?

   For each of the following things about the song,
tell how it helps to produce this general feeling:

   A. the singer’s voice.
   B. the tempo (how fast the song is).
   C. the instrument being played.
   D. sounds in the background.
   E. the words (list words or phrases that help create
      the feeling).

2. Imagine that you are aboard the Fitzgerald on the
   night of the storm. The darkness and the cold rain
   are uncomfortable, but until now no one has
   doubted that you will reach your destination.

   The song reports that “at 7 p.m. a main hatchway
caved in.” Write a one-page description of what
you might have witnessed aboard the ship as it
sank. This can be done as if you are recording
events in a diary or writing a last letter to a friend.
Since you have probably decided for yourself what
must have happened that night, this is a way of
providing the world with an “eyewitness” account
of the events.

Some people have survived “close encounters”
with the Bermuda Triangle, others have not. The last
messages from ships and planes that have disapp-peared are examined in Berlitz’s book, Without A
Trace, a follow-up to The Bermuda Triangle. The book
also includes the testimony of witnesses and survivors.
It serves to enlarge the mystery of the Triangle as it
searches for the natural or supernatural causes for
happenings there.

As you read these accounts, search for ways to
explain the happenings naturally. Both Berlitz’s and
Gourley’s books imply that forces from outer space
are responsible for triangle disappearances. Though
this idea is an interesting one, most scientists would
tell us that science fact is stranger than science
fiction. It is very likely that some natural factors such
as those you investigated in this activity have been
responsible for disappearances in both the Great
Lakes and Bermuda Triangles.

There are more things in heaven and earth...
    than are dreamt of in our philosophy.
Shakespeare
A FINAL NOTE

As this activity was being prepared, another incident was added to the Great Lakes Triangle mystery. This incident did not result in the loss of the plane or any lives, but it is the type of accident that makes people believe that unnatural things are happening in the Triangle. Try to figure out what natural forces might have caused this near-disaster.

Columbus Dispatch  FRI, APRIL 6, 1979

Survival Of Supersonic Dive Called Miracle

DETROIT (AP) — The 80 passengers aboard the TWA flight from New York to Minneapolis had just eaten a midair snack when they felt the craft begin to vibrate.

Suddenly, the plane swerved to the right, completed a 360-degree barrel roll and nose-dived from 39,000 to 12,000 feet — five miles — in a matter of seconds at a speed apparently exceeding that of sound.

"YOU COULD FEEL your face pressed back and the blood rush to your head," said Chell Roberts, 22, a University of Utah student who was aboard. "Everyone was screaming. I thought it was over."

"We were just eating when it happened ... people started to scream and a flight attendant started to cry," he said. "It's really a funny feeling to see what everybody does before they think they are going to die."

But nobody died Wednesday night. Only three people aboard suffered minor injuries.

FEDERAL AVIATION Administration (FAA) inspectors said it was "miraculous" and "unprecedented" that the Boeing 727 jetliner survived such midair trauma before being brought under control in a desperation maneuver. Langhorne Bond, head of the FAA, commended the pilot, identified only as H. Gibson of Chicago.

"I can't think of any other incident where a (commercial, passenger) plane has done a complete 360-degree rollover and survived," Bond said Thursday. "The miracle is that it held together under such extraordinary speed and circumstances."

Preliminary evidence, Bond said, indicated that the flight was "very routine in clear weather" when the plane "began to vibrate, went out of cruise control, rolled to the right, did a complete turnover and dived to the ground."

"WE DON'T KNOW what caused it at this time," Bond said.

At that point, the pilot tried to slow the descent by deploying devices on the plane designed to increase drag. But the wing flaps, spoilers and leading-edge slats proved ineffective at the speed the plane was traveling and were torn off.

The pilot then lowered the landing gear.

"It is clear that that is the event that allowed the crew to regain control of the plane," Bond said.

"THERE IS NOTHING in the manual to tell you what to do," he said, commending the pilot.

Bond and other FAA officials flew in from Washington to survey the damaged craft at Detroit Metropolitan Airport. The plane, with a seven-member crew, made an emergency landing at 10:30 p.m. Wednesday.

Proped up by jacks, the plane sat on an airport runway as mechanics, FAA officials and reporters examined the damage. Flaps on the right wing were ripped off during the descent. Pieces of metal hung from that wing and from the fuselage around the landing gear doors on both sides. Inside the airliner, newspapers and magazines were strewn on the floor. A large sack of used airsickness bags stood in the aisle.

TWO TAPES, ONE recording cockpit conversations and one recording radio conversations with the ground, were sent for study to the National Transportation Safety Board in Washington.

Chuck Foster, associate administrator of the FAA for aviation standards, said the plane was flying about 600 mph before the trouble hit, but in the dive apparently exceeded 650 mph — above the speed of sound at that altitude and temperature.

"I've been told that the airspeed indicator was pegged all the way over to the edge," Foster said. "If that proves to be the case, it will be the first time in FAA history that an airplane (not designed for it) had exceeded those speeds and survived."
THE GREAT LAKES TRIANGLE
WORKSHEET

ACTIVITY A: WHAT IS THE GREAT LAKES TRIANGLE?

Study Figure 2 in your student guide. Then answer these questions.

1. Are there some areas where large numbers of losses have occurred? __________. If so, where?

2. Are there logical explanations for large numbers of losses having occurred at these particular areas? _____ What explanations?

3. Do most of the losses include missing people? __________________________

4. Why do you think some of the planes, ships and people have never been found? __________________________

ACTIVITY B: HOW CAN DISAPPEARANCES WITHIN THE TRIANGLE BE EXPLAINED?

Read and follow the instructions on page 5 of your student guide before answering the questions below.

1. Could ship design be responsible for the loss of some vessels in the Triangle areas? Explain

2. How bad is a severe storm on the Great Lakes:
   a. Wind speeds?
   b. Wave heights?
   c. Duration (how long the storm lasts)?
   d. Visibility?

3. What kinds of areas in lakes and oceans may be safer when a storm is in progress?

4. How are bathymetric measurements made?
5. Is it possible that there are features on lake and ocean bottoms that mariners don't know about? 

Explain. 

6. What are the "Three Sisters" in the mariner's language? 

7. Consider the Edmund Fitzgerald as an example of a Great Lakes Triangle disaster. Are there natural forces that could explain the sinking? What are some possible explanations? 

8. Considering the storm, the water depth and temperature, and what possibly happened to the Fitzgerald, why do you think the bodies of the crewmen were never found? 

Topic 1: Great Lakes Bulk Carrier Design

1. & 2. Follow the instructions in your guide.

3. Experiment with your model to find the answers to the following questions:

A. Balance the model on the side of a pencil. What do you have to do to find the balancing point (center of gravity)? 

B. Which motion — roll or pitch — is likely to shift the cargo out of balance? 

C. Waves break over the ship one after another. The water from one wave doesn't even clear the deck before more water piles on. How could this affect the ship's balance? 

D. A hatchway caves in or comes unsealed, letting water enter the hold. How could this affect the ship's balance? 

E. A series of waves raises up the stern and rolls under the ship toward the bow. If the cargo shifted strongly toward the bow, what could happen to the ship's balance? 

F. The Fitzgerald was 727 feet long. She sank in 530 feet of water. What could happen to the ship if it suddenly nosedived to the bottom? 

4. How could ship design could be at least partly responsible for the loss of some vessels? 

5. Share with the class the meaning of these terms:

draft
scale
model
hull

bulkheads
center of gravity
pitch
roll
Topic 2: Storm Tracking

Answer the following questions based on your maps:

1. In what direction was the storm moving? (Note the movement of the low pressure center) ____________

2. Do the winds around a low pressure center blow clockwise or counter-clockwise? ________________

   Toward or away from the center? ____________________________________________________________

   Are wind speeds greater or less as they get closer to the low pressure center? ________________

3. On weather maps 1-4, check the station models for coastal weather and mid-lake weather. Which areas — coastal or mid-lake — had higher wind and waves? ________________________________________

4. Which areas had higher wind and waves, island areas or mid-lake areas? ______________________

5. Which side of the lake — Canadian or U.S. — had more severe weather conditions? ___________

6. Did the Fitzgerald choose the best possible course in view of the weather conditions? ____________

   Draw a good course on the transparency provided.

7. Follow the instructions in the student guide.

Topic 3: Lake Bottom Characteristics

Read and follow procedures. Then answer questions below.

1. Are there other zeroes besides the lakeshore ones? _______ What is at Point-A? ________________

2. 9. Follow the procedure given.

Activity C: What Happened Aboard The Edmund Fitzgerald

After listening to the recording of Gordon Lightfoot’s “The Wreck of the Edmund Fitzgerald,” answer these questions:

1. How does the song make you feel? __________________________________________________________

   For each of the following things about the song, tell how it helps to produce this general feeling:

   A. the singer’s voice ____________________________________________________________

   B. the tempo (how fast the song is) _________________________________________________

   C. the instruments being played _____________________________________________________

   D. sounds in the background ________________________________________________________

   E. the words (list words or phrases that help create the feeling) ______________________

2. The song reports that “At 7 p.m. a main hatch-way caved in.” On a separate piece of paper, write a one-page description of what you might have witnessed and felt aboard the ship as it sank.