

# On the Trail of the Hudson's Migratory Fish

*Students will practice addition and subtraction skills by tracking the movements of migratory fish of the Hudson River estuary.*

**Objectives:** Students will solve word problems that require them to:

- add and subtract using data from tagged fish to calculate distance traveled, elapsed time, and growth;
- understand the life cycle of anadromous fish.

**Grade level:** Elementary (Grades 3-5)

**Subject Area:** Math, Social Studies (Geography), Science

**New York State Learning Standards:**

Mathematics, Science, & Technology Standards 3, 4

**Skills:**

- Use whole numbers to identify locations and measure distances.
- Add and subtract whole numbers.
- Apply mathematics in real world settings.
- Reason mathematically.

**Duration:**

Preparation time: 5 minutes

Activity time: 45 minutes

**Materials:** Each student should have:

- Worksheet: On the Trail of the Hudson's Migratory Fish
- Calendar (to determine number of days in each month)
- Hudson River Miles map
- Pencil
- If available, a wall map showing the Hudson and the eastern coast of North America is very helpful for in-class discussion.



## Background:

Scientists attach numbered tags to fish to track their travels and growth. Anglers who catch tagged fish contact the scientists using information on the tags. The data they provide can be used to determine how far and how fast fish travel and how quickly they grow.

Striped bass, Atlantic sturgeon, and American shad are born in the freshwater part of the Hudson but eventually swim out into the Atlantic Ocean. They spend most of their adult lives at sea, returning to the river only to spawn (lay eggs). We think of them as "our" fish, but their visit here is just one piece of their long-distance migrations. Fishes with this life cycle (living in the ocean but entering fresh water to spawn) are called anadromous fishes.

Distances on the Hudson are often measured in Hudson River Miles. Hudson River Miles start at the southern tip of Manhattan. This spot, called The Battery, is River Mile 0. The estuary part of the Hudson ends at the Federal Dam in Troy at River Mile 153.

## Activity:

1. In preparation for this lesson, have students do the Readings in Hudson River Natural History lesson titled "Atlantic Sturgeon of the Hudson River."
2. Discuss the concept of migration and the anadromous life cycle of many Hudson River fish.
3. Introduce the Hudson River Miles system; show students the Hudson River Miles map.
4. Go over the worksheet with the class or hand out as an in-class or homework assignment.
5. Some questions require students to add distance between a point upriver and New York to distance between New York and another site along the coast. A U.S. map is helpful here.

## Assessment:

- Have students share answers to questions from worksheets, or collect and grade sheets.
- Make up similar elapsed time/distance/growth problems for quiz.
- Extension: Have students cut out two small paper tags of different colors to represent fish - one for when it was tagged, the other for when it was recaptured. Paste each to the Hudson River Miles map or map of the Atlantic Coast in the appropriate spot.

## Vocabulary:

**anadromous:** lives in salt water but migrates back to freshwater to spawn

**angler:** a person who fishes with hook and line

**data:** pieces of information

**fresh water:** water that is not salty (rainwater is freshwater)

**Hudson River miles:** distance measured north from the Battery at Manhattan's southern tip

**migration:** animals' movement from one place to another

**recapture:** to capture again

**scientist:** a person skilled in science

**sonic tag:** tags that, when attached to fish, send signals heard by underwater microphones

**spawn:** to lay eggs; usually refers to animals that live in water

## Resources:

The Hudson River Foundation's striped bass tagging program posts results at <http://www.hudsonriver.org/sb/> Illustrations and information about the fish described in this activity can be found on the New York State Department of Environmental Conservation website at <http://www.dec.ny.gov/animals/269.html>



## On the Trail of the Hudson's Migratory Fish: ANSWER KEY

### On the Trail of the Hudson's Migratory Fish

Many Hudson River fish are **anadromous**. This means that they are born in **fresh water**, travel to the ocean to grow up, and then return to the Hudson to **spawn** (lay their eggs).

**Scientists** attach numbered tags to fish to study **migration** and growth. When a tagged fish is caught, the lucky **angler** uses an address or phone number on the tag to report where and when the fish was caught and how big it was.

You will use real scientific **data** from tagged fish to find out how far fish travel and how much they grow. Show your work as you answer the questions below.



*The tag on this striped bass is a thin plastic strip. It is inserted through the skin, much like the way people get*  
← *body piercings.*

*The tagged fish is then released back into the water.*



1. Striped bass #388381 was 16 inches long when tagged near the Statue of Liberty in November 1996. When caught near Seaside Park, New Jersey, in November 2001 it was 26 inches long.

(a) How many years had gone by since this bass was tagged? 5 years

$$\begin{array}{r} 2001 \\ - 1996 \\ \hline 5 \text{ years} \end{array}$$

(b) How much had it grown from 1996 to 2001?

$$\begin{array}{r} 26 \\ - 16 \\ \hline 10 \text{ inches} \end{array}$$

10 inches



2. Striped bass #289667 was tagged on September 16, 1992, at Danskammer Point on the Hudson, 67 miles north of the Battery in Manhattan. This fish was **recaptured** near the Statue of Liberty, 2 miles south of the Battery, on September 27, 1992.

(a) How many miles had it traveled since September 16? ***\_69 miles\_***

$$\begin{array}{r} 67 \\ - 0 \\ \hline 67 \text{ miles} \end{array} \qquad \begin{array}{r} 67 \\ + 2 \\ \hline 69 \text{ miles} \end{array}$$

(b) How many days did it take the bass to travel from Danskammer Point to the Statue of Liberty? ***\_11 days\_***

$$\begin{array}{r} 27 \\ - 16 \\ \hline 11 \text{ days} \end{array}$$

3. Striped bass #32057 was tagged on May 31, 1989 on the Hudson near Kingston, 90 miles north of New York City. It was caught on September 30, 1989 off Nova Scotia, Canada, 850 miles northeast of New York City.

(a) How many miles had the bass swum since being tagged? ***\_940 miles\_***

$$\begin{array}{r} 90 \\ - 0 \\ \hline 90 \text{ miles} \end{array} \qquad \begin{array}{r} 90 \\ + 850 \\ \hline 940 \text{ miles} \end{array}$$

(b) How many months had gone by? ***\_4 months\_***

$$\begin{array}{r} 9 \\ - 5 \\ \hline 4 \text{ months} \end{array}$$

4. American shad #12640 was tagged on April 9, 2001, near Cape May, New Jersey, 161 miles south of New York City. It was caught on May 6, 2001, in the Hudson near Selkirk, at **Hudson River Mile 136**.

(a) How many miles had it traveled since April 9? ***\_297 miles\_***

$$\begin{array}{r} 136 \\ - 0 \\ \hline 136 \text{ miles} \end{array} \qquad \begin{array}{r} 161 \\ + 136 \\ \hline 297 \text{ miles} \end{array}$$

(b) How many days had gone by? ***\_27 days\_***

$$\begin{array}{r} \text{April has 30 days} \\ - 9 \\ \hline 21 \text{ days} \end{array} \qquad \begin{array}{r} 21 \\ + 6 \text{ days in May} \\ \hline 27 \text{ days} \end{array}$$



5. In June 2004 at Kingston, an Atlantic sturgeon received tag #16709 plus a **sonic tag**. Sonic tags send a signal heard by underwater microphones. Scientists followed the signal as the fish swam south that summer. They last heard its signal in Haverstraw Bay, Hudson River Mile 40, in October.

In January 2005 this sturgeon was recaptured near Matapeake, Maryland, 180 miles up the Chesapeake Bay. The entrance to the Chesapeake is 310 miles south of New York City.

*People pierce their ears to hang earrings. The same idea is used to attach tags on an Atlantic sturgeon.*



(a) How many miles did this sturgeon travel from Haverstraw Bay to New York City?

$$\begin{array}{r} 40 \\ - 0 \\ \hline 40 \text{ miles} \end{array}$$

(b) How many miles did this fish travel from New York City to the entrance of the Chesapeake Bay?

**310 miles**

(c) How many miles did the sturgeon travel from the entrance of Chesapeake Bay to Matapeake?

**180 miles**

(d) In total, how many miles did this fish swim from Haverstraw Bay to Matapeake?

$$\begin{array}{r} 40 \\ 310 \\ + 180 \\ \hline 530 \text{ miles} \end{array}$$



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## On the Trail of the Hudson's Migratory Fish

Many Hudson River fish are **anadromous**. This means that they are born in fresh water, travel to the ocean to grow up, and then return to the Hudson to **spawn** (lay their eggs).

**Scientists** attach numbered tags to fish to study **migration** and growth. When a tagged fish is caught, the lucky **angler** uses an address or phone number on the tag to report where and when the fish was caught and how big it was.

You will use real scientific **data** from tagged fish to find out how far fish travel and how much they grow. Show your work as you answer the questions below.



*The tag on this striped bass is a thin plastic strip. It is inserted through the skin, much like the way people get*  
← *body piercings.*

*The tagged fish is then released back into the water.*



1. Striped bass #388381 was 16 inches long when tagged near the Statue of Liberty in November 1996. When caught near Seaside Park, New Jersey, in November 2001 it was 26 inches long.

(a) How many years had gone by since this bass was tagged? \_\_\_\_\_ years

(b) How much had it grown from 1996 to 2001? \_\_\_\_\_ inches



2. Striped bass #289667 was tagged on September 16, 1992, at Danskammer Point on the Hudson, 67 miles north of the Battery in Manhattan. This fish was **recaptured** near the Statue of Liberty, 2 miles south of the Battery, on September 27, 1992.

(a) How many miles had it traveled since September 16? \_\_\_\_\_ miles

(b) How many days did it take the bass to travel from Danskammer Point to the Statue of Liberty?

\_\_\_\_\_ days

3. Striped bass #32057 was tagged on May 31, 1989 on the Hudson near Kingston, 90 miles north of New York City. It was caught on September 30, 1989 off Nova Scotia, Canada, 850 miles northeast of New York City.

(a) How many miles had the bass swum since being tagged? \_\_\_\_\_ miles

(b) How many months had gone by? \_\_\_\_\_ months

4. American shad #12640 was tagged on April 9, 2001, near Cape May, New Jersey, 161 miles south of New York City. It was caught on May 6, 2001, in the Hudson near Selkirk, at **Hudson River Mile 136**.

(a) How many miles had it traveled since April 9? \_\_\_\_\_ miles

(b) How many days had gone by? \_\_\_\_\_ days



5. In June 2004 at Kingston, an Atlantic sturgeon received tag #16709 plus a **sonic tag**. Sonic tags send a signal heard by underwater microphones. Scientists followed the signal as the fish swam south that summer. They last heard its signal in Haverstraw Bay, Hudson River Mile 40, in October.

In January 2005 this sturgeon was recaptured near Matapeake, Maryland, 180 miles up the Chesapeake Bay. The entrance to the Chesapeake is 310 miles south of New York City.

*People pierce their ears to hang earrings. The same idea is used to attach tags on an Atlantic sturgeon.*



(a) How many miles did this sturgeon travel from Haverstraw Bay to New York City?

\_\_\_\_\_ miles

(b) How many miles did this fish travel from New York City to the entrance of the Chesapeake Bay?

\_\_\_\_\_ miles

(c) How many miles did the sturgeon travel from the entrance of Chesapeake Bay to Matapeake?

\_\_\_\_\_ miles

(d) In total, how many miles did this fish swim from Haverstraw Bay to Matapeake?

\_\_\_\_\_ miles



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# On the Trail of the Blue Crab

*Students will practice subtraction skills by tracking the movements of blue crabs in the Hudson River estuary.*

**Objectives:** Students will solve word problems that require them to:

- subtract using data from tagged crabs to calculate distance traveled and elapsed time;
- understand that blue crabs migrate.

**Grade level:** Elementary (Grades 3-5)

**Subject Area:** Math, Social Studies (Geography), Science

**New York State Learning Standards:**

Mathematics, Science, & Technology Standards 3, 4

**Skills:**

- Use whole numbers to identify locations and measure distances.
- Subtract two digit whole numbers.
- Apply mathematics in real world settings.
- Reason mathematically.

**Duration:**

Preparation time: 5 minutes

Activity time: 40 minutes

**Materials:** Each student should have:

- Worksheet: On the Trail of the Blue Claw Crab
- Hudson River Miles map
- Pencil



## Background:

The blue crab's life cycle involves migration between regions of high and low salinity in estuaries. This migration is aided by back legs, shaped like paddles, that enable the animal to swim rapidly. To track crab migration, scientists attach numbered tags to blue crabs. People who catch tagged crabs contact the scientists using a phone number on the tags. The data they provide adds to knowledge of how far and how fast the crabs migrate.

Also called blue claw crabs, these crustaceans are born in the saltiest parts of the estuary around New York Harbor. They then migrate upriver into less salty areas of the Hudson which serve as nurseries, providing plenty of food and shelter from predators. Male crabs tend to go further north than females, entering fresh water and sometimes reaching the Federal Dam at Troy. Females stay downriver, closer to the high salinities that their eggs will need to develop properly. As winter approaches, blue crabs move back downriver to New York Harbor.

Distances on the Hudson are often measured in Hudson River Miles. Hudson River Miles start at the southern tip of Manhattan. This spot, called The Battery, is River Mile 0. The estuary part of the Hudson ends at the dam in Troy at River Mile 153. Only two digit milepoints are used in this lesson, though blue crabs do travel more than 100 miles upstream.

## Activity:

1. In preparation for this lesson, have students do the Readings in Hudson River Natural History lesson titled "Blue Claw!"
2. Discuss the concept of migration and how it fits into the blue crab's life cycle.
3. Introduce the Hudson River Miles system; show students the Hudson River Miles map.
4. Go over the worksheet with the class or hand out as an in-class or homework assignment.

## Assessment:

- Have students share answers to questions from worksheets, or collect and grade sheets.
- Make up similar elapsed time/distance problems for quiz.

## Vocabulary:

**estuary:** a body of water in which fresh and salt water meet

**fresh water:** water that is not salty like ocean water (rainwater is freshwater)

**Hudson River miles:** distance measured north from the Battery at Manhattan's southern tip

**life cycle:** the stages of form and activity

through which a living thing passes as it develops from a beginning stage to an adult able to reproduce and restart the cycle

**migrate:** animals moving from one place to another

**recapture:** to capture again

**scientist:** a person skilled in science

## Resources:

There are many websites about blue crabs, among them "Blue Crab Info" at <http://www.bluecrab.info/> . While much of the research and information available on crabs focuses on the Chesapeake Bay, a brochure and technical reports about Hudson River crabs are available from DEC at <http://www.dec.ny.gov/animals/6953.html> .



## On the Trail of the Blue Crab: ANSWER KEY

### On the Trail of the Blue Crab



The blue crab lives in **estuaries** like the Hudson River. In its **life cycle**, this animal **migrates** between very salty water and less salty water. Sometimes blue crabs even swim into **fresh water**.



**Scientists** attach numbered tags to blue crabs to learn about crab migrations. A phone number is printed on each tag. A lucky person who catches a tagged crab can call to report where and when the crab was caught.

Use the Hudson River Miles map to answer the questions below. They use information about crabs tagged in 2005. Show your work.

1. A blue crab with tag #1328 was released on September 14 near Newburgh at **Hudson River Mile** (abbreviated HRM) 56. This crab was **recaptured** on September 23 at HRM 36 near Haverstraw.

(a) How many days did this crab take to swim from Newburgh to Haverstraw?  
$$\begin{array}{r} 23 \\ - 14 \\ \hline 9 \end{array}$$
*9 days*

(b) How many miles did the crab travel?  
$$\begin{array}{r} 56 \\ - 36 \\ \hline 20 \end{array}$$
*20 miles*

(c) Using the Hudson River Miles map, tell which direction the crab traveled on its journey from Newburgh to Haverstraw. *south*



2. On August 10, a crab with tag #1527 was released near the Beacon-Newburgh Bridge at HRM 63. It was recaptured on August 19 at HRM 74 near Poughkeepsie.

(a) How long did it take this crab to go from HRM 63 to HRM 74?  $19$   
 $\underline{\text{9 days}}$   $\underline{- 10}$   
 $9 \text{ days}$

(b) How many miles did the crab travel?

$\underline{\text{11 miles}}$   $74$   
 $\underline{- 63}$   
 $11 \text{ miles}$

(c) In what direction did this crab travel?  $\underline{\text{north}}$

3. Blue crab #1872 was tagged and released on August 17 near Newburgh at HRM 56. It was recaptured on August 24 near Poughkeepsie at HRM 73.

(a) How much time went by from when the crab was tagged to when it was recaptured?

$24$   
 $\underline{\text{7 days}}$   $\underline{- 17}$   
 $7 \text{ days}$

(b) How many miles did the crab travel?

$\underline{\text{17 miles}}$   $73$   
 $\underline{- 56}$   
 $17 \text{ miles}$

(c) In what direction did this crab swim?  $\underline{\text{north}}$

4. Blue crab #450 was tagged and released near the Beacon-Newburgh Bridge at HRM 63 on June 20. On June 26 it was recaptured near Croton at HRM 35.

(a) How long did it take this crab to travel from HRM 63 to HRM 35?

$26$   
 $\underline{\text{6 days}}$   $\underline{- 20}$   
 $6 \text{ days}$

(b) How many miles did the crab travel?

$63$   
 $\underline{\text{28 miles}}$   $\underline{- 35}$   
 $28 \text{ miles}$

(c) In what direction did it swim?  $\underline{\text{south}}$



**5. Challenge question:** Imagine that you caught blue crab #450 again one year later. Do you think it would still have its tag? Why or why not? *Hint: How do crabs grow?*

***The crab would probably not have its tag. It grows by shedding its shell and along with it the tag.***



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## On the Trail of the Blue Crab



The blue crab lives in **estuaries** like the Hudson River. In its **life cycle**, this animal **migrates** between very salty water and less salty water. Sometimes blue crabs even swim into **fresh water**.



**Scientists** attach numbered tags to blue crabs to learn about crab migrations. A phone number is printed on each tag. A lucky person who catches a tagged crab can call to report where and when the crab was caught.

Use the Hudson River Miles map to answer the questions below. They use information about crabs tagged in 2005. Show your work.

1. A blue crab with tag #1328 was released on September 14 near Newburgh at **Hudson River Mile** (abbreviated HRM) 56. This crab was **recaptured** on September 23 at HRM 36 near Haverstraw.

(a) How many days did this crab take to swim from Newburgh to Haverstraw? \_\_\_\_\_ days

(b) How many miles did the crab travel?  
\_\_\_\_\_ miles

(c) Using the Hudson River Miles map, tell which direction the crab traveled on its journey from Newburgh to Haverstraw. \_\_\_\_\_



2. On August 10, a crab with tag #1527 was released near the Beacon-Newburgh Bridge at HRM 63. It was recaptured on August 19 at HRM 74 near Poughkeepsie.

(a) How long did it take this crab to go from HRM 63 to HRM 74?  
\_\_\_\_\_ days

(b) How many miles did the crab travel?  
\_\_\_\_\_ miles

(c) In what direction did this crab travel? \_\_\_\_\_

3. Blue crab #1872 was tagged and released on August 17 near Newburgh at HRM 56. It was recaptured on August 24 near Poughkeepsie at HRM 73.

(a) How much time went by from when the crab was tagged to when it was recaptured?  
\_\_\_\_\_ days

(b) How many miles did the crab travel?  
\_\_\_\_\_ miles

(c) In what direction did this crab swim? \_\_\_\_\_

4. Blue crab #450 was tagged and released near the Beacon-Newburgh Bridge at HRM 63 on June 20. On June 26 it was recaptured near Croton at HRM 35.

(a) How long did it take this crab to travel from HRM 63 to HRM 35?  
\_\_\_\_\_ days

(b) How many miles did the crab travel?  
\_\_\_\_\_ miles

(c) In what direction did it swim? \_\_\_\_\_



Name \_\_\_\_\_ Date \_\_\_\_\_

**5. Challenge question:** Imagine that you caught blue crab #450 again one year later. Do you think it would still have its tag? Why or why not? *Hint: How do crabs grow?*



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# Tracking the Salt Front

*Students will use Hudson River salinity data to practice math skills as they track movements of the salt front in response to storms and other weather events.*

**Objectives:** Students will solve word problems that require them to:

- understand interactions between salt water entering the river from the sea and fresh water entering the river from its watershed;
- interpret data displayed in graphs and on maps;
- add and subtract river mile data to track salt front movements.

**Grade level:** Elementary (Grades 3-5)

**Subject Area:** Math, Science

**New York State Learning Standards:**

Mathematics, Science, & Technology Standards 3, 4

**Skills:**

- Use graphs and maps to see patterns and relationships observed in the physical environment.
- Use whole numbers to identify locations and measure distances.
- Add and subtract whole numbers.
- Apply mathematics in real world settings.
- Reason mathematically.

**Duration:**

Preparation time: 5 minutes

Activity time: 1 hour (about 30 minutes for each worksheet)

**Materials:** Each student should have:

- Worksheet: Tracking the Salt Front
- Worksheet: Salt Front Math
- Hudson River Miles map
- Pencil



## Background:

The lower Hudson is an estuary, where fresh water from the river's watershed and salt water from the Atlantic Ocean meet and mix. Seawater entering the Hudson is diluted by fresh water; its leading edge—the salt front—is where the concentration of chlorides (mostly sodium chloride, like table salt) reaches 100 milligrams per liter (mg/L). Its location depends on freshwater runoff from the watershed. After heavy rains, runoff pushes the salt front seaward. As runoff lessens in dry spells, seawater pushes further upriver. The salt front usually ranges between Newburgh and the Tappan Zee Bridge. Droughts may allow it to reach Poughkeepsie; major rainstorms may force the front downriver to Manhattan. Tidal currents have minor impacts on salt front location, moving it a few miles up or down the river on each tide cycle. The front's location is given in Hudson River Miles (HRM), starting at the southern tip of Manhattan. This spot, called The Battery, is HRM 0. Ocean tides influence the Hudson north to the Federal Dam at Troy (HRM 153).

## Activity:

1. In preparation for this lesson, have students do the ELA lesson titled "From the Mountains to the Sea."
2. Discuss the concepts of estuary and salt front.
3. Introduce the Hudson River Miles system; show students the Hudson River Miles map.
4. Do "Tracking the Salt Front" worksheet in class; assign "Salt Front Math" as homework.

## Assessment:

- Have students share answers to questions from worksheets, or collect and grade sheets.
- Make up similar problems for quiz.

## Vocabulary:

**current:** water moving continuously in a certain direction

**dilute:** to lessen the amount of a substance dissolved in a liquid by adding more liquid

**downriver:** towards a stream's mouth

**estuary:** a body of water in which fresh and salt water meet

**flood:** a large flow of water that rises above and spreads out past a stream's banks

**fresh water:** water that is not salty (rainwater is freshwater)

**Hudson River miles:** distance measured north

from the Battery at Manhattan's southern tip

**salt front:** the leading edge of seawater entering an estuary

**salt water:** seawater or other water that contains salt

**scientist:** a person skilled in science

**seawater:** salty ocean water

**upriver:** towards a stream's source

**watershed:** the area of land from which water drains into a body of water

**tides:** the alternate rising and falling of the surface of the ocean

## Resources:

[http://ny.water.usgs.gov/projects/dialer\\_plots/saltfront.html](http://ny.water.usgs.gov/projects/dialer_plots/saltfront.html) The U.S. Geological Survey Hudson River Salt Front website has tables and a map showing the front's location plus real-time data on water temperature, tide stage, and conductivity (a salinity indicator) from Hastings on Hudson, West Point, Poughkeepsie, and Albany (no conductivity data here).



# Tracking the Salt Front: ANSWER KEY

## Tracking the Salt Front

The lower portion of the Hudson River is an **estuary**. Here **fresh water** flowing down the river meets **salt water** pushing in from the Atlantic Ocean. The leading edge of ocean water entering the estuary is called the **salt front**.

After heavy rains, lots of fresh water runs into the Hudson. It presses against the salty **seawater**, moving the salt front south down the river and closer to the ocean. In periods of dry weather, less fresh water enters the estuary. Ocean water pushes further north up the Hudson, moving the salt front inland.

**Scientists** track the salt front using **Hudson River Miles**, abbreviated HRM. Hudson River Miles start at the southern tip of Manhattan in New York City. This spot, called The Battery, is HRM 0. The George Washington Bridge is at HRM 12, the city of Kingston at HRM 91. Ocean tides reach the Federal Dam in Troy at HRM 153.

Using the graph "Hudson River Salt Front: Average Location by Month" and the map of Hudson River Miles, answer the questions below.

1. (a) In what month is the salt front closest to New York City? **April**

(b) In that month, where is the salt front located in Hudson River Miles?  
Hudson River Mile **37**

(c) On your Hudson River Miles map, mark this location with the numeral 1.

What is the nearest town? **Haverstraw**

2. (a) In what month is the salt front furthest north up the Hudson? **Sept**

(b) In that month, where is it located in Hudson River Miles?  
Hudson River Mile **66**

On your Hudson River Miles map, mark this location with the numeral 2.

(c) What two towns are closest to it? **Newburgh** **Beacon**



3. On your Hudson River Miles map, what is the distance between the salt front's location at numeral 1 and its location at numeral 2? 29 miles

$$\begin{array}{r} 66 \\ - 37 \\ \hline 29 \text{ miles} \end{array}$$

The graph you just studied gives the average location of the salt front in each month. However, the salt front can move many miles over several weeks—even in a single day—depending on weather. Use the graph **Hudson River Salt Front Location: June 20 to July 10, 2006** to answer the questions below.

4. (a) Where was the salt front located (in Hudson River Miles) on June 26?  
Hudson River Mile 48

Mark this spot on your Hudson River Miles map and label it June 26.

(b) Where was it on July 2? Hudson River Mile 9

Mark this spot on your Hudson River Miles map and label it July 2.

(c) How many miles apart are these two locations? 39 miles

$$\begin{array}{r} 48 \\ - 9 \\ \hline 39 \text{ miles} \end{array}$$

5. What do you think caused the salt front to move down the river between June 26 and July 2? Support your answer with evidence from the text above.  
***Heavy rains caused lots of fresh water to run into the Hudson where it pushed the salty seawater south, closer to the ocean.***

6. (a) During the period shown by this graph, when did the salt front make its biggest move from one day to the next? July 2 to July 3

(b) How far did it move? 18 miles

$$\begin{array}{r} 27 \\ - 9 \\ \hline 18 \text{ miles} \end{array}$$

(c) Did it move **upriver** (north) or **downriver** (south)? upriver (north)



## Salt Front Math: ANSWER KEY

### Salt Front Math

*Heavy rains in the Hudson's watershed may cause **floods** along streams that flow into the estuary. How might these rains affect the salt front?*



In the Hudson River estuary, fresh water flowing from the Hudson's watershed meets seawater pushing in from the Atlantic Ocean. The fresh water **dilutes** the incoming salt water, but scientists can detect the leading edge of this ocean water—the salt front.

The salt front moves up and down the Hudson depending on how much fresh water is flowing off the watershed. This usually means that the salt front is closest to the ocean in spring, when there's lots of rain and snow is melting. The front moves upriver in the drier weather of summer and early fall. However, extreme weather events—major storms, for example—can upset this pattern.

This worksheet explores how weather and other factors control the salt front's location. Use the Hudson River Miles map to help answer the questions.

Example: On March 28, 2005, the salt front was at Hudson River Mile (HRM) 62. On your Hudson River Miles map, this is near Newburgh. A heavy rain began that day and lasted overnight. Three days later the salt front was at HRM 31. How many miles did the front move? Did it move downriver towards the ocean or upriver towards the dam at Troy?

$$\begin{array}{r} \text{HRM } 62 \\ - \text{HRM } 31 \\ \hline \end{array}$$

31 miles downriver towards the ocean



1. Spring 2002 was rainy. In early June, the salt front was at HRM 32. Then the rain stopped, and the weather stayed dry into fall. By September 10, 2002, the salt front had pushed north 49 miles.

(a) What was the Hudson River Mile location of the front on September 10?

$$\begin{array}{r} 32 \\ + 49 \\ \hline 81 \text{ miles} \end{array} \qquad \underline{\text{81 miles}}$$

(b) On September 10, the salt front was closest to which town on your Hudson River Miles map?

Poughkeepsie

2. On December 5, 2003, a foot of snow fell on the Hudson Valley. Five days later, a big rain storm hit the valley. As the rain began, the salt front was at HRM 62. The rain melted the snow, sending lots of fresh water into the Hudson. By December 13, the salt front was at HRM 40.

(a) How many miles did the salt front move because of the rain? 22 miles

$$\begin{array}{r} 62 \\ - 40 \\ \hline 22 \text{ miles} \end{array}$$

(b) Did the salt front move downriver (south) towards the ocean or upriver (north) towards the dam at Troy? downriver (south)

3. Native Americans called the Hudson "The River That Flows Both Ways." About every six hours, tides make the river current reverse direction. This affects the salt front. On January 8, 2005, at 12:00 noon the salt front was near West Point at HRM 52. At 6:00 PM, the front was near the Bear Mountain Bridge at HRM 47. How many miles and in what direction did the salt front move between 12:00 noon and 6:00 pm? 5 miles downriver (south)

$$\begin{array}{r} 52 \\ - 47 \\ \hline 5 \text{ miles} \end{array}$$

Challenge questions:

At which time - 12:00 noon or 6:00 PM - was the tide high? At which time was it low? tide high at 12 noon, low at 6 PM

Later on, at midnight, would the salt front be closer to West Point or the Bear Mountain Bridge? Why? at midnight, salt front near West Point because current reverses direction and flows upriver between 6 P.M. and midnight



## Tracking the Salt Front

The lower portion of the Hudson River is an **estuary**. Here **fresh water** flowing down the river meets **salt water** pushing in from the Atlantic Ocean. The leading edge of ocean water entering the estuary is called the **salt front**.

After heavy rains, lots of fresh water runs into the Hudson. It presses against the salty **seawater**, moving the salt front south down the river and closer to the ocean. In periods of dry weather, less fresh water enters the estuary. Ocean water pushes further north up the Hudson, moving the salt front inland.

**Scientists** track the salt front using **Hudson River Miles**, abbreviated HRM. Hudson River Miles start at the southern tip of Manhattan in New York City. This spot, called The Battery, is HRM 0. The George Washington Bridge is at HRM 12, the city of Kingston at HRM 91. Ocean tides reach the Federal Dam in Troy at HRM 153.

Using the graph "Hudson River Salt Front: Average Location by Month" and the map of Hudson River Miles, answer the questions below.

1. (a) In what month is the salt front closest to New York City? \_\_\_\_\_

(b) In that month, where is the salt front located in Hudson River Miles?

Hudson River Mile \_\_\_\_\_

(c) On your Hudson River Miles map, mark this location with the numeral 1.

What is the nearest town? \_\_\_\_\_

2. (a) In what month is the salt front furthest north up the Hudson? \_\_\_\_\_

(b) In that month, where is it located in Hudson River Miles?

Hudson River Mile \_\_\_\_\_

On your Hudson River Miles map, mark this location with the numeral 2.

(c) What two towns are closest to it? \_\_\_\_\_



3. On your Hudson River Miles map, what is the distance between the salt front's location at numeral 1 and its location at numeral 2? \_\_\_\_\_ miles

The graph you just studied gives the average location of the salt front in each month. However, the salt front can move many miles over several weeks—even in a single day—depending on weather. Use the graph **Hudson River Salt Front Location: June 20 to July 10, 2006** to answer the questions below.

4. (a) Where was the salt front located (in Hudson River Miles) on June 26?

Hudson River Mile \_\_\_\_\_

Mark this spot on your Hudson River Miles map and label it June 26.

(b) Where was it on July 2?

Hudson River Mile \_\_\_\_\_

Mark this spot on your Hudson River Miles map and label it July 2.

(c) How many miles apart are these two locations? \_\_\_\_\_ miles

5. What do you think caused the salt front to move down the river between June 26 and July 2? Support your answer with evidence from the text above.

6. (a) During the period shown by this graph, when did the salt front make its biggest move from one day to the next? \_\_\_\_\_

(b) How far did it move? \_\_\_\_\_ miles

(c) Did it move **upriver** (north) or **downriver** (south)? \_\_\_\_\_



## Salt Front Math

*Heavy rains in the Hudson's watershed may cause **floods** along streams that flow into the estuary. How might these rains affect the salt front?*



In the Hudson River estuary, fresh water flowing from the Hudson's watershed meets seawater pushing in from the Atlantic Ocean. The fresh water **dilutes** the incoming salt water, but scientists can detect the leading edge of this ocean water—the salt front.

The salt front moves up and down the Hudson depending on how much fresh water is flowing off the watershed. This usually means that the salt front is closest to the ocean in spring, when there's lots of rain and snow is melting. The front moves upriver in the drier weather of summer and early fall. However, extreme weather events—major storms, for example—can upset this pattern.

This worksheet explores how weather and other factors control the salt front's location. Use the Hudson River Miles map to help answer the questions.

Example: On March 28, 2005, the salt front was at Hudson River Mile (HRM) 62. On your Hudson River Miles map, this is near Newburgh. A heavy rain began that day and lasted overnight. Three days later the salt front was at HRM 31. How many miles did the front move? Did it move downriver towards the ocean or upriver towards the dam at Troy?

$$\begin{array}{r} \text{HRM } 62 \\ - \text{HRM } 31 \\ \hline \end{array}$$

31 miles downriver towards the ocean



1. Spring 2002 was rainy. In early June, the salt front was at HRM 32. Then the rain stopped, and the weather stayed dry into fall. By September 10, 2002, the salt front had pushed north 49 miles.

(a) What was the Hudson River Mile location of the front on September 10?  
HRM \_\_\_\_\_

(b) On September 10, the salt front was closest to which town on your Hudson River Miles map?  
\_\_\_\_\_

2. On December 5, 2003, a foot of snow fell on the Hudson Valley. Five days later, a big rain storm hit the valley. As the rain began, the salt front was at HRM 62. The rain melted the snow, sending lots of fresh water into the Hudson. By December 13, the salt front was at HRM 40.

(a) How many miles did the salt front move because of the rain? \_\_\_\_\_ miles

(b) Did the salt front move downriver (south) towards the ocean or upriver (north) towards the dam at Troy? \_\_\_\_\_

3. Native Americans called the Hudson "The River That Flows Both Ways." About every six hours, **tides** make the river **current** reverse direction. This affects the salt front. On January 8, 2005, at 12:00 noon the salt front was near West Point at HRM 52. At 6:00 PM, the front was near the Bear Mountain Bridge at HRM 47. How many miles did the salt front move between 12:00 noon and 6:00 pm? \_\_\_\_\_ miles

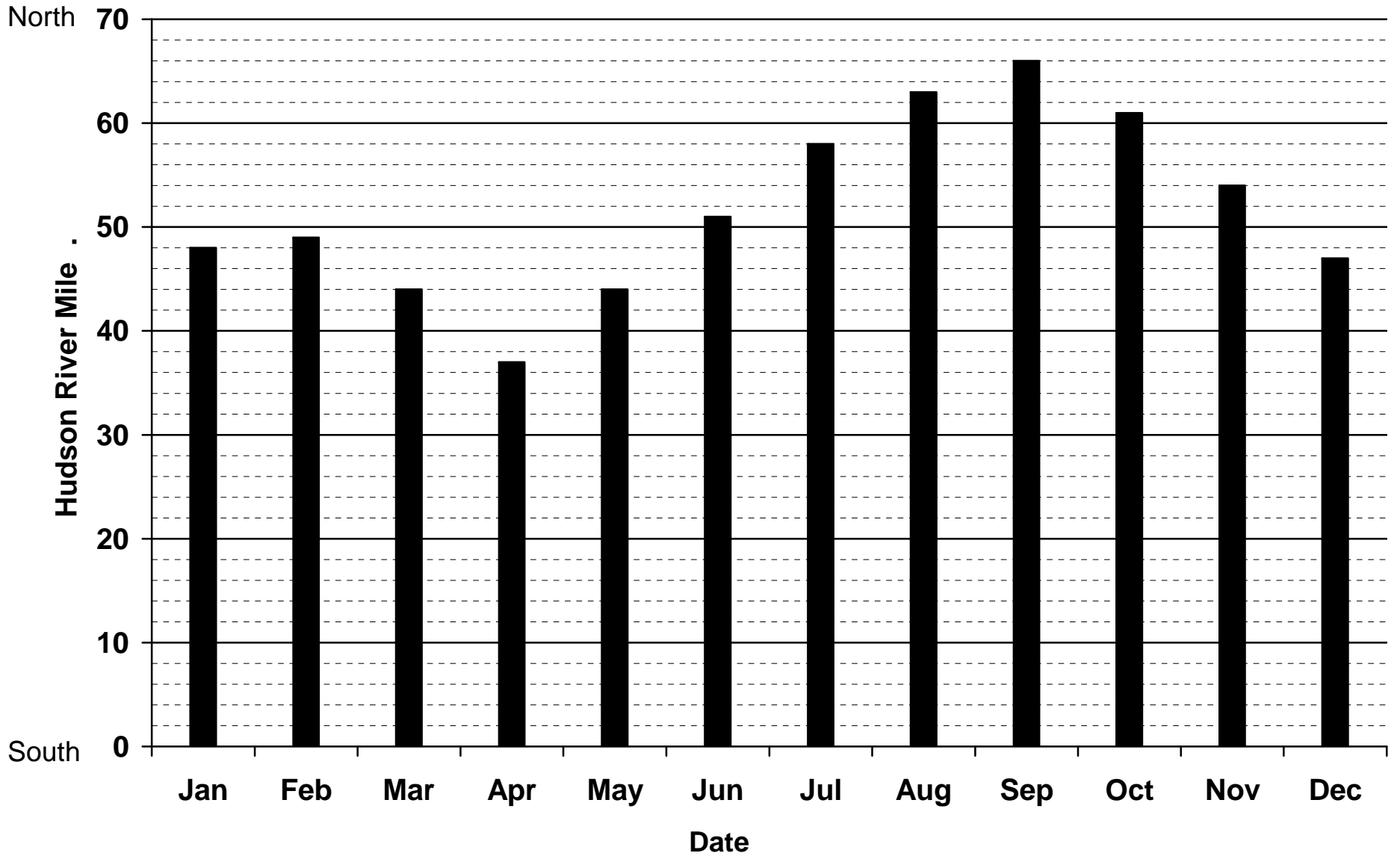
**Challenge questions:**

At which time - 12:00 noon or 6:00 PM - was the tide high? At which time was it low?

Later on, at midnight, would the salt front be closer to West Point or the Bear Mountain Bridge? Why?

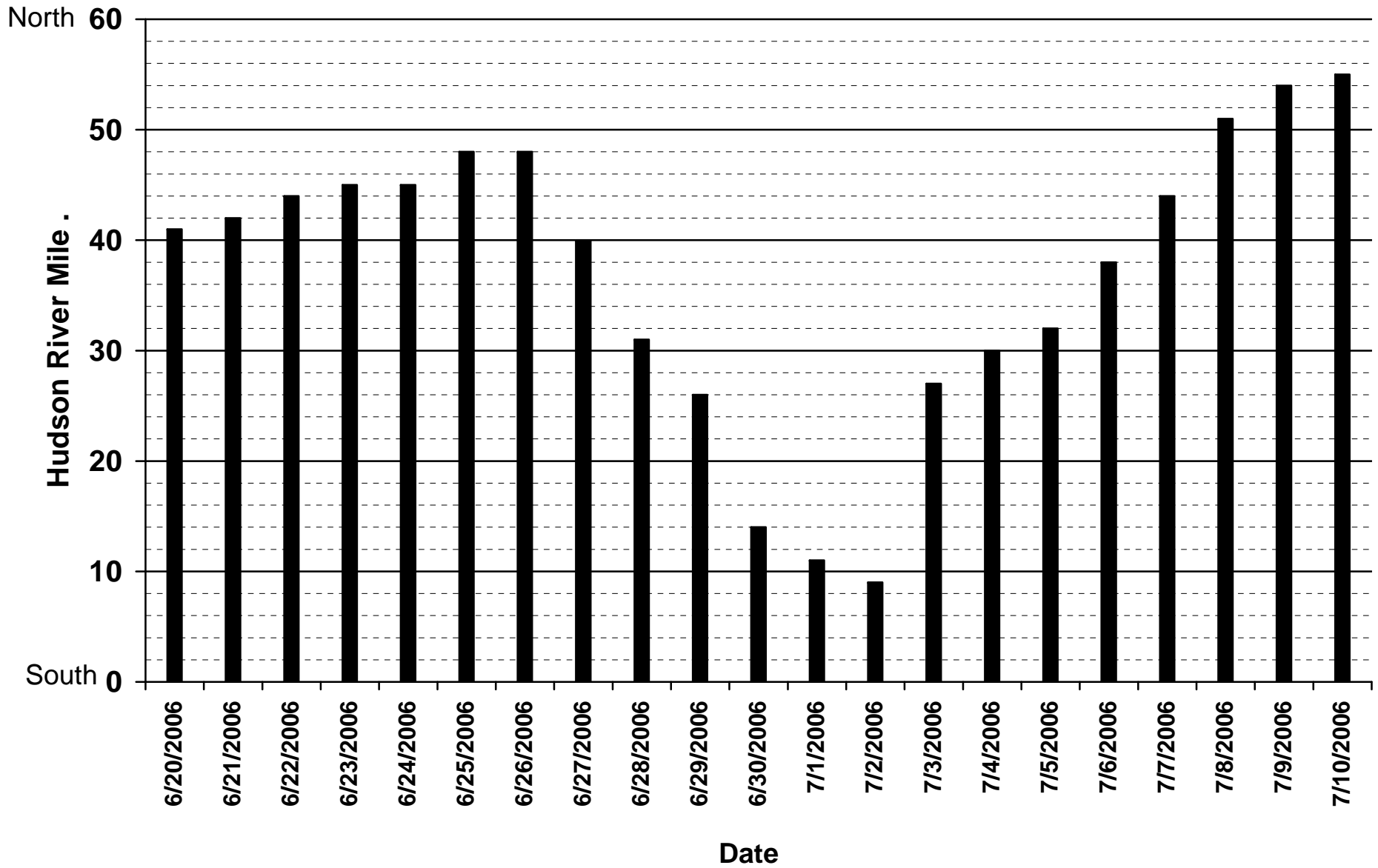


# Hudson River Salt Front: Average Location by Month



Source: U.S. Geological Survey data for 1992-2001

# Hudson River Salt Front Location: June 20 - July 10, 2006



Source: U.S. Geological Survey

# Add & Subtract with Hudson River Shipping

*Students will practice addition and subtraction skills by tracking the movements of ships, tugboats, and barges on the Hudson River estuary.*

**Objectives:** Students will solve word problems that require them to:

- read and interpret data from a table;
- add and subtract to calculate distances traveled by vessels on the Hudson;
- add and subtract using hours and minutes to determine elapsed time required by vessels to move between river milepoints.

**Grade level:** Elementary (Grades 3-5)

**Subject Area:** Math, Social Studies (Geography)

**New York State Learning Standards:**

Mathematics, Science, & Technology Standards 1, 2, 3  
Social Studies Standard 3

**Skills:**

- Interpret data from a table.
- Use whole numbers to identify locations and measure distances.
- Add and subtract whole numbers.
- Apply mathematics in real world settings.
- Reason mathematically.

**Duration:**

Preparation time: 5 minutes

Activity time: 30 minutes

**Materials:** Each student should have:

- Worksheet: Add & Subtract with Hudson River Shipping
- Hudson River Miles map
- Pencil



## Background:

The Hudson River is a major shipping route for oil, grain, cement, and road salt. A small unit of any of these products has little worth; transporting huge loads by water minimizes shipping costs. By volume and value, petroleum products are the most important cargoes on the river; tanker barges are the most common commercial vessels. Ships carry gypsum to wallboard factories in Rensselaer, Verplanck, and Haverstraw. Road salt also arrives by ship. Powdered cement goes downriver in barges. Stone quarried in Ulster, Dutchess, and Rockland Counties is pushed downriver in scows (barges without a deck over their cargo area).

The Port of Albany is the destination of many vessels seen on the Hudson. Scrap metal is shipped in and out of Albany, as is wood pulp. Heavy equipment leaves the port on heavy lift vessels. Containers are barged between Albany and New York Harbor. Food products are also carried on ships. Grain goes in and out of Albany while cocoa beans and molasses come in from points south. Raw sugar is barged from Florida to a refinery in Yonkers.

Distances on the Hudson are often measured in Hudson River Miles. Hudson River Miles start at the southern tip of Manhattan. This spot, called The Battery, is River Mile 0. The estuary part of the Hudson ends at the Federal Dam in Troy at River Mile 153.

## Activity:

1. Introduce the Hudson River Miles system; show students the Hudson River Miles map.
2. Discuss the kinds of ships and cargoes seen on the Hudson.
3. Go over the worksheet with the class, or assign as in-class work or homework.

## Assessment:

- Have students share answers to questions from worksheet, or collect and grade sheets.
- Make up similar elapsed time/distance problems for quiz.

## Vocabulary:

**barge:** a wide, flat-bottomed boat that is pushed or towed by other boats to transport goods

**factory:** a building or set of buildings with machinery for making products

**gypsum:** a colorless mineral that consists of calcium sulfate occurring in crystals or masses

**Hudson River miles:** distance measured north from the Battery at Manhattan's southern tip

**tugboat:** a strongly built, powerful boat used to tow or push other vessels

**vessel:** a boat, ship, or other craft used for travel on water

**wallboard:** a building material made in large stiff sheets to form interior walls and ceilings; often called sheetrock

## Resources:

Photos and dimensions of the barges described in this activity, as well as many tugboats commonly seen on the Hudson, can be viewed at the websites of the Bouchard Transportation Company <http://www.bouchardtransport.com/HomePage.htm> and the Reinauer Transportation Company <http://www.reinauer.com/RTCWeb/DesktopDefault.aspx?tabindex=4&tabid=3>.



# Add & Subtract with Hudson River Shipping: ANSWER KEY

## Add & Subtract with Hudson River Shipping

On October 6, 2004, students recorded information about vessels they saw on the river. Use this table of their observations to answer the questions below.

		Vessels: Time Seen/Direction of Travel			
		<i>Gypsum Baron</i>	<i>Bouchard B#35</i>	<i>Alice Oldendorff</i>	<i>RTC 120</i>
Hudson River Miles/Town	HRM 124/Stuyvesant		11:30 AM/south	1:02 PM/south	
	HRM 115/Athens			1:35 PM/south	9:00 AM/south
	HRM 97/Ulster				10:30 AM/south
	HRM 87/Esopus				11:17 AM/south
	HRM 61/Beacon		4:45 PM/south		
	HRM 18/Yonkers	9:45 AM/south			
	HRM 7/Manhattan	10:45 AM/anchored			



*The Alice Oldendorff passes Stuyvesant (photo by Doug Reed)*

1. The ship *Alice Oldendorff*, 633 feet long, carries road salt and gypsum.

(a) How long did the *Alice Oldendorff* take to go from Stuyvesant to Athens?

$$\begin{array}{r} \underline{\text{33 minutes}} \\ 1:35 \\ - 1:02 \\ \hline 0 \text{ hours } 33 \text{ minutes} \end{array}$$

(b) How many miles did the *Alice Oldendorff* travel between those two points?

$$\begin{array}{r} \underline{\text{9 miles}} \\ 124 \\ - 115 \\ \hline 9 \text{ miles} \end{array}$$



2. The *Gypsum Baron*, 495 feet long, carries gypsum to **wallboard factories** on the Hudson at Haverstraw, Buchanan, and Rensselaer.

(a) How many miles did *Gypsum Baron* travel from Yonkers south to Manhattan?

$$\begin{array}{r} \underline{\mathbf{11 \text{ miles}}} \\ 18 \\ - 7 \\ \hline 11 \text{ miles} \end{array}$$

(b) How long did it take *Gypsum Baron* to make the trip?

$$\begin{array}{r} \underline{\mathbf{1 \text{ hour}}} \\ 10:45 \\ - 9:45 \\ \hline 1 \text{ hour} \quad 0 \text{ minutes} \end{array} \quad \begin{array}{r} 10 \text{ hours} \quad 45 \text{ minutes} \\ - 9 \text{ hours} \quad 45 \text{ minutes} \\ \hline 1 \text{ hour} \quad 0 \text{ minutes} \end{array}$$

(c) Using your answers from (a) and (b), how fast was the *Gypsum Baron* going in miles per hour? **11 miles per hour**



*A tugboat pushes the RTC 120 past Poughkeepsie. The barge is empty, so it floats high in the water.*

3. The tanker **barge** *RTC 120*, 405 feet long, carries oil. Tugboats push or pull the barge through the water.

(a) How long (in hours and minutes) did it take *RTC 120* to go from Athens to Ulster?

$$\begin{array}{r} \underline{\mathbf{1 \text{ hour}, 30 \text{ minutes}}} \\ 10:30 \\ - 9:00 \\ \hline 1 \text{ hour} \quad 30 \text{ minutes} \end{array} \quad \begin{array}{r} 10 \text{ hours} \quad 30 \text{ minutes} \\ - 9 \text{ hours} \quad 0 \text{ minutes} \\ \hline 1 \text{ hour} \quad 30 \text{ minutes} \end{array}$$

(b) How long did it take *RTC 120* to go from Ulster to Esopus? **47 minutes**

$$\begin{array}{r} 11:30 \\ - 10:30 \\ \hline 1 \text{ hour} \quad 0 \text{ minutes} \\ - 10 \text{ hours} \quad 30 \text{ minutes} \\ \hline 47 \text{ minutes} \end{array} \quad \begin{array}{r} 10 \text{ hrs} + (60 + 17) \text{ min} \\ 10 \text{ hours} \quad 77 \text{ minutes} \\ - 10 \text{ hours} \quad 30 \text{ minutes} \\ \hline 47 \text{ minutes} \end{array}$$

(c) How many miles did *RTC 120* travel between Athens and Esopus?

$$\begin{array}{r} \underline{\mathbf{28 \text{ miles}}} \\ 115 \\ - 87 \\ \hline 28 \text{ miles} \end{array}$$



4. The tanker barge *Bouchard B#35*, 338 feet long, also carries oil.

(a) A football field is 300 feet long from one goal line to the other. Is the *Bouchard B#35* longer than a football field? no **X**yes

How much longer? **38 feet**

$$\begin{array}{r} 338 \\ - 300 \\ \hline 38 \text{ feet} \end{array}$$

(b) How long did it take *Bouchard B#35* to go from Stuyvesant to Beacon?

**5 hours, 15 minutes**

4:45 PM	16 hours 45 minutes
<u>-11:30 AM</u>	<u>-11 hours 30 minutes</u>
	5 hours 15 minutes

(c) How many miles did *Bouchard B#35* travel between the two places?

**63 miles**

$$\begin{array}{r} 124 \\ - 61 \\ \hline 63 \text{ miles} \end{array}$$


*A tugboat brings a tanker barge to an oil tank farm in Troy. Since the barge is loaded with oil, it floats low in the water.*



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## Add & Subtract with Hudson River Shipping

On October 6, 2004, students recorded information about **vessels** they saw on the river. Use this table of their observations to answer the questions below.

		Vessels: Time Seen/Direction of Travel			
		<i>Gypsum Baron</i>	<i>Bouchard B#35</i>	<i>Alice Oldendorff</i>	<i>RTC 120</i>
Hudson River Miles/Town	HRM 124/Stuyvesant		11:30 AM/south	1:02 PM/south	
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	HRM 87/Esopus				11:17 AM/south
	HRM 61/Beacon		4:45 PM/south		
	HRM 18/Yonkers	9:45 AM/south			
	HRM 7/Manhattan	10:45 AM/anchored			



*The Alice Oldendorff passes Stuyvesant (photo by Doug Reed)*

1. The ship *Alice Oldendorff*, 633 feet long, carries road salt and **gypsum**.

(a) How long did the *Alice Oldendorff* take to go from Stuyvesant to Athens?

\_\_\_\_\_

(b) How many miles did the *Alice Oldendorff* travel between those two points?

\_\_\_\_\_ miles



2. The *Gypsum Baron*, 495 feet long, carries gypsum to **wallboard factories** on the Hudson at Haverstraw, Buchanan, and Rensselaer.

(a) How many miles did *Gypsum Baron* travel from Yonkers south to Manhattan?  
\_\_\_\_\_ miles

(b) How long did it take *Gypsum Baron* to make the trip?  
\_\_\_\_\_

(c) Using your answers from (a) and (b), how fast was the *Gypsum Baron* going in miles per hour? \_\_\_\_\_ miles per hour



*A tugboat pushes the RTC 120 past Poughkeepsie. The barge is empty, so it floats high in the water.*

3. The tanker **barge** *RTC 120*, 405 feet long, carries oil. Tugboats push or pull the barge through the water.

(a) How long (in hours and minutes) did it take *RTC 120* to go from Athens to Ulster? \_\_\_\_\_

(b) How long did it take *RTC 120* to go from Ulster to Esopus? \_\_\_\_\_

(c) How many miles did *RTC 120* travel between Athens and Esopus?  
\_\_\_\_\_ miles



4. The tanker barge *Bouchard B#35*, 338 feet long, also carries oil.

(a) A football field is 300 feet long from one goal line to the other. Is the *Bouchard B#35* longer than a football field? \_\_\_\_no \_\_\_\_yes  
How much longer? \_\_\_\_\_ feet

(b) How long did it take *Bouchard B#35* to go from Stuyvesant to Beacon?  
\_\_\_\_\_

(c) How many miles did *Bouchard B#35* travel between the two places?  
\_\_\_\_\_ miles



*A tugboat brings a tanker barge to an oil tank farm in Troy.  
Since the barge is loaded with oil, it floats low in the water.*



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# Big Boats Up The River

DRAFT

*Students will practice addition skills using information about ships visiting the Port of Albany on the Hudson River estuary.*

**Objectives:** Students will solve problems that require them to:

- read and interpret data from a table;
- add strings of single digit numbers to compare use of the Port of Albany by different vessels;
- recognize that ships play a role in transportation and commerce in the Hudson Valley.

**Grade level:** Elementary (Grades 2-3)

**Subject Area:** Math, Social Studies (Geography)

**New York State Learning Standards:**

Mathematics, Science, & Technology Standards 1, 2, 3  
Social Studies Standard 3

**Skills:**

- Interpret data from a table.
- Add using single digit whole numbers.
- Apply mathematics in real world settings.
- Reason mathematically.

**Duration:**

Preparation time: 5 minutes

Activity time: 20 minutes

**Materials:** Each student should have:

- Worksheet: Big Boats Up The River
- Pencil



## Background:

The Port of Albany is the destination of many vessels seen on the Hudson. The largest grain export elevator east of the Mississippi loads ships with grain brought to Albany by rail. A few loads of molasses come in each year, to be mixed with grain to produce feed for livestock. Road salt also arrives by ship. Scrap metal is shipped out of Albany, as is wood pulp. Heavy equipment - windmill blades, generators, and turbines - enters and leaves the port on heavy lift vessels. Containers are barged between Albany and New York Harbor.

While oil is not included in data on cargoes handled at the Port of Albany (the tank farms located in the area are privately owned), gasoline, heating oil, jet fuel, and other petroleum products are - by volume and value - the most important cargoes on the Hudson River. Tankers and tanker barges bring oil to Albany, and carry ethanol, brought in by rail, to refineries elsewhere in the Northeast, where it is blended into gasoline. Likewise not included in the port data are the frequent shipments of gypsum brought by ship to a wallboard (sheetrock) factory in Rensselaer, across from Albany.

## Activity:

1. Discuss the kinds of ships and cargoes seen on the Hudson.
2. Go over the worksheet with the class, or assign as in-class work or homework.

## Assessment:

- Have students share answers to questions from worksheet, or collect and grade sheets.
- Use other data from the table to make up similar problems for quiz.

## Vocabulary:

**cargo:** the goods or materials carried on a ship

**dock:** (verb) to guide a ship onto a pier or wharf; (noun) a platform for unloading ships

**estuary:** a body of water in which fresh and salt water meet

**grain:** seeds from grass-like plants such as corn and wheat; used to make flour

**grain elevator:** buildings used to store grain and transfer it to and from boats, railroad cars, or trucks

**machinery:** sets of parts connected in ways that transmit force to do work

**molasses:** a thick, dark syrup made from raw sugar

**port:** a harbor area where ships load and unload cargo

## Resources:

Information about the Port of Albany is available at the Albany Port District Commission's website <http://www.portofalbany.com>.

Line drawings and descriptions of types of ships seen on the Hudson and New York Harbor can be viewed at [http://www.worldtraderef.com/WTR\\_site/cargo\\_vessels.asp](http://www.worldtraderef.com/WTR_site/cargo_vessels.asp)



## Big Boats Up The River: ANSWER KEY

This table shows the numbers of ships that docked at the Port of Albany from January to June, 2008. It also shows what cargoes they carried, including the grain, scrap iron, and heavy lift cargoes mentioned above. The molasses brought to Albany is mixed with grain to make food for farm animals. The salt is the kind spread on roads during snow and ice storms. Steel and pipe are used in construction projects. Wood pulp is the raw material from which most paper is made. Use the table to answer the questions below.

**Ships Docking at the Port of Albany, January to June 2008**

		Month					
		January	February	March	April	May	June
<b>Cargo</b>	grain	3		1		1	1
	heavy lift	2		1	7	2	4
	molasses			1			
	salt		1				
	scrap iron	1		1	1	1	1
	steel/pipe			3		2	2
	wood pulp	1	1	1		2	1

1. In what month did the greatest number of heavy lift ships dock at Albany?  
How many docked at Albany in that month? April     7

2. In what month did the greatest number of ships dock at Albany? June  
How many docked in Albany in that month? 9  
 $1 + 4 + 1 + 2 + 1 = 9$

3. In what month did the smallest number of ships dock at Albany? **February**  
How many docked in Albany in that month? 2  
 $1 + 1 = 2$

4. How many times did ships carrying steel or pipe dock at Albany during these six months? 7  
 $3 + 2 + 2 = 7$

5. Which cargo was carried in and out of the Port of Albany most often?  
heavy lift How many times? 16  
 $2 + 1 + 7 + 2 + 4 = 16$



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## Big Boats Up The River

### DRAFT

If you spend a few days along the Hudson River **estuary**, then you are likely to see some very big ships pass by.

Ships up to 750 feet long travel to and from the **Port** of Albany. They carry many different kinds of **cargo**.



This ship is being loaded with **grain**. Behind the ship is a building called a **grain elevator**. The grain stored in this building is brought to Albany from western states by railroad trains.

These are stacks of huge blades for windmills. The windmills will make electricity. The ships that carry these blades and other large **machinery** are called heavy lift ships.



**Scrap iron** is shipped from Albany. The rusted iron from wrecked cars, broken washing machines, and other items can be recycled to make new metal.



This table shows the numbers of ships that **docked** at the Port of Albany from January to June, 2008. It also shows what cargoes they carried, including the grain, scrap iron, and heavy lift cargoes mentioned above.

The **molasses** brought to Albany is mixed with grain to make food for farm animals. The salt is the kind spread on roads during snow and ice storms. Steel and pipe are used in construction projects. Wood pulp is the raw material from which most paper is made. Use the table to answer the questions below.

### Ships Docking at the Port of Albany, January to June 2008

		Month					
		January	February	March	April	May	June
Cargo	grain	3		1		1	1
	heavy lift	2		1	7	2	4
	molasses			1			
	salt		1				
	scrap iron	1		1	1	1	1
	steel/pipe			3		2	2
	wood pulp	1	1	1		2	1

- In what month did the greatest number of heavy lift ships dock at Albany?  
How many docked at Albany in that month? \_\_\_\_\_
- In what month did the greatest number of ships dock at Albany? \_\_\_\_\_  
How many docked in Albany in that month? \_\_\_\_\_
- In what month did the smallest number of ships dock at Albany? \_\_\_\_\_  
How many docked in Albany in that month? \_\_\_\_\_
- How many times did ships carrying steel or pipe dock at Albany during these six months? \_\_\_\_\_
- Which cargo was carried in and out of the Port of Albany most often?  
\_\_\_\_\_ How many times? \_\_\_\_\_



# Tens! Hundreds!! Thousands!!! of Tons

**DRAFT**

*Students will practice mathematics skills using information about ships visiting the Port of Albany on the Hudson River.*

**Objectives:** Students will solve problems that require them to:

- read and interpret data from a table;
- use estimation in finding solutions involving large numbers;
- compute average loads of ships docking in Albany;
- recognize that ships play a role in transportation and commerce in the Hudson Valley.

**Grade level:** Elementary (Grade 5)

**Subject Area:** Math, Social Studies (Geography)

**New York State Learning Standards:**

Mathematics, Science, & Technology Standards 1, 2, 3  
Social Studies Standard 3

**Skills:**

- Interpret data from tables.
- Use rounding and estimation to find reasonable answers.
- Calculate the mean for a given set of data.
- Apply mathematics in real world settings.
- Reason mathematically.

**Duration:**

Preparation time: 5 minutes

Activity time: 30 minutes

**Materials:** Each student should have:

- Worksheet: Tens! Hundreds!! Thousands!!! Of Tons
- Pencil
- Calculator



## Background:

The Hudson River is a major shipping route for oil, grain, cement, and other commodities. A small unit of any of these products has little worth; transporting huge loads by water minimizes shipping costs.

The Port of Albany is the destination of many vessels seen on the Hudson. The largest grain export elevator east of the Mississippi loads ships with grain brought to Albany by rail. Molasses brought to the port is mixed with grain to produce feed for livestock. Road salt also arrives by ship, as does wood pulp. Scrap metal is shipped out of Albany. Heavy equipment - windmill blades, generators, and turbines - enters and leaves the port on heavy lift vessels.

While oil is not included in data on cargoes handled at the Port of Albany (the tank farms located in the area are privately owned), gasoline, heating oil, jet fuel, and other petroleum products are - by volume and value - the most important cargoes on the Hudson River. Tankers and tanker barges bring oil to Albany, and carry ethanol, brought in by rail, to refineries elsewhere in the Northeast, where it is blended into gasoline. Also not included in the data are the frequent shiploads of gypsum brought to a wallboard (sheetrock) factory in Rensselaer, across from Albany.

## Activity:

1. Discuss the kinds of ships and cargoes seen on the Hudson.
2. As needed, review skills (estimating; calculating means) required to answer the questions.
3. Point out that some questions require gleaning data from more than one table.
4. Go over the worksheet with the class, or assign as in-class work or homework.

## Assessment:

- Have students share answers to questions from worksheet, or collect and grade sheets.
- Use other data from the table to make up similar problems for quiz.

## Vocabulary:

**bulk carrier:** a ship that carries large amounts of raw or minimally processed materials

**cargo:** the goods or materials carried on a ship

**generator:** a machine that produces electricity from mechanical energy

**machinery:** sets of parts connected in ways that transmit force to do work

**turbines:** an engine in which water, air, or other liquids or gases rotate a shaft

## Resources:

Information about the Port of Albany is available at the Albany Port District Commission's website <http://www.portofalbany.com>.

Line drawings and descriptions of types of ships seen on the Hudson and New York Harbor can be viewed at [http://www.worldtraderef.com/WTR\\_site/cargo\\_vessels.asp](http://www.worldtraderef.com/WTR_site/cargo_vessels.asp)



## Tens! Hundreds!! Thousands!!! Of Tons: ANSWER KEY

1. For each of the cargoes listed below, write whether it is unloaded at Albany, loaded at Albany, or both.

grain loaded heavy lift loaded & unloaded

molasses unloaded salt unloaded

scrap iron loaded steel/pipe unloaded

wood pulp unloaded

2. To fill in the blanks below, estimate using information in Tables 1 and 2.

steel/pipe More tons of this cargo were unloaded in Albany than of any other cargo unloaded there from January to June.

grain More tons of this cargo were loaded at Albany than of any other cargo loaded from January to June.

January More tons of cargo were loaded at Albany in this month than in any other month in this time period.

3. Use data from the three tables to answer the following questions. Write each question out in numerical form, then answer it using a calculator.

(a) How big was the average load of grain loaded at Albany in January?

$$63,519 \text{ (from Table 2)} \div 3 \text{ (from Table 3)} = 21,173 \text{ tons}$$

(b) How big was the average load of scrap iron loaded at Albany between January and June, 2008?

$$(22,014 + 27,180 + 20,561 + 15,101 + 17,509) \div 5 = 20,473 \text{ tons}$$

(c) From January to June 2008, what was the average load per month of wood pulp unloaded at the Port of Albany?

$$(2,930 + 3,400 + 2,187 + 7,283 + 3,280) \div 6 = 3,180 \text{ tons}$$

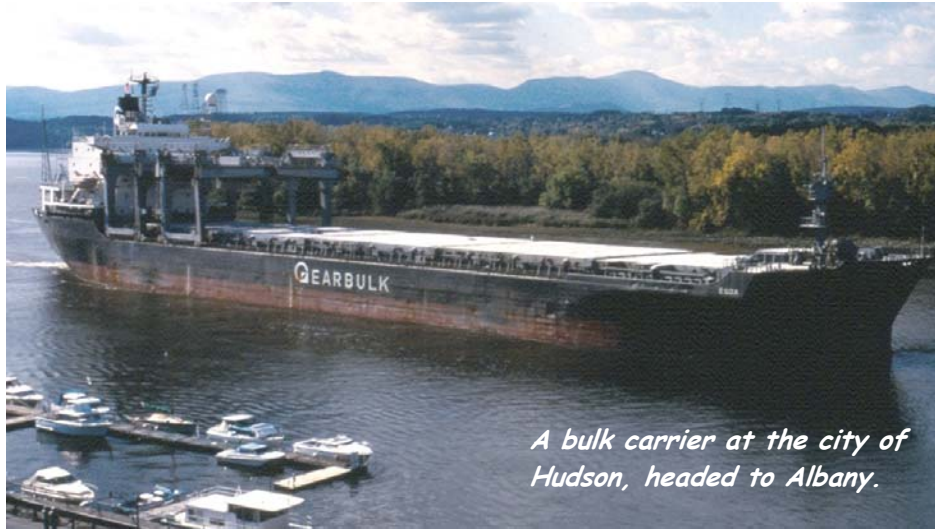
(d) Assuming that salt is worth \$70 per ton, what was the value of the salt unloaded at Albany in February?

$$34,532 \times 70 = \$2,417,240$$



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## Tens! Hundreds!! Thousands!!! of Tons DRAFT



Many of the big ships that travel to and from the Port of Albany are **bulk carriers**. They carry huge loads of loose material such as wheat. Such **cargo** is not valuable in small amounts. Only by transporting large amounts can the ships make money.

An example is the salt used to melt winter's ice and snow from sidewalks and roads. A shovelful of salt from your town's salt pile is worth only a few cents. Your highway department buys it by the ton (2,000 pounds), perhaps paying \$70 for each ton. Ten tons would cost \$700; one hundred tons would cost \$7,000.

Now \$7,000 may seem like a lot of money. But think about the costs of operating a large ship. The owners must pay for fuel, crew, repairs, and much more. They also must pay back loans for the millions of dollars that it costs to build a big ship. It helps to haul as much cargo as possible.

So how much salt could one bulk carrier bring to Albany? It would not be unusual for a ship to carry a cargo of 30,000 tons. At \$70 a ton, that salt would be worth \$2,100,000 - two million, one hundred thousand dollars!

On the other hand, the cargoes carried by heavy lift ships - **machinery** such as **turbines** and **generators** - are very valuable. As a result, these ships do not have to carry such large amounts of cargo to make money.



Table 1 below shows the types and amounts of cargo that were brought to Albany and unloaded from January to June, 2008. Table 2 shows the types and amounts of cargo loaded and shipped out from Albany in the same months. Table 3 shows the number of ships that docked in Albany. Use these tables to answer the questions on the next page.

### 1. Tons of Cargo Unloaded at Albany, January to June 2008

		Month					
		January	February	March	April	May	June
Cargo in tons	grain						
	heavy lift			2,862	4,675	1,245	2,302
	molasses			13,202			
	salt		34,532				
	scrap iron						
	steel/pipe	574	512	17,862	1,264	22,058	11,480
	wood pulp	2,930	3,400	2,187		7,283	3,280

### 2. Tons of Cargo Loaded at Albany, January to June 2008

		Month					
		January	February	March	April	May	June
Cargo in tons	grain	63,519		25,022		27,477	19,694
	heavy lift	1,247			6,687		3,334
	molasses						
	salt						
	scrap iron	22,014		27,180	20,561	15,101	17,509
	steel/pipe						
	wood pulp						

### 3. Ships Docking at the Port of Albany, January to June 2008

		Month					
		January	February	March	April	May	June
Cargo	grain	3		1		1	1
	heavy lift	2		1	7	2	4
	molasses			1			
	salt		1				
	scrap iron	1		1	1	1	1
	steel/pipe			3		2	2
	wood pulp	1	1	1		2	1



Name \_\_\_\_\_ Date \_\_\_\_\_

1. For each of the cargoes listed below, write whether it is unloaded at Albany, loaded at Albany, or both.

grain \_\_\_\_\_ heavy lift \_\_\_\_\_

molasses \_\_\_\_\_ salt \_\_\_\_\_

scrap iron \_\_\_\_\_ steel/pipe \_\_\_\_\_

wood pulp \_\_\_\_\_

2. To fill in the blanks below, estimate using information in Tables 1 and 2.

\_\_\_\_\_ More tons of this cargo were unloaded in Albany than of any other cargo unloaded there from January to June.

\_\_\_\_\_ More tons of this cargo were loaded at Albany than of any other cargo loaded there from January to June.

\_\_\_\_\_ More tons of cargo were loaded at Albany in this month than in any other month in this time period.

3. Use data from all the tables to answer the following questions. Write each question out in numerical form, then answer it using a calculator.

(a) How big was the average load of grain loaded at Albany in January?

(b) How big was the average load of scrap iron loaded at Albany between January and June, 2008?

(c) From January to June 2008, what was the average load per month of wood pulp unloaded at the Port of Albany?

(d) Assuming that salt is worth \$70 per ton, what was the value of the salt unloaded in Albany in February?

