

## **Snapshot Day Lesson Plan - Tracking the Salt Front**

**Summary:** Students will work with Hudson River salt front data from October 2004 – September 2005 to locate the high and low points of the salt front for each month, determine the range for each month, determine the modal range for each month, and discuss the physical “drivers” of this system.

**Objective:** Students will

- working with actual USGS salt front data locate the high point of the salt front for each month
- working with actual USGS salt front data locate the low point of the salt front for each month
- compute the salt front range for each month
- determine a modal range for each month
- explain the effects of seasonal weather patterns on the location of the salt front (spring freshet, spring rains, summer dry spells)

**Subject areas:** math, science

**Standards:** MST 4, MST 3, ELA

**Skills:** basic mathematical computations, computing mode, interpreting data, communicating

**Vocabulary:** salt front, watershed, estuary, tributaries, brackish, freshet, modal range,

**Estimated Duration:**

Preparation Time: 10 minutes

Activity Time: 30 minutes

**Materials:**

- One worksheet per student
- pencil
- calculator if desired

**Background:**

The Hudson River flows from the Adirondacks to the Atlantic Ocean, some 315 miles from one end to the other. The area that drains into the river is known as the Hudson River Watershed. The *watershed* drainage area covers over 12,500 square miles. This drainage area provides freshwater to the Hudson as snowmelt, groundwater and rain through its smaller streams known as *tributaries*. The lower 153 miles of the Hudson River is referred to as an *estuary*. An estuary is where freshwater from the watershed mixes with salt water from the ocean, creating water of moderate salinity referred to as *brackish*. For the Hudson the saltwater comes from the Atlantic. The leading edge of salt water pushing up from the estuary, measured as 100 mg/L of chloride concentrate, is called the

*salt front*, and is monitored daily by the US Geological Survey. The USGS monitors the front since there are communities along the river that use the river for their drinking water source. The southern most community using the Hudson for drinking water is Poughkeepsie (RM72). The salt front is controlled by the volumes of freshwater entering the estuary from the tributaries, pushing against the salt water moving in from the ocean. The first large spring snowmelt is referred to as the *freshet* and causes a large freshwater pulsing in the system.

**Activity:**

- Ask the students what type of water is in the Hudson River? (*depending on where you are it can be salty, fresh or brackish a mix of the two*)
- Explain that the Hudson River is an estuary (*where fresh water and salt water mix*)
- Ask the students what effects the movement of the salt front? (*Rain, snow melt*)
- Ask the students to hypothesize which months during the year would have the largest range in location of the salt front, and which would have the smallest range (*generally early spring rain and snow melt will cause the largest ranges, and hot dry summer months or early fall can have the least range*)
- Ask the students to hypothesize for each month where the **mode or modal range\*** will be for the salt front.
- Hand out the worksheet and have students complete questions.

\***modal range** – Because the salt front can vary between 1 or 2 river miles for much of the month it is often more meaningful to discuss the data in terms of **modal range** rather than a single digit **mode**. For the purposes of this exercise **modal range** will be determined as a 5 number span as follows:

<1	26-30	56-60
1-5	31-35	61-65
6-10	36-40	66-70
11-15	41-45	71-75
16-20	46-50	
21-25	51-55	

*Notes:*

*This data was obtained from the USGS website. There is no Snapshot Day data included in this chart as in 2004 our Snapshot Day was scheduled in Sept. and in 2005 it was scheduled in October, however, the activity encompasses the concepts and data focuses of the Annual Snapshot Day event. Additional note – salt front data is all provisional data and subject to correction and revision by the USGS.*

**Assessment:**

Answers:

**Computing highs and lows:**

- Have students share answers to the questions from the worksheet
- Have them explain what are the most significant single event contributors effecting the salt front in the river

- During what months would the USGS be most concerned about reviewing their salt front data and why? (August and September when the fresh water input is limited and the salt water has pushed further up the river.
- For question #3 the monthly low on the salt front is more dynamic given the variance in freshwater input pushing against the salt intrusion.
- If you wanted to validate why certain months have a greater range in the high and low reading on the salt front you could have your students check the rainfall data for your region to determine if there is a correlation.

### **Modal Range**

- Modal ranges are useful ways to look at the where the salt front had the longest residency in a given month. However, determining the modal ranges will not allow you to draw a comparison between month to month situations.

In **November '04** the salt front spent almost 50% of the days in the modal range (RM 56-60):

14 days in RM56-60,  
 11 days in RM 61-65  
 3 days in RM 51-55  
 2 days between RM 46-50

In **January '05** the salt front moved through nine separate ranges, hovering for 4 or 5 days in many of them and spending only 6 days in the modal range (RM 61-65):

6 days in RM 61-65  
 2 days in RM 56-60  
 4 days in RM 51-55  
 5 days in RM 46-50  
 5 days in RM 41-45  
 3 days in RM 36-40  
 3 days in RM 31-35  
 1 day in RM 26-30  
 2 days in RM 21-25

INCLUDED BELOW IS A GRAPH OF THE DATA IN THE ACTIVITY CHARTS

### **Data Source:**

USGS Hudson River salt front data

[http://ny.water.usgs.gov/projects/dialer\\_plots/saltfront.html](http://ny.water.usgs.gov/projects/dialer_plots/saltfront.html)

Please note that the lowest USGS gage is located at Hastings-on-Hudson, ~RM 22. Salt front data located below this point has been interpolated.

