

Snapshot Day Definitions & Activities

(Common terms & definitions, extended activities, with teacher guidance in red)

What is a Watershed? A watershed is the area of land whose water drains into a body of water, such as a river, lake, or sea. Rain that falls anywhere within a watershed will eventually drain into that body of water. Pollution anywhere within the watershed can potentially affect life anywhere downstream from it.

Extra Discussion Item: Did you know that there can be watersheds inside of watersheds - these are called sub-watersheds. Find out for your area what sub-watershed you are in. If you are in New York City, what is different about your "watershed"? **What is often referred to as the New York City Watershed is a created watershed based on service for drinking water. The DEP generally defines it as the Catskill and the Croton Watershed area.**

What is an Estuary? An estuary is the area of a river where it meets the sea. It is an area where salt water and fresh water mix.

Extra Discussion Item: The Hudson River Estuary is not defined only by the salt water and fresh water mixing. What other ways can an estuary be defined? **Estuaries can also be defined by the area of tidal influence. Tide is one force in the exchange between the fresh and saltwater systems, gravity is another. The salinity is the chemical and the tides are the physical components of an estuary.**

What does Lake Tear of the Clouds have to do with the Hudson River? Lake Tear of the Clouds is the source of the Hudson River. It is on Mount Marcy, and is the highest lake in New York State.

Extra Discussion Item: The Hudson River is a 'drowned river valley' created by glacier melt. Lake Tear of the Clouds is described as a small 'tarn' - or a bowl like mountain lake formed in a valley excavated by a glacier. How can this small tarn be the source of the great Hudson River? **All the water in the Hudson does not come from the "source". Many tributaries drain into the Hudson, as well as the Atlantic Ocean contributing saltwater.**

What causes the Tides? Tides are the daily rising and falling of the sea level. They are caused by the gravitational pull of the sun and the moon. In most places there are 2 high tides and two low tides every 24 hours.

Extra Discussion Item: Does high tide occur at the same time each day on the Hudson River? If it is high tide in the New York harbor is it high tide in Albany? **No tides are on a cycle of 24 hours and 50 minutes so they move each day by approximately an hour. Because of the length of the river it takes many hours for the tidal influence to move through the river. An ebb tide in the northern part of the estuary will have started almost nine hours earlier in the southern end of the estuary.**

What is Dissolved oxygen and why is it important? DO, or dissolved oxygen is the amount of oxygen gas that is found in water. It is usually measured in parts milligrams per liter (m/L) or per million (ppm). Aquatic organisms need DO to survive; if it gets low, these organisms begin to die off. The DO count of an aquatic ecosystem is an indicator of how healthy that water is. Oxygen gets into the water through photosynthesis, or by mixing of the water with air (as in wave activity).

Extra Discussion Item: There are several factors that can impact the amount of DO in the water including salinity, temperature, and the number of submerged aquatic plants. What impact does each of these items have on DO? **The higher the salinity and temperature the less DO the water is able to hold. Submerged plants will photosynthesize adding DO back into the system during the day.**

What is Turbidity? Turbidity is the cloudiness of water that is caused by small particles such as clay, plankton, and dirt that are suspended in it. The more turbid the water, the less light that can get through.

Extra Discussion Item: Turbidity can be considered a negative impact on a healthy water system, but in some instances it represents a positive measure. Can you explain when it would be considered positive?

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Turbidity is actually caused by several very positive things in the Hudson: phytoplankton and zooplankton living in the water column; detritus (or decaying plant and animal matter) which is a major piece in the Hudson River food chain and in its role as a spawning river; small pieces of sediment that move through the river as part of the natural geologic process of weathering (this process contributes to the building of marshes and other habitat for the biological community).

There are negative parts to turbidity as well for example: human caused sediment 'loading' caused by increases in sedimentation from land clearing and increases in impervious surfaces; sewage from combined sewage overflows in extreme rain events; algal blooms from increased nutrients from fertilizers etc. washing into the river.

What is Salinity? Salinity is a measure of the amount of salt in water. Ocean water has a high salinity.

Extra Discussion Item: What causes water to get less saline as it moves north into the estuary? The water mixes with the freshwater coming down from the tributaries and is diluted.

What are Phytoplankton? Microscopic aquatic organisms that float in the currents and carry out photosynthesis. They are the basis of most aquatic food chains.

Extra Discussion Item: Phytoplankton is extremely important to the Hudson River. Can you come up with a hypothesis (explanation) that would explain why?

Phytoplankton is incredibly important for two reasons: it is the primary food source for just about every animal that lives in the River; phytoplankton produces an enormous amount of oxygen, a necessary part of the river ecosystem.

How long is the Hudson River? The Hudson River is 315 miles long. It goes from Lake Tear of the Clouds in the Adirondack Mountains to New York City Harbor where it meets the Atlantic Ocean.

Extra Discussion Item: If the Hudson River is 315 miles long why is the estuary only half that long? Once the River meets the Troy Dam there is a large elevation change, and it loses its tidal influence. Without tides or salinity it is no longer considered an estuary.

What are Zooplankton? Microscopic aquatic organisms that float in the currents, and do NOT carry out photosynthesis.

Extra Discussion Item: If zooplankton don't carry out photosynthesis how do they survive?

Zooplankton are small animals and larvae that eat phytoplankton. Complete an aquatic food chain and see how both zooplankton and phytoplankton fit in.

What is "brackish water"? Brackish water is between the salinity of ocean water and fresh water. The lower portion of the Hudson River is brackish.

Extra Discussion Item: Brackish waters are highly productive areas, and are excellent fish nurseries, yet species diversity is often lower than rivers or the ocean. Can you 'hypothesize' why this would be?

While brackish waters are considered excellent nursery areas for several species of fish, it is a select group of fish that can tolerate the uncertain salinity ranges of brackish water. Examine our fish data for Snapshot Day and see if you can determine which fish are tolerant of brackish conditions by where they were found in the estuary (you will need to look at the salinity readings for the day to determine this).

What are Zebra mussels? Zebra mussels are aquatic animals that came, by mistake, to the United States in the 1980's. They have become invasive in many freshwater ecosystems of the US. They attach to any hard surface and eat both phytoplankton and zooplankton by filtering them out of the surrounding water. By eating large

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quantities of plankton (which are the basis of most aquatic food chains) zebra mussels starve the other organisms that are native to the area. Zebra mussels have not been found in salty environments to date.

Extra Discussion Item: Given the information provided above where would you expect to find zebra mussels in the Hudson River? What effect would you expect to find on the turbidity of the river where you find zebra mussels?

You would expect to find zebra mussels in the upper freshwater sections of the river where there are areas of erosion or hard substrate or shells or any other hard surface for them to attach to. You would expect turbidity to be low since the zebra mussels eat and filter enormous amounts of water each day. Looking at the Snapshot data can you determine where you might find zebra mussels?

What is photosynthesis? Using sun as a catalyst, photosynthesis is a process of converting light energy into food energy. It occurs in green plants and other organisms that contain chlorophyll. Photosynthesis involves 6 molecules of water plus 6 molecules of carbon dioxide recombining to form one molecule of sugar (or energy) and six molecules of oxygen.

Extra Discussion Item: Chlorophyll 'a' is green pigment found in all photosynthetic organisms that allows plants to conduct photosynthesis? During Snapshot Day we look at the amount of chlorophyll 'a' which we sampled as a proxy for productivity. Looking at a 24 hr. clock, when would you expect the highest amount of photosynthesis to take place?

During daylight hours, and especially at mid day when the sun is at its height.

What does pH measure? pH is a measure of how acidic or how alkaline a solution is. A pH scale goes from 0 to 14. Acidic solutions have a pH of below 7, alkaline (or basic) solutions have a pH of above 7, and neutral solutions have a pH of 7.

Extra Discussion Item: Some substances release hydrogen ions (H^+), or cause hydrogen ions to be formed when they dissolve in water, others release or create hydroxyl ions (H^-). The pH is the balance sheet of which one has the most present at any time. What are some items that affect the pH balance sheet in the Hudson River?

The river bottom bedrock (alkaline), seawater (alkaline), acid rain (acid), fish respiration (acid), photosynthesis (alkaline).

What is an invertebrate? An invertebrate is an animal that doesn't have a backbone. Crabs, insects, sponges, mussels, worms and crayfish are all examples of invertebrates.

Extra Discussion Item: The river's invertebrates can be classified by their habitat: Benthic (river bottom dwelling); and water column inhabitants. List some invertebrates of each type.

Benthics: aquatic worms, crabs, mollusks, aquatic insect larvae; **Water column:** zooplankton, jelly fish and comb jellies.

Water Chestnut (Trapa natans): *Trapa natans* is the scientific name for the water chestnut. It is an aquatic plant found in the Hudson River and also many other freshwater ecosystems in the northeast. It originally came from Eurasia and was brought to the United States in the late 1900's. It has become an invasive species here.

Extra Discussion Item: What makes something an invasive species? Are all introduced plants invasive species? Why or why not? What are some of the issues or concerns with Water Chestnut?

Invasive species are highly adaptable and have no natural predators in their new location, out competing native species. Not all introduced species are invasive. Water chestnut grows as a dense mat on top of the water blocking out the sun used for photosynthesis for any plants below. Water chestnut also respire into the air, therefore not adding oxygen back into the water system.

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Why do we study the movement of sediments in the Hudson: We study the deposition (collecting) and erosion (removal) of sediments in the river, as well their grain sizes. Where sediments collect or erode can influence what habitat is available for marine life, both plant and animal. Sediments also have surface areas where contaminants can attach. A river bottom composed of lots of small grain sized sediments has more surface areas to combine with contaminants than a river bottom composed of fewer larger grain sized sediments.

Extra Discussion Item: If contaminated sediments become buried by other sediments do we need to be concerned about them any longer? This is a question that is debated by educated adults. Sediments can be uncovered and redistributed through a variety of ways. Storms, dredging, repairs and renovations on piers & waterfront areas can cause re-exposure of once buried sediment. In addition worms and benthic inhabitants are known to process and re-suspend sediments.