Understanding Salinity
Introduction

Welcome to the Understanding Salinity learning module. This section provides information on the following topics:

- ☑ How salinity is defined and measured in numbers
- ☑ Why salinity is important
- ☑ Natural and human influences on salinity

After completing this module you should be able to perform the following:

- ☑ Define the term salinity
- ☑ Explain how salinity is measured in numbers
- ☑ List two reasons why salinity is important to aquatic life
- ☑ List some natural and human influences on salinity

To begin the module, click the **Next** button at the bottom right of the screen.

Understanding Salinity
What is salinity?

Salinity refers to the saltiness of seawater.

To be more specific, salinity is a measure of the concentration of dissolved salts in seawater—that is, the total amount of salts, in grams, dissolved in one kilogram of seawater.

Understanding Salinity
How is salinity measured in numbers?

Salinity is typically measured as a concentration of grams of salt per kilogram of water (g/kg). For example, the average concentration of salt in seawater is about 35 g/kg. In other words, there are 35 grams of salt dissolved in 1 kilogram of typical seawater.

This quantity is usually expressed as the measure of parts salt per thousand parts seawater (ppt or $^{0}/_{00}$). For example, 35 grams of salt dissolved in 1 kilogram of seawater is equal to 35 parts of salt dissolved in 1000 parts of seawater, or 35 ppt.

Understanding Salinity
Do all waters contain dissolved salts?

All natural waters, even freshwater lakes and rivers, contain dissolved salts at various concentrations. This is because dissolved salts originate primarily from the chemical and physical weathering of rocks and minerals contained in the Earth's crust. These weathered materials are dissolved by rainfall, which transports them to lakes, rivers, and oceans.

- ☑ Freshwater salinity < 0.5 ppt
- ☑ Estuarine salinity > 0.5 ppt and < 30.0 ppt
- ☑ Ocean salinity > 30.0 ppt

Understanding Salinity
Understanding the numbers

Which of the following statements is false?

A) Salinity is typically measured as a concentration of grams of salt per kilogram of water (g/kg).
B) Salinity is typically measured as a concentration of parts salt per thousand parts water (ppt).
C) 20 g/kg = 20 ppt
D) 20 g/kg = 40 ppt

The correct response is D!

Salinity is typically measured as a concentration of grams of salt per kilogram of water (g/kg). This quantity is equal to the measure of parts salt per thousand parts water (ppt). For example, 20 grams of salt per kilogram of water is equal to 20 parts salt per thousand parts water (that is, 20 g/kg = 20 ppt).

Understanding Salinity
The importance of salinity

Salinity influences where aquatic plants and animals can live and affects other aspects of water quality.

- ☑ Oysters in South Carolina are most prevalent in intertidal locations with a salinity concentration of 20 to 30 ppt.
- ☑ Dissolved oxygen concentrations decrease as salinity increases.

Understanding Salinity
Understanding the importance of salinity

Which of the following statements is true?

A) Salinity influences where aquatic plants and animals can live.
B) Salinity affects other aspects of water quality.
C) Neither A nor B
D) Both A and B

The correct response is D!

Salinity influences where aquatic plants and animals can live and affects other aspects of water quality as well.

Understanding Salinity
Influences on salinity

Salinity can be affected by both natural and human influences.

Natural influences:

- ☑ Freshwater flow
- ☑ Tidal stage
- ☑ Stratification of estuarine waters
- ☑ Rainfall

Human influences:

- ☑ Dams and river diversions
- ☑ Land development
- ☑ Wastewater discharges

Understanding Salinity
Natural influences on salinity (freshwater flow)

The salinity of an estuary is influenced by the amount of freshwater that flows into it from rivers and streams. The more freshwater flow an estuary receives, the lower its salinity.

The amount of freshwater flow an estuary receives is influenced by a number of factors including size of the watershed that drains into the estuary, rainfall within that watershed, and tidal stage.

- ☑ Freshwater flow typically increases as watershed size increases.
- ☑ Freshwater flow increases during heavy rainfall periods and decreases during periods of drought.
- ☑ Freshwater flow increases as tides fall and decreases as tides rise.

Understanding Salinity
Natural influences on salinity (tidal stage)

Estuarine salinity increases when tides rise and decreases when tides fall.

- ☑ As tides rise, salty seawater from the ocean pushes its way up the estuary.
- ☑ As tides fall, salty seawater drains from the estuary and back into the ocean.

Understanding Salinity
Natural influences on salinity (stratification)

Due to stratification, estuarine salinity can vary with depth. Stratification is a layering effect that occurs between freshwater and seawater.

- ☑ When freshwater and seawater meet, they do not readily mix.
- ☑ Freshwater flowing into estuaries from rivers tends to float on top of the more dense seawater.
- ☑ In many estuaries, the degree of mixing that occurs between freshwater and seawater depends on the strength of tidal currents. The stronger the tidal current, the more freshwater and saltwater mix.

Estuaries are often classified into three basic types based on the degree of mixing that occurs between freshwater and seawater:

- ☑ Highly stratified (not mixed)
- ☑ Moderately stratified (partially mixed)
- ☑ Vertically mixed (fully mixed)

Understanding Salinity
Natural influences on salinity (rainfall)

Heavy rainfall can temporarily lower estuarine salinity at the surface by diluting salt water with freshwater. This is most evident in shallow tidal creeks and other shallow estuarine waters.

Understanding Salinity
Understanding natural influences on salinity

Which of the following statements is true?

A) Estuarine salinity increases when tides rise.
B) Estuarine salinity decreases when tides rise.

The correct response is A!

When tides rise, and seawater from the ocean pushes its way up the estuary, estuarine salinity increases. When tides fall, and seawater drains from the estuary back into the ocean, estuarine salinity decreases.

Understanding Salinity
Understanding natural influences on salinity

Estuaries with weak tidal currents are often highly stratified. In highly stratified estuaries, which of the following statements is true?

A) Salinity concentration decreases with depth.
B) Salinity concentration increases with depth.

The correct answer is B!

In highly stratified estuaries, salinity concentration increases with depth. When tides are weak, little mixing generally occurs between freshwater and seawater. When low mixing occurs, freshwater flowing in from rivers tends to float on top of the more dense seawater.

Understanding Salinity
Understanding natural influences on salinity

Which of the following statements is true?

A) Heavy rainfall can temporarily increase estuarine salinity at the surface.
B) Heavy rainfall can temporarily decrease estuarine salinity at the surface.

The correct response is B!

Heavy rainfall can temporarily decrease estuarine salinity at the surface by diluting salt water with freshwater.

Understanding Salinity
Human influences on salinity (dams and river diversions)

As stated earlier, the salinity of an estuary is influenced by the amount of freshwater that flows into it from rivers and streams. The more freshwater flow an estuary receives, the lower its salinity. Human alterations to freshwater flow can significantly affect estuarine salinity, particularly the damming of rivers and the diversion of river flow from one watershed to another.

- ☑ Dammed rivers often alter the amount and natural timing of freshwater flow an estuary receives.
- ☑ Diverting river flow from one watershed to another alters the amount of freshwater each estuary receives.

Understanding Salinity
Human influences on salinity (land development)

Development of land leads to an increase in impervious surfaces. Impervious surfaces can lower estuarine salinity by increasing the amount of freshwater that flows into an estuary.

- ☑ Impervious surfaces—such as roads, rooftops, and parking lots—prevent rainwater from soaking into the ground.
- ☑ Impervious surfaces increase stormwater runoff, which flows across the land and into estuaries.
- ☑ Stormwater runoff typically contains few dissolved salts.

Understanding Salinity
Human influences on salinity (wastewater)

Industrial and municipal (domestic) wastewater released into estuaries lowers salinity by diluting salt water with freshwater.

Sources of industrial and municipal wastewater include the following:

- ☑ Pulp and paper mills
- ☑ Petrochemical (oil and gas) facilities
- ☑ Pharmaceutical facilities
- ☑ Sewage treatment plants

Understanding Salinity
Understanding human influences on salinity

Which of the following human activities can influence estuarine salinity?

A) Development of land
B) Release of wastewater
C) Both A and B
D) Neither A nor B

The correct answer is C!

Development of land leads to an increase in impervious surfaces. Impervious surfaces—such as roads, rooftops, and parking lots—influences salinity by increasing stormwater runoff (which flows across the land and into estuaries). The release of wastewater into estuaries influences salinity by diluting salt water with freshwater.

Understanding Salinity
Review

Congratulations! You have completed the Understanding Salinity learning module. In this section you learned about the following topics:

- ☑ How salinity is defined and measured in numbers
- ☑ Why salinity is important
- ☑ Natural and human influences on salinity

You should now be able to perform the following:

- ☑ Define the term salinity
- ☑ Explain how salinity is measured in numbers
- ☑ List two reasons why salinity is important to aquatic life
- ☑ List some natural and human influences on salinity

To choose another module, click the drop-down menu at the top of the screen.