Name:	Date:

Natural and Urban "Stormwater" Water Cycles Handout Answer Key

Instructions: Before the teacher's presentation begins, complete the left column by writing in your known answers or best guesses. During the presentation, complete the right column. After the presentation, compare the answers in your two columns.

Slide #	Your Predictions	From the Presentation
Slide 1	• Our planet is covered by water, an astonishing _71__ percent! • If the world was uniform all the way around, water would cover the planet to a depth of __2.6__ km, (__1.6__ miles).	• Our planet is covered by water, an astonishing _71__ percent! • If the world was uniform all the way around, water would cover the planet to a depth of __2.6__ km, (__1.6__ miles).
Slide 2	• It would take __15.5 billion___ years for that volume of water to go over the Niagara Falls. Our planet is ___4.54 billion__ years old. • It takes the average American__7.5__ years to use the amount of water that flows over Niagara Falls every second.	• It would take __15.5 billion___ years for that volume of water to go over the Niagara Falls. Our planet is ___4.54 billion__ years old. • It takes the average American__7.5__ years to use the amount of water that flows over Niagara Falls every second.
Slide 3	• ___2.5__ % of the water on our planet is considered fresh water. • ___1.7__ % trapped as polar ice, __0.76___ % fresh groundwater, and __0.1__ % in the planet's surface and atmosphere. • That means ~__131__ gallons are available per person per day.	• ___2.5__ % of the water on our planet is considered fresh water. • ___1.7__ % trapped as polar ice, __0.76___ % fresh groundwater, and __0.1__ % in the planet's surface and atmosphere. • That means ~__131__ gallons are available per person per day.
Slide 4	• Civil and environmental engineers design systems to pump water from __surface__ and __groundwater__ sources to water treatment facilities and then to our homes. It is their job to provide __quality__ drinking water and a sufficient __quantity__ of water.	• Civil and environmental engineers design systems to pump water from __surface__ and __groundwater__ sources to water treatment facilities and then to our homes. It is their job to provide __quality__ drinking water and a sufficient __quantity__ of water.
Slide 5	• Civil and environmental engineers use the __rates__ of __reaction__ to design treatment systems and must understand the __phase transformation__ occurring as a result of the reaction, in order to provide water that is safe to drink and release back into nature.	• Civil and environmental engineers use the __rates__ of __reaction__ to design treatment systems and must understand the __phase transformation__ occurring as a result of the reaction, in order to provide water that is safe to drink and release back into nature.
Slide 6	• These engineers must have an -depth knowledge of the water cycle. List the different components of the water cycle: _____evaporation_____ stormwater runoff_____ _____condensation_____ groundwater flow_____ _____precipitation_____ plant uptake_____ _____infiltration_____ transpiration_____	• These engineers must have an -depth knowledge of the water cycle. List the different components of the water cycle: _____evaporation_____ stormwater runoff_____ _____condensation_____ groundwater flow_____ _____precipitation_____ plant uptake_____ _____infiltration_____ transpiration_____

Slide 7	• _____Evaporation_____: When water changes from a liquid to gas or vapor. • Phase change: Heat from the sun creates energy that ___breaks____ the bonds holding water molecules together.	• _____Evaporation_____: When water changes from a liquid to gas or vapor. • Phase change: Heat from the sun creates energy that ___breaks____ the bonds holding water molecules together.
Slide 8	• _____Condensation_____: When water vapor changes from gaseous state (vapor) to the liquid phase. • Phase change: Evaporated water vapor condenses in the atmosphere due to ____lower_____ temperatures resulting from __less____ atmospheric pressure. • Rate: On average, the residence time for moisture in the atmosphere is ___8.2_____ days • A large cumulonimbus cloud can weigh as much as a 747 jumbo jet. So why does it not come crashing down to the ground? Answer: The rising air responsible for the cloud formation keeps the cloud __floating__ in the air because the air below the cloud is __denser__ than the cloud.	• _____Condensation_____: When water vapor changes from gaseous state (vapor) to the liquid phase. • Phase change: Evaporated water vapor condenses in the atmosphere due to ____lower_____ temperatures resulting from __less____ atmospheric pressure. • Rate: On average, the residence time for moisture in the atmosphere is ___8.2_____ days • A large cumulonimbus cloud can weigh as much as a 747 jumbo jet. So why does it not come crashing down to the ground? Answer: The rising air responsible for the cloud formation keeps the cloud __floating__ in the air because the air below the cloud is __denser__ than the cloud.
Slide 9	• _____Precipitation_____: Condensed water vapor that falls to Earth as rain, snow or hail. • Phase change: Water molecules combine with tiny __dust__ particles that act as a nucleus to form cloud droplets. ____Millions_____ of collisions occur with other droplets until the mass of the droplet creates a fall velocity that is ____greater_____ than the cloud updraft speed, resulting in rain, snow or hail.	• _____Precipitation_____: Condensed water vapor that falls to Earth as rain, snow or hail. • Phase change: Water molecules combine with tiny __dust__ particles that act as a nucleus to form cloud droplets. ____Millions_____ of collisions occur with other droplets until the mass of the droplet creates a fall velocity that is ____greater_____ than the cloud updraft speed, resulting in rain, snow or hail.
Slide 10	• ____Infiltration_____: Movement of water into the media layer. • ____Percolation_____: Movement of water within the media layer. • ____Media layer_____: The combination of inorganic and/or organic earth materials (for example, sand, soil, mulch, compost, limestone, granite, gravel).	• ____Infiltration_____: Movement of water into the media layer. • ____Percolation_____: Movement of water within the media layer. • ____Media layer_____: The combination of inorganic and/or organic earth materials (for example, sand, soil, mulch, compost, limestone, granite, gravel).
Slide 11	• ____Stormwater runoff_____: The flow of rainwater that occurs as a result of the precipitation rate exceeding the soil infiltration and percolation rate or as a result of impervious surfaces. • Also generated from __impervious surfaces___ such as roofs, roads, and sidewalks. • Collects ___particulates___, ___nutrients____, and ___heavy	• ____Stormwater runoff_____: The flow of rainwater that occurs as a result of the precipitation rate exceeding the soil infiltration and percolation rate or as a result of impervious surfaces. • Also generated from __impervious surfaces___ such as roofs, roads, and sidewalks. • Collects ___particulates___, ___nutrients____, and ___heavy

	metals____ as it travels down the street and into the storm sewer.	metals____ as it travels down the street and into the storm sewer.
Slide 12	• ____Groundwater flow_____: The lateral or horizontal flow of water beneath the ground surface. • Groundwater levels are typically the surface level at which you can see water in a ___lake___ or the level of a ___well__. • Storm water replenishes the groundwater table and underground aquifer through ___infiltration____ and _____percolation_____ of water, which then flows to streams, lakes and wells.	• ____Groundwater flow_____: The lateral or horizontal flow of water beneath the ground surface. • Groundwater levels are typically the surface level at which you can see water in a ___lake___ or the level of a ___well__. • Storm water replenishes the groundwater table and underground aquifer through ___infiltration____ and _____percolation_____ of water, which then flows to streams, lakes and wells.
Slide 13	• ____Plant uptake_____: The process of plants absorbing water and nutrients from roots in order to grow. • Phase change: Plants use the energy from the sun (__photosynthesis__) and __capillary action__ to draw up water and nutrients and transform inorganic nutrients into organic above-ground and below-ground biomass.	• ____Plant uptake_____: The process of plants absorbing water and nutrients from roots in order to grow. • Phase change: Plants use the energy from the sun (__photosynthesis__) and __capillary action__ to draw up water and nutrients and transform inorganic nutrients into organic above-ground and below-ground biomass.
Slide 14	• _____Transpiration_____: The process by which plants release water into the air. • In the fall, trees typically drop their leaves in order to _____ _____ conserve water by stopping the pathway for transpiration___ • As a result of transpiration, an acre of corn can give off ____3,000-4,000___ gallons of water per day. • As a result of transpiration, a large oak tree can give off _____40,000_____ gallons of water per year.	• _____Transpiration_____: The process by which plants release water into the air. • In the fall, trees typically drop their leaves in order to _____ _____ conserve water by stopping the pathway for transpiration___ • As a result of transpiration, an acre of corn can give off ____3,000-4,000___ gallons of water per day. • As a result of transpiration, a large oak tree can give off _____40,000_____ gallons of water per year.

Additional notes and questions:

Slide 15	**Urban "Stormwater" Water Cycle — Vocabulary and Definitions**	
	surface water	Water that is contained by stormwater ponds, rivers, lakes, estuaries, bays, dams, wetlands, oceans or Gulf Coast areas
	impervious surface	A surface that water will NOT pass through.
	pervious surface	A surface that water will pass through.
	wastewater	Water that exits your home through a drain.
	storm sewer	A series of pipes that collects and transports only stormwater.
	sanitary sewer	A series of pipes that collects and transports only wastewater and does not include stormwater.
	combined sewer	A series of pipes that collects and transports stormwater and wastewater.
	urban infrastructure	A structure or system that supports the urban environment. Examples: Roads, bridges, buildings, water distribution, sanitary and storm sewers, stormwater pond, electricity transmission lines, cable and internet.
Slide 16	**Your RAFT Assignment:** Take on the role of a journalist to describe the journey through the urban water cycle—from a water droplet's point of view. • You are a travel magazine journalist for *Urban Environment Weekly*. • Your assignment this week is to follow the life of a drop of water as it makes its way through the urban environment. • In your article, include all the descriptive details about whom the drop met and what it encountered along the way.	