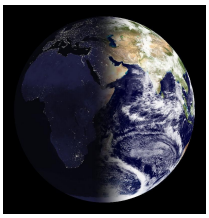
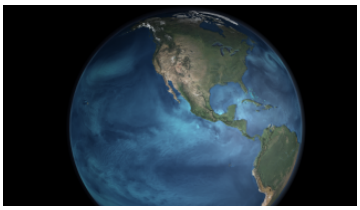
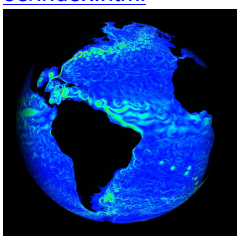
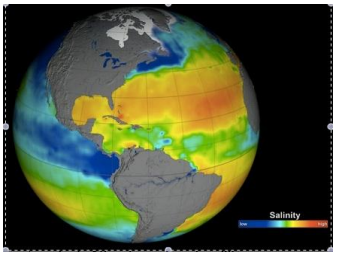
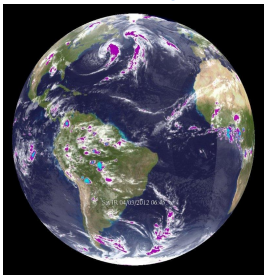
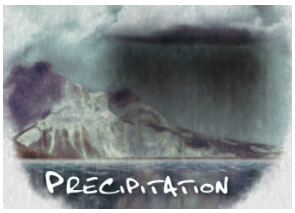
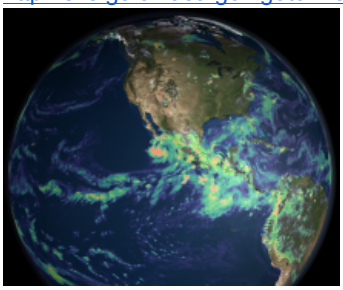
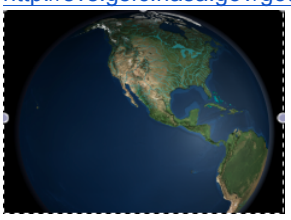
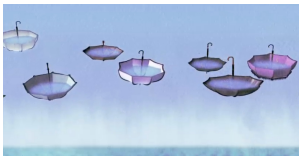
WATER FALLS DOCENT SCRIPT: WATER CYCLE

Key Points	Visuals
Water supports life on Earth. **Water exists in 3 forms:** **- solid: ice and snow** **- liquid: the world's oceans, lakes, rivers** **- gas: water vapor in the atmosphere**	**1) Blue Marble and Nightlights** **NASA GSFC** http://sos.noaa.gov/Datasets/dataset.php?id=85 
Water moves between these forms of state in the water cycle: evaporation and transpiration from plants, condensation, precipitation, and runoff.	**2) Water Cycle Components** 
Evaporation **occurs when water is heated enough to change from a liquid to a gas, forming water vapor:** **- about 90% from oceans, lakes, rivers** **- remaining 10% from plant transpiration** **In this animation of evaporation from satellite data combined with a model over 25 days: white indicates more water vapor and dark indicates dry air. Notice:** **- day/night differences over land. Heating from the Sun causes more daytime warming over land leading to more evaporation (white) than at night (dark).** **- little day/night differences over the ocean, which heats more slowly** **- more evaporation over warm water** **- tropical cyclones have more evaporation due to their fast-moving air (strong winds)** **- midlatitude storms have strong winds and humidity differences between air masses which both increase evaporation (dry air coming off continents can absorb a lot of water, while moist maritime air cannot)** **- 86% of global evaporation is over ocean**	**3) Evaporation for Water Falls**  **Evaporation Animation** **NASA GSFC** http://svs.gsfc.nasa.gov/vis/a000000/a003800/a003837/index.html 

Earth is 70% covered in water. 97% of that water is ocean or salt water. The ocean doesn't just sit there, but moves as currents that are governed by temperature differences and the Earth's rotation. **In this animation of wind-driven ocean surface currents blues are slowest, greens are faster (0.5 m/s ~ 1.2mph) and red shows the fastest currents (1m/s ~ 2.25 mph).** **Notice:** **- Western boundary currents (Gulf Stream in the N. Atlantic, Kuroshio in the N. Pacific). Along the east coasts of continents, these very fast currents flow poleward transporting heat and momentum from the tropics, impacting the weather at northern latitudes and, ultimately, how much water ends up on land.** **- For the return flow, eastern boundary currents, are slower, wider and barely evident here (e.g. California current) as they transport cold water away from the poles** **- Equatorial currents in all ocean basins flow from east to west.** **- When major currents meander or form wavey patterns, eddies or rings can spin off (e.g. Loop Current in the Gulf of Mexico)**	**4) OSCAR Ocean Current** **(Ocean Surface Current Analysis Real-time)** **Earth and Space Research** **NASA GSFC** http://svs.gsfc.nasa.gov/vis/a000000/a003900/a003958/index.html 
Small changes in ocean salinity or saltiness, can have a big effect on ocean circulation and the water cycle. NASA's Aquarius mission helps scientists monitor variations in ocean salinity. Here red colors are high salinity while blues are low. **Notice:** **- Centers of ocean gyres have high salinity because they're away from fresh water input from rivers and land run-off. Also evaporation is greater than precipitation here: salt is left behind when sea water evaporates.**	**5) Aquarius Sea Surface Salinity 2012** **NASA GSFC** **http://svs.gsfc.nasa.gov/vis/a000000/a004000/a004046/4046-portal.mov** 

- Low salinity near the equator is due to more precipitation than evaporation: much rainfall from the Inter-Tropical Convergence Zone (ITCZ). **- Near the poles the salinity minimum is due to the seasonal freezing and thawing of seawater: as water freezes in winter, the salinity that's left (brine) sinks and forms deep ocean water; in summer, melting of sea ice introduces fresher surface water** **- High salinity in the Mediterranean shows that it experiences more evaporation than precipitation**	
<u>Condensation</u> **When water vapor in the atmosphere cools and condenses, it forms droplets and ice crystals in clouds** **Clouds are important because they can reflect incoming heat from the Sun and absorb or reemit heat back down to Earth, having both a cooling and warming effect over different areas.** **Here we see clouds and water vapor detected by infrared satellite measuring heat emitted: land is warmer, so clouds show up cooler than the ground. Cumulonimbus clouds can extend higher up in the atmosphere, shown here in purple and teal, are coolest and often cause the most severe weather.** **This animation is a collection of imagery from several satellites: the faint seams or color variation between areas show where different satellite data sets were patched together to form a complete global picture.**	**6) Condensation for Water Falls**  **Real-time: Clouds & Water Vapor NOAA color-enhanced Infrared GOES/Meteosat/GMS** http://sos.noaa.gov/Datasets/dataset.php?id=56 

Precipitation **When the atmosphere becomes saturated, or reaches 100% humidity, the condensed water vapor precipitates as rain, sleet, snow, or hail, depending upon the temperature.** **Over past 15 years, the Tropical Rainfall Measuring Mission has been providing three hourly precipitation estimates:** **- Heavy rainfall (red) happens most in the tropics** **- Lightest rainfall (blue) happens in the subtropics** **- Two-thirds of the world's rain falls in tropical areas** **- 78% of global precipitation is over ocean** **- Very little rain falls near the poles, though that is not shown here because TRMM is a tropical sensor.**	**7) Precipitation for Water Falls**  **Global TRMM Rainfall, Aug-Sep, 2003** **NASA GSFC** http://svs.gsfc.nasa.gov/goto?2910 
Run-off **Rain water that doesn't soak into the ground runs off or flows across Earth's surface in streams, rivers, ponds, lakes and reservoirs.** **Run-off is influenced by gravity acting on topography and the surface type:** **- flows from higher to lower areas within its drainage basin (e.g. Chesapeake Bay, Mississippi, Colorado, Columbia Rivers)** **- run-off occurring from rainfall or snowmelt is important for replenishing aquifers, lakes, rivers and wetlands, as well as contributing to natural erosion processes.**	**8) Run-off for Water Falls**  **Pulsing Global Rivers from Groundwater Resources of the World** **NASA GSFC** http://svs.gsfc.nasa.gov/goto?3648 
From the movie, recall the conceptual movement of water between these forms of state: solid water evaporates into vapor, condenses into clouds, then precipitates as rain, and runs off land back into the ocean.	**9) Water Falls: Umbrellas** 

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