Surface Water and Groundwater Interactive Module

1) **Audio**

   Texas gets an average of 32 inches of rain each year.

   Visual

   A block-shaped diagram representing a landscape with a river, a normal fault and subsurface rock formations with a blue layer containing groundwater is shown. A scale next to the landscape shows the Rain Gauge. A rain cloud appears over the landscape and precipitation falls. The rain gauge measure 32 inches.

2) **Audio**

   But not all of that rain falls equally across the state. The driest parts of west Texas have annual averages of as little as 8 inches.

   Visual

   A bright sun appears and rotates over the landscape.

3) **Audio**

   In the wettest parts of East Texas, it can average up to 54 inches of rain in a year.

   Visual

   A large rain cloud forms over the landscape and precipitation falls. The rain gauge shows a rise to 54 inches of rain.

4) **Audio**

   And throughout the state, occasional heavy rains can cause floods due to major cloudbursts and hurricanes on the Gulf of Mexico. The largest rainfall on record in Texas was 40 inches in 24 hours in the City of Alvin.

   Visual

   The rainfall continues and the rain gauge disappears. The river widens as the rain causes flooding on the land.

5) **Audio**

The floodwaters carry soil washed into the river by the rains, and when the flood retreats, it leaves this soil, also called silt, on the low areas alongside the river, called floodplains.

Visual
The floodwaters shown of the landscape retreat and leave behind brown sediment including silt on the land. This land is the floodplain. Labels for sediment, silt and floodplains appear on the landscape diagram.

6) Audio
Meanwhile, underground water is at work in ways we can't see.

Visual
The underground portion of the landscape which shows the rock formations, fault and water-bearing formation changes color to dark tan and blue to indicate where the water is located underground.

7) **Audio**
Gravity slowly forces water to seep through the soil and in the small spaces between rocks and sand in a process called infiltration.

Visual
The scene changes to a cross section of a field of grass which shows the above ground section of the plants, as well as, the roots and soil in the shallow soil. Drops rain appear and seep into the soil. Arrows, which are labeled "infiltration", appear and show the direction of flow downward through the sediments. The scene moves lower into the subsurface until a light blue section labeled "water table" is reached. Below the water table, the color of the sediments is blue indicating that water fills the pore spaces. The blue section is labeled, "zone of saturation". The tan section of sediments above the water table is labeled, "zone of infiltration".

8) **Audio**
Underground soil types and rocks that allow water to pass through are called porous, and the water flowing underground is called groundwater.

Visual
The scene changes to a close up view of the sediments. Large and small rounded rocks can be seen and water flow between the rocks. Labels for "porous" and "groundwater" appear to show that the water in the pour space is the groundwater.

9) **Audio**

Eventually, the seeping groundwater reaches a layer of much less porous or non-porous clay or rock that can be fractured in places, and the water begins to collect in a saturated underground area called an aquifer.

Visual

The scene changes back to the landscape. Rain clouds appear and precipitation falls. Arrows pointing downward through the underground sediments show infiltration to a saturated rock layer labeled “aquifer”. The rock formation below the aquifer stops the flow of water and is labeled “non-porous”. The underground cross section is labeled “zone of Infiltration” for the section of rock above the aquifer that allows water to flow downward towards the aquifer. The layer of rock formation that is filled with water is labeled “aquifer” and “zone of saturation”. The top of the zone of saturation is labeled “water table”.

10) **Audio**

Most aquifers have a general direction of flow, where water moves from higher to lower elevations.

Visual

Arrows showing the direction of water flow in the subsurface from are shown on the landscape. Where the water table is below the surface, the arrows indicate that the water flows downhill. Where the water table reaches the land surface, the arrows show the water flowing upwards into the river system.

11) **Audio**

Where the water table is high enough, groundwater can feed the river and water flows to the surface at springs.

Visual

The scene changes to a close up of a cross section through a dry creek bed. Blue color representing the water table rises upward through the tan sediments and move upwards filling the dry creek with water. A large arrow pointing upwards shows the flow of “spring” water into the creek bed.

12) **Audio**

But in dry areas, during droughts, when aquifers are used heavily, or when aquifers are deep underground, groundwater may not reach the surface of the river.

Visual

The scene changes back to the landscape. A big yellow sun rotates over the landscape and two red circles highlight the river beds that are no longer in contact with the zone of saturation. The water levels in the aquifer fall and do not reach the land surface.

13) **Audio**

Now that you understand how surface waters and groundwater function in nature, see what happens when more people begin using these resources.

Visual

The landscape returns to the original level showing average river flow and aquifer levels that reach the surface.

14) **Audio**

Folks are drawn to the river because of its water and because of the fertile soil in its floodplain. Wells tap water from the aquifer.

Visual

A covered wagon drives across the landscape. Houses, a church, a red barn, windmill, crops and a hay stack appear near the river.

15) **Audio**

See what happens when you cause a flood by clicking the rain cloud, or a drought by clicking the sun.

Visual

A rain cloud appears to the left of the landscape. The sun appears on the right of the landscape.

16) **Audio**

Now add a dam or well and create a flood or drought by clicking on the cloud and sun to see what happens. Then test your knowledge with a quiz.

Visual

Three different selection boxes appear. One for “add well” is represented with a windmill. A second for “add dam” is represented with an image of a dam, and the third choice “what do you know” is represented by a graduation cap.

17) **Audio** (If you select “add well”)

Too many wells or too much water being pumped from a few large wells can lower levels in aquifers and dry up natural springs.

Visual

A windmill with a well appear in the landscape next to the homes and church.

18) **Audio** (If you select “add dam”)
Dams can hold back flood waters by slowing the water’s journey, and can allow for a more controlled flow downstream during dry spells. The reservoir created by the dam can be used for recreation and as a source of drinking water for nearby residents. But fish that migrate upriver can have their paths blocked by the dam.

Visual
A dam and lake appear on the river. There is a person on the riverbank fishing and another person in a boat on the lake.

19) **Audio** (If you click on the sun and the prompt that appears saying “take a closer look”)

A reservoir can hold enough water for people to use during droughts, through hot, dry weather increases evaporation from the reservoir.

Visual
A new box with illustration pops up. The scene in the box shows a cross section through the lake and dam. The land with trees and the lake with fish are visible. The word “evaporation” appears over the lake. White arrows appear on the surface of the lake and move upwards to the sky representing evaporation. The lake level drops.

20) **Audio** (If you click on the rain cloud and the prompt that appears saying “take a closer look”)
A dam provides protection from flooding for folks living along the river downstream, and it can give a steady flow of water downstream during dry spells. But sediment that once was deposited as silt on the floodplain downstream builds up behind the dam.

Visual
The rain cloud drops precipitation over the lake. The lake levels rise. A new box with illustrations pops up. The scene in the box shows a cross section through the lake and dam. The land with trees and the lake with fish are visible. Tan sediment appears at the bottom of the lake and flows across to the dam. The sediment is thickest near the dam. The fish that were once on the lake bottom near the dam swim to a higher lake level.

21) **Audio** (If you click on the graduation cap)
Click on the hotspots on this landscape and see if you can select the correct term for what’s happening there, then click the term that best describes what you just saw to fill in the blank.

Visual
The landscape appears again. Blue circles with red outlines and highlighted areas appear on various places on the landscape as the “hotspots” to select words from a table and match them with a fill in the blank sentence.

Fill in the blank Assessment

Silt
Infiltration
Floodplain
Aquifer
Water table
Non-porous
Infiltration zone
Saturation zone
Evaporation zone
Sediment
Porous

a. Substances like sand and rock that can hold water in cracks and spaces between particles are ***porous.***
b. The area above the aquifer is called the ***infiltration zone*** and the aquifer itself is also called the ***saturation zone***.
c. An area of underground water is an ***aquifer.***
d. The solid rock below the aquifer is ***non-porous*** but can be fractured in places***.***
e. The top of the aquifer is called the ***water table***.
f. Particles such as ***silt*** can be left over after a flood in a ***floodplain***.
g. The process of water seeping below ground is called ***infiltration***.