Sinkhole Model Building and Operating Instructions

Materials:
- Aquarium with water input and output valves on opposite sides of the tank (figure 1)
- Decorative River Pebbles, or Large gravel (figure 2)
- Decorative All-Purpose Stone or pea sized gravel (figure 3)
- Paver sand or play sand
- Water Softener Crystal salt (figure 4)
- Flexible wire fencing piece, roughly 17.5cm tall, 33cm wide with openings large enough that water can flow through it but small enough to keep the rock and gravel out of the middle (figure 5).
- Water from the sink
- Funnel (figure 6)
- Plastic flexible tubing, long enough to reach from the sink to the model (figure 6)
- 2 hose clamps
- Plastic House and shrubs for decoration
- Ring Stand (figure 6)
- Large bucket (figure 7)

Instructions:
1. Bend the wire cage piece into a semi-circle shape, place the piece vertically with the opening toward the front of the aquarium up against the glass. This piece will keep the rock from falling into the sinkhole, allow for easy filling and refilling of the sinkhole, and provide a cut-away view of the sinkhole in action (figure 8).
2. Carefully add the large gravel rocks to the bottom of the aquarium to a height of around 7.5cm (figure 8). This measurement does not have to be exact, just need enough to fill the bottom but allow for the other layers of rock and sand.
3. Add the pea sized gravel to the aquarium covering the large gravel. This should be roughly a depth of 8cm over the large gravel (figure 9).
4. Add the sand in a thinner layer above the pea-sized gravel. The top of the sand should reach the top of the wire cage piece at this point.
5. Add water softener salt crystals to the bottom of the sinkhole area and alternate thick layers of salt with pea-sized gravel to the top of the sinkhole cage (figure 10).
6. Add a thin layer of sand over this area and make it even throughout the aquarium. This will give the surface of the aquarium the appearance of solid ground (figure 10).
7. Add decorations, being sure to add some to where the surface will sink into the sinkhole. A House gives a good effect of how detrimental sinkholes can be (figure 10).
8. Attach a piece of plastic tubing to the input side of the tank and seal it tightly with a hose clamp. Attach the other side of the tubing to a funnel (figure 6).
9. Place the funnel in a ring stand so that hands free operation can be used for this model. Place the ring stand and funnel in a sink under the faucet (figure 6).
the sink faucet has a tube attachment, such as a barbed fitting/coupling, attach the tube directly to the faucet.

10. Place the bucket under the output to catch the water as it flows through the tank (figure 7).

**Operation:**

1. After setting up the tank, turn on the faucet and let it flow into the funnel with the tube. The water may overflow out of the funnel until it can set a good flow into the aquarium adjust water flow as necessary.
2. Depending on how high the output flow is, it may take time for the water to begin emptying. Make sure the bucket is placed appropriately.
3. After just a few minutes of the water running, the salt will begin to dissolve and as the salt is carried away the surface of the sinkhole will begin to drop.

**Result:**

1. As the water is carried away from the sinkhole the remaining salt, gravel, and sand begins to fall downward due to gravity, filling in the vacated areas (figure 11).
2. The longer the model runs, the more salt is removed and the deeper the sinkhole becomes.
3. Slowly developing sinkholes give warnings at the surface, such as subsiding land.
4. This model should take about 5 minutes to complete.

**Resetting:**

Resetting this model between classes if necessary, takes time but can be done in the matter of about 5 minutes.

1. Remove any decorations that have fallen into the sinkhole.
2. Scoop out the sinkhole area protected by the fence. This can be laid out to dry and reused another day if interested.
3. Repeat steps 5-6 of the model Instructions.
4. Run the model again.

**Photos:**

- Figure 1. Diagram of empty tank/aquarium with water input and output ball valves on either side of the tank.
- Figure 2. River rocks or large gravel will work with this project.
Sinkhole model idea from Dr. Matthew Kirby. Model instructions by Kate Gibson and Dr. Natalie Bursztyn

Figure 3. Small pea sized gravel will be placed on top of the larger gravel within the model.

Figure 4. Water softener salt to fill the sinkhole which will be dissolved by the water flowing through the tank.

Figure 5. Wire fencing piece coated with anti-rust paint. This will serve to support the sinkhole walls so the model can be run multiple times within a day.

Figure 6. Funnel, plastic hosing, ring stand, and ring supporting the funnel below the sink faucet. These allow water to flow through the model with hands-free operation.
Sinkhole model idea from Dr. Matthew Kirby. Model instructions by Kate Gibson and Dr. Natalie Bursztyn

Figure 7. Large plastic bucket set up below the output valve to catch the water that has gone through the model.

Figure 8. Wire cage piece bent into a half circle shape creating space for the rock salt to be placed. Large gravel pieces surround the wire cage and act as a foundation to the model.

Figure 9. Pea sized gravel has been placed above the larger gravel.

Figure 10. Rock salt has filled the sink hole area and sand has filled the top of the land surface giving the appearance of solid ground. House and plants have been added for effect.

Figure 11. Sinkhole model is complete, the house has fallen in causing damage to property, bringing the human element into the model and lesson.