Simply Simulating!

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ABSTRACT:
Simulations and demonstrations help engage participants in learning- especially if the participants are directly involved in their presentation! They are also fun to do!

In this workshop, we will share some simulations and demonstrations that have been created and used in response to school needs in the Wimmera. Simulations can vary in length from those taking up part of a teaching session to those that extend over days and weeks. Simulations vary in size and the materials they require. They may use materials that are cheap, relatively easy to transport and store, or even reusable from /for other purposes! Or the materials may be expensive, more durable, and manufactured for the purpose.

Some examples of themes covered by simulations developed by Wimmera Community Waterwatch (WCW) coordinators are: drought (Water Fractions), water saving behaviours, catchment knowledge (eg Catchment Jigsaw), global water, water cycle, salinity (eg CSI: Catchment Salinity Investigations, barley grown in different salinities) and water life themes (Web of Water Life). All use tangible materials - none are computer-based simulations.

Simulations evolve! They have been and continue to be, modified for new needs. At any time, discussion during, or after, their presentation may make them adaptable to different ages or purposes in addition to their original design.

INTRODUCTION:
Waterwatch education is great! We are privileged to be a vehicle teaching people about the environment they live in, and hopefully thereby contributing to its long term sustainability! The problem is that it isn't always easy to take children especially out into the environment to see something or to have time to watch a slow process taking place.

As educators we have many tools. Most commonly Waterwatch comes in as guest presenters, often talking about the places and processes that we can't take people out to see, so supporting this with photos and films. However, there may be times when we want to engage our audience more actively so that the messages we have brought about the environment are better understood and remembered.

This is when I may choose a simulation. What is a simulation to me? Any model of a process or part of the Earth which simplifies it to make it easier for the basic information to be understood and recalled. They may be in the form of a game, puzzle, modelling, or acting out. They can be made of many sorts of materials, from re-usables to specifically manufactured ones. As I work from home, I like to use simulations that are as light weight, and as easy to transport as possible. In this workshop, I will not be considering computer based simulations.

Simulations and demonstrations are not unique to the Wimmera. You will find there are many to choose from in various manuals, eg Waterwatch, Saltwatch, and websites. Waterwatch

Victoria distributed its “Run of the River” Game for secondary schools last year. It is a simulation of the story of a river, and can be played in various ways. There are several Waterwatch regions which have catchment models which demonstrate topography and land use both as an overview and as an opportunity to see where a local area fits into the whole.

The Wimmera Community Waterwatch (WCW) coordinators have developed quite a collection of simulations and demonstration. Some have been adapted from other areas, some are unique. Some demonstrate general principals, while others are specific to our local catchment. Many of our simulations are related to water resources, stormwater or salinity.

In this workshop, I have developed most of the simulations, except where otherwise acknowledged. Harvey Champness has also developed some eg his Catchment Jigsaw, focuses on local catchments in the Western Wimmera. Stormwater simulations are to be found in Harvey’s Stormwater Education Paper. This year, Bronwyn Bant has developed a game that can be used for stormwater or salinity. It will be at the ‘Show and Tell Session’.

CATCHMENT WIDE SIMULATIONS

Example 1: ‘Streams and Pipes’ Game

This is a new game for the Wimmera created mainly by Bronwyn Bant, with the support of the other WCW coordinators. It is loosely based on Snakes and Ladders.

Demonstrates:

- the nature and issues of the Wimmera Catchment from its source to its terminal lakes
- salinity issues
- stormwater issues

Materials:

- The large game board - 4.05m by 4.25m - is made of durable PVC;
- large dice,
- sets of laminated game cards.
- a large space for ‘playing’ and … transporting it.

Creating the materials:

- The game board was designed to be large enough to enable people to be the pieces. There are 49 squares on the board, each 55cm^2 in size – big enough for a person to stand on (See Fig 1 below). Over its numbered squares, it has a stylised Wimmera Catchment (creeks) and a series of pipes. The board was made commercially.
- Sets of cards, depending on the focus of the game, and the level of difficulty are used for the chance of landing on green or purple squares and imparting the knowledge. Bronwyn made these and laminated them.
- Finding appropriately large dices was a shopping challenge that Bronwyn enjoyed!

Basic Procedure:

- Move from Start (upper catchment) to Finish (terminal lakes) according to the roll of a large dice stepping onto landform symbols, different coloured squares, stream lines and pipes.
- Discussion on target topics can take place all along the journey.
- When landing at the base of a river or creek, move further along the board.
- When landing at the top of a pipe, the move is backwards.
- When landing on a light green square, a question must be answered eg “What does EC stand for?” Only a correct answer will move the player forward that bit extra.

- When landing on a purple square an environmental chance card is read. If the effect is positive, there will be an accompanying instruction to move forward, eg "You planted deep rooted pastures, lowering the water table. Move forward two spaces".

Fig 1. Using this game board can lead to impromptu discussion and learning about the catchment and local issues, which is supported by the chance and question cards prompts.

Example 2: Creating a catchment

Many people will have used versions of this. Harvey has used a sandbox version for primary- aged mixed groups of children to create an imaginative catchment. The discussion then focuses on whether the features would work properly in reality, and so helps develop an understanding of natural and man-made features.   I have used both the sandpit and sandbox versions with a range of children from Junior Primary to Secondary to model our Wimmera Catchment. This factually-based version is described below.

Demonstrates:

- Basic geographic knowledge of the catchment
- Water runs downhill and links places in our catchment
- The size of our catchment
- Our position, man-made and natural features, in our catchment

Materials:

- base map of the catchment
- sand pit or box
- labels on cards may be laminated.
- Trowels may sometimes be useful.
- space needs dictated by what is available

Creating the materials:

- Ensure an onsite sand pit or bring in box with sand.
- Bring a map to aid sketching the features of the catchment.
- Make labels in format desired beforehand if possible.
- Collect useful materials for streams and roads.

Basic Procedure:

- Mark out locations where mounds are to be built up and where channels are to be dug out.
- Form the sand into the topography needed.
- Put labels on the key features.
- In a sandpit, students holding cards can be put into positions.
- Decorate to the level desired, then photograph to give to students.
- Discuss desired themes eg where towns are located and why; known problems and possible sources .

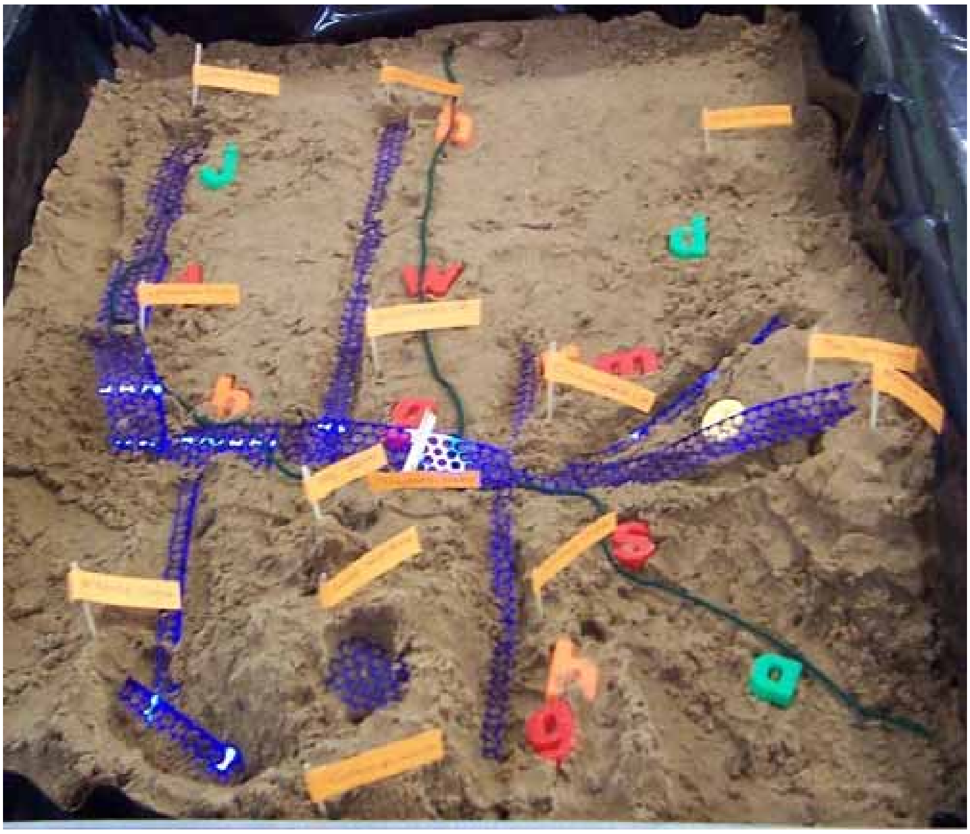


Fig 2: Half a dozen Warracknabeal Special Developmental School students created this sandpit model of the Wimmera Catchment, as a lead-up to a school bus trip to the upper catchment. Labels indicate the first letter of the towns. Flags indicate the names of features. Blue ribbons indicate key streams and lakes. The green wool indicates key roads.

Example 3 : catchment model
Several Waterwatch regions have 3D models of their catchments. This Wimmera one is in a stylised form rather than geographically accurate. It was designed mainly by Brad Hollis, with the support of the WCW team. It was manufactured in two pieces and has the added feature that water can run down in it …. and disappear!

Demonstrates:
- Birds eye view in one snapshot
- Main water stream paths above and below ground.
- Topography
- Landuse

Materials:
- Large 3D model in 2 pieces
- Table to sit the model on
- Bucket of water

Creating the materials:
- Made commercially

Basic Procedure:
- Run water down the model
- Allow hands to wander over it, and get the feel of the catchment
- Discuss desired themes eg the movement and uses of water over the catchment (See Fig. 3 below)

Fig 3: Harvey uses the Wimmera Catchment 3D Model during a discussion about the western Wimmera's wetlands at the Wild Games in the West. The water has run down the river, into a lake and is seeping down and out onto the child's hand at right.

SUB-CATCHMENT SCALE SIMULATIONS
Example 4: Western Wimmera Jigsaw puzzles
Harvey created large scale jigsaws for younger students to help them focus on the natural and man-made features of their part of their local environment. This version uses aerial photographs. It could be done also with maps.

Demonstrates:
- Features found on aerial views
- Geographic knowledge of the catchment
- Direction of water flow.

Materials:
- Sets aerial photos

Creating the materials:
- Harvey had the aerial photographs of key sites in the Western Wimmera printed for this purpose.
- He cut them up and laminated them.

Basic Procedure:
- In a team competition, or individually, hand out a set to each team.
- Teams race to correctly assemble the photo. (See Fig 4).
- Discussion eg the features on the jigsaw, clues that help fit the photo together
- May be a starting point for discussing issues affect the local area.

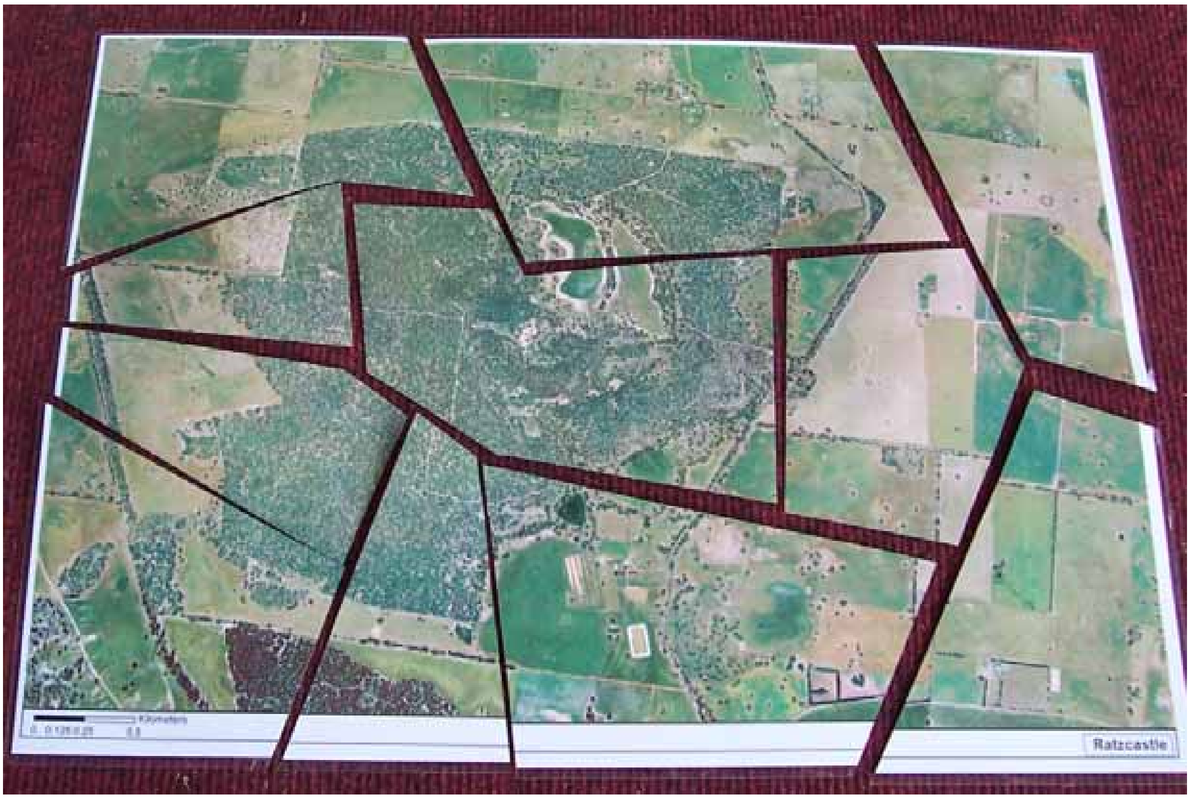


Fig 4 An example of the Lake Ratzacastle Catchment Jigsaw pieces assembled – almost! Children and adults always seem fascinated by the birds eye view of their local environment.

Example 5: CSI - Catchment Salinity Investigation #1 .
Harvey developed **the 'CSI: Catchment Salinity Investigation'** game for mid Primary to Lower Secondary students. Teams investigate a range of information, including salinity, from several sites along the River in order to identify each site. This basic idea could be adapted and applied to any river catchment in Australia, with modifications to fit the ability level.

Demonstrates:

- Understanding of map features, photographic information and location clues
- Geographic knowledge of the catchment
- knowledge of water issues in their catchment
- linking of salinity, landform and location and the way they change in a stretch of river.
- Direction of water flow
- requires teamwork to complete the tasks quickly and successfully.
- Using a range of information types to describe a location.
- Working together helps solve complex environmental puzzles

Materials:

- Four masonite puzzle boards on which the key features or transport, towns and landform have been painted. They fit together to form the middle section of the Wimmera River.
- Laminated, velcroed labels for key features on the boards.
- Water sample for each chosen site
- Photo for each site water is taken from
- Laminated, clue cards for each site.
- Salinity scans, etc
- Textas to note salinity on cards

Creating the materials:

- The full activity is best done with two coordinators.
- Harvey made the boards, labels and game cards.
- Another coordinator collected the water samples, took photos and laminated them.

Basic Procedure:

- Introductory talk with map includes locating the CSI area in the catchment and direction of flow of the River through it.
- Divide the group into the four teams.
- Provide each with one board and task to join correctly to the others.
- Once successfully matched, provide each group with a set of location and waterway labels to place on their board to identify the locations on it.
- Once completed, provide each group with a set of cards with landform, water use, and flow clues about four selected sites along the Wimmera River – one from each board- and with photographs of the four sites.
- While most of the group reads these 'Clue Cards' and tries to try to work out which of the four boards each belongs on, another member goes to test the water samples for salinity. This is written on a clue card, and this member returns with this information to their group. (See Fig 5 below)
- The group works together to consider all these clues so they can place their photographs on the jigsaw boards to show where they think each site is located. (A modification is to only place the photo that they think is located on their original board.)

- When all have made their selection, the coordinator directs the discussion around which have been correctly identified and what clues needed to have been paid more attention to those which were not.
- Further discussion on specific issues can follow if desired eg salinity increasing downstream.

Fig 5 Two of the key parts in the CSI at the Wimmera Catchment Management Authority's Kids Conference:
Left - Horsham 298 Primary School students use their clue sheets to help them place their site photos on the Middle Catchment Jigsaw Boards;
Right - Glenorchy and Edenhope Primary Schools' students test the water samples for salinity.

Example 6: CSI #2
I modified the CSI #1 for a year 8 Science Prac session. I replaced the boards and cards with a record table and focussed more on water quality clues from water samples and photographs. This prac was linked to a unit on Ecology in which differences in water life were related to the differences in water quality.

Demonstrates:
- Water quality from different locations
- The value of careful observations for stream colour, ground and plant health visible in general and close- up photographs, and from water testing for salinity, pH, turbidity and aquatic macro-invertebrate life in water samples.
- Depending on sites chosen, links between water quality and health of water life (eg salinity and plants and macro's; or effects of drought.)

Materials:
- Water samples from selected sites (eg 6 sites)
- A4 photographs of each site taken when collection the sample.
- Record sheet to cover the chosen aspects of water quality (replacing the cards in #1)
- Testing equipment
- Space to set everything out well

Creating the materials:
- The day before I visited the sites to collect samples and take photos.
- From this visit, I created a record table containing all the clues (see Fig 6 below).

Basic Procedure:

- Keeping photos and water samples separate, place samples at stations around the room with equipment needed for testing.
- Explain how to do observations from photos and water tests, if necessary.
- Divide the group into teams to rotate around the stations gathering records on the table. (see Fig
- Allow time to compare the photos at the top with the observations from the water samples in trying to allocate which site name (last row) belongs to each (numbered) water sample.
- Discuss observations and implications for care of different water places.

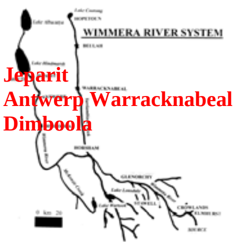
Sites	Yarriambiack Creek **Lions Park** Warracknabeal	Yarriambiack Creek **Boat Ramp** Warracknabeal
Site Photo 		
Water plant life		
Water colour		
Water plants		
Signs of drought		
Water quality tests		
Sample number	**1**	**2**
salinity		
pH		
turbidity		
Water bugs		
Site name		

Fig 6: This is an excerpt from the CSI record sheet for the Warracknabeal Secondary College Yr 8 Ecology Unit Science 'Prac' session. (There were 6 sites on the sheet.) These sites came from the four towns in the lower Wimmera Catchment labelled in red on the map. Students observed and recorded 3 visual clues under the general and close-up photos. They tested the numbered water samples for the 4 visual and chemical characteristics in the bottom half of the sheet. Their solution to this CSI was entered in the last row from the choices in the 'site names' in the top row to show what they thought matched with the sample numbers in the middle of the sheet.

WATER RESOURCES SIMULATIONS
Example 7: Global Water Fractions
I have used this demonstration for World Water Day in March for a number of years, and sometimes linked it to Saltwatch to emphasise that water is a limited resource, globally and locally. I have also used it to lead into sessions on the water cycle or the 3 forms of water.

Demonstrates:
- The relative proportions of world water in ice, groundwater, on land, in the air and in the sea

Materials:
- 10 litre bucket
- 4 plastic jars, containing water that has been dyed blue so it can be seen better:
    - slightly less than1 cup,
    - 2 tablespoons,
    - Slightly less than 2 teaspoons
    - a drop of water

Creating the materials:
- Plastic jars are re-used materials from homeand once set up, they can be stored for repeated use
- Dye is a cooking one

Basic Procedure:
- Identify the 5 global water forms;
- Challenge class to think of rank order by amounts;
- Select 5 children to collect jars and rank selves without letting others see;
- Present correct rank order. (see Fig 7 below)
- Discuss implications of limited resources eg with very little of the world's water being good rainwater available for our use, we need to know how to take care of the good water we get.

Fig 7: Global water converted into fractions of a 10 litre bucket, from left: 97.5% is left in the bucket; 2% is in the 'ice' jar; 0.5% is in the 'underground' jar; 0.01% is in 'water on the land' jar i.e. streams, lakes, ponds, etc; and only 0.001% is 'in the air' as gas or droplets [1].

Example 8: Reservoir Water Fractions
This simulates changing levels of the Grampians water storages over more than a decade. I developed it to help students understand that why we needed water restrictions and why we hadn't always lived with them.

Demonstrates:
- Water runs into reservoirs from mountains sides,
- Water leaves a reservoir as evaporation or flow uses.
- The variability of the levels of water in the Grampians Reservoirs on which most of the Wimmera Mallee Stock and Domestic Channel System has depended for nearly a century.
- Filling and emptying of Grampians reservoirs could be adapted to any other reservoir.

Materials:
- Record of a reservoir or group of reservoirs, converted to % full.
- Know ahead of time the group size to have percentages converted to number of people (see Fig 8 below)
- Big space, eg outdoors.
  - If possible, a raised area around a lower area, eg seating area.
- You may want to add in the local rainfall to the story.

Creating the materials:
- Prepare expected numbers beforehand s
- The Grampians Wimmera Mallee Water storages levels are available on their website.
- Rainfall stats are available from the Bureau of Meteorology website.

Basic Procedure:
- Explain what the simulation is about ie the water cycle from clouds to wet ground to flow downhill into reservoirs and change over time which has led to water restrictions.
- Children stand in a circle (may have to be 2 deep in a big class) around a central area.
- The story of the reservoirs is told by how many people are in the reservoir at the time.
  - For each year, state % full and the number of children to be in middle
  - local rainfall may be added if known as rainfall does not directly match reserves
  - embellish as you desire eg with children's and local stream milestones.
- Go from some time ago to present to ensure a time when the reservoir was (almost) full is included.
- Moving into the reservoir is a step forward or down if on two levels.
- Taking people back out of the reservoir means they can choose to flow out a nominated spill way location or be evaporated. In either case they move back to the circle or higher position.
- Ensure each student experience both flowing in and moving out of the reservoir.
- When finished, discuss how participants felt about how quickly the water in reservoirs changes, and the reasons for this as inflow and outflow, including competing demands
- Can be used as an introduction to distribution of water from the reservoirs.
- Can be used as an introductory activity to Saltwatch,
- Can be used as an activity for World Water Day to encourage students to think of ways they can conserve water and why they should
- Discussion about the reasons for the rationing of water and at its different levels.

Grampians Wimmera Mallee Water Storages table for 'Reservoirs Water Fractions'				
Year	Reservoir % fill	If 25, number in 'reservoir'	If 25 , number moving in/out	Additional story
1991	57%	14	+14	wetter years
1992	69%	17	+3	
1993	89%	23	+6	Wettest year
1994	82 %	20	-3	
1995	52 %	13	-7	2007's year 6's born
1996	62 %	15	+2	last flood = Oct 96
1997	74 %	18	+3	Benefiting still from Oct 96
1998	48 %	12	-6	
1999	32%	8	-4	no restrictions
2000	16%	4	-4	restrictions came in and stayed
2001	12%	3	-1	
2002	19%	5	+2	
2003	6%	2	-3	
2004	10%	3	+1	1/3rd stock dams only filled
2005	11%	3		
2006	6.6%	2	-1	dry times, no farm dam fills

Fig 8: At this reservoir scale, the overall pattern of wet and dry decades appears. When children start moving in and out of the 'reservoir', they can feel the change in the amount of resource that we have left now in this drought compared to a generation before them.

Example 9: Local Water Fractions
Bringing the scale back to the home front, I developed this simulation to help the town and farm students appreciate that they had different sources and reserves of water, though both were under different types of water restrictions. This could be applied to any water resources.

Demonstrates:

- Proportion of water in a range of local water storage types: rain water tanks, farm water dams, town water reservoirs.

Materials:

- 10 blue squares of paper or card with white colour on the back
- Data on water storages or rainfall that is to be used.

Creating the materials:

- Obtain from an Art room
- Water information from the web water provider or Bureau of Met.

Basic Procedure:

- Choose 10 students to stand out the front.
- Provide each with a blue square.
- All squares face blue to the audience at the start.
- State the type of water source (rain tanks, then farm dams, then town storage) and ask students how much they think is left in their storage of this type.
- Provide the answer by asking a fraction of students to turn their blue squares over to white (see Fig 9 below).
- If you know proportions ahead of the session, other fractions can be used:

  - eg 100% of farm house dams were filled in 2004, could use the whole class
  - only 1/3rd of farm stock dams were filled in 2004 could use 3 people
  - 75% of Beulah's average rainfall fell in 2004 could use 4 people, while for Dimboola, at 60% of their average, it would be better to stick to 10 people.
- Discuss the variability seen and the implications for our uses of water.

Fig 9: Beulah Primary School students demonstrate the proportion of water left in the Grampians Wimmera Mallee Water storages in March 2005 (12 %).

NATURAL PROCESSES SIMULATIONS
Example 10: A Water Cycle Box
The Central Highlands Water Education Kit describes how to make a model water cycle. Leigh has used this as the basis for creating unique water cycles for Primary School classes. This simulation makes it easy to observe movements of water and its effects on plant growth.

Demonstrates:
- Ratio of water to land on Earth (3:1) is repeated in the box.
- Water runs downhill (slope of soil down to water receptacle in box)
- Seeds germinate in soil and grow.
- Evaporation will condense on cover of box
- Sunlight will encourage plant growth

Materials:
- Waterproof container (eg plastic tub) and see-through material for lid
- Soil
- Water and container eg bowl
- Grass seeds and other plants as desired
- Stones, shells etc for decoration
- Strong sticky tape.
- Place in the sunlight where it can rest for a few weeks

Creating the materials:
- A mixture of local shopping and re-use materials

Basic Procedure:
- Review water cycle processes as an introduction
- With the children, organise the box with water to soil at ratio of 3:1; soil sloping down to a water container; grass seeds on the soil until they germinate (then cover with soil); securely covered box so the moisture cannot escape when it is evaporated.
- Place the box where children can see changes easily.
- Discuss the changes that take place.

Fig 10: Rupanyup Primary School children finish preparing their Water Cycle Simulation Box with water, soil, rocks and plants ready to observe changes over the next few weeks.

Example 11: Rain on Earth Simulation
I developed this simulation originally as part of a World Water Day session, but it has also been useful as an introductory activity for Saltwatch and salinity monitoring. This simulation of the global split up of rainfall follows on well from the Global Water Fractions Simulation.

Demonstrates:
- Rain falls anywhere, but most of the Earth is sea, so more falls on sea than land (¾ on sea)

Materials:
- Globe of the Earth
- Clear box with some water in it (sea),
- Pot-plant (land)
- 4 (blue) shakers (clouds)
- Water to go in shakers (rain)

Creating the materials:
- Using materials from the school or home

Basic Procedure:
- Pose the question as to how easy is it for our land to get new water.
- Review split up of global water especially 97.5% water is in sea, 0.001% in atmosphere (Use globe)
- Review of water cycle as the box is set up with water (sea) beside a pot plant (land)
- Choose 4 helpers
- Provide each with a shaker to fill with water (evaporation converting to condensation) while class suggests how many shakers will rain on land and how many on the sea.
- Students rain into boxes – 3 on sea, 1 only on land (see Fig 11 below)
- Discuss implications for how we care for the water we already have on the land.

Fig 11: Four students at Warracknabeal Primary School rain on the Earth: ¾ into the sea, and ¼ onto the land. This split up of total world rain often surprises children and helps them realise how valuable our water resources are.

Example 12: Web of Water Life Simulation

This was one of the first simulations that I developed and it has been in continuous use now for almost a decade. It can be modified for a variety of ages and played anywhere, so long as you have two key materials, the script and the creature cards.

Demonstrates:

- Changes in water life as Spring progresses
- Changes that follow to the water life if plants are lost
- Effects of Spring - increasing sunlight and warmth on plant life – on land or in water.
- Herbivores, carnivores and detritivores link in food chains and ultimately a food web.
- Importance of plants to a healthy water place.
- Similarity of food webs on land and in water places

Materials:

- Water place bed eg brown blanket,
- Growing plants eg green strip of material or crepe paper roll,
- Named, drawn Creature Cards for each child, colour coded for food preferred eg with colour used for writing. If possible, base the choice of creatures on a local place.
- Script
- Fair amount of space
- Can have aquatic macro-invertebrates ready as a follow-up
- Crepe paper costumes for youngest children. (see Fig 12 below)

Creating the materials:

- Know number in session beforehand,
- choose creatures in the simulation that reflect those that students might find locally
- I created all the materials needed and laminated the cards for repeated use.
    - In the earliest version I made cards mounted on head bands to make it easier to see on the floor, but the simulation runs just as well with cards held in hands.
    - I have two sets of cards depending on whether teachers want the creatures classified as herbivores etc or plant-eaters etc.

Basic Procedure:
Warning: Tolerance for noise and overacting is needed for this simulation – some kids will enjoy creating a loud prolonged death … or 'eating' others!

- Group class around the 'bed' to describe the Rules:
- The left hand holds creature card so name can be seen at all times;
- The right hand is placed on the shoulder of creature to be eaten (forms the chain).
- A dead creature hangs its head, and can only be eaten once!
- Issue creature cards (choose the best water bird eg teacher, or small child?)
- Tell the story stopping for each to be enacted (and giving instructions as to how to do this)
- Identify the 'pond' (brown blanket);
- The effects of Spring: warmth and sunlight = plant growth (add green strip in middle of pond);
- invite herbivores to feed on plants (green strip);
- invite carnivores to feed on herbivores (creature of choice);
- invite detritivores to feed on dead plants or creatures (creature of choice);
- invite water bird to eat (creature or plant of choice). (see Fig 12 below)
- Create a disaster to remove plant life (whip green away);
- follow effects through the food web and its chain parts:
- all uneaten herbivores head down = dead;
- detritivores thrive,
- carnivores survive some time;
- water bird flies away! (boatmen may too if they have survived)
- Discuss what happened especially the importance of plants in water places.
- Follow-up could be, or this could follow, an aquatic macro-invertebrate session.
- Some teachers have also photocopied the cards for colouring

Fig 12: Web of Water Life Simulations will vary with the group
Left: The Rainbow Secondary College year 8 Science class had a pelican (at the back) at the top of their Web of Water Life Simulations. Clear linkages illustrated a possible food web.
Right: For the Hopetoun Preschool, crepe costumes helped the children become the creatures. For these pre-readers, the shapes, colour and movement to act out, specific to their creature, were discussed as each part of the story unfolded. Each 'creature' then entered the 'pond' scene with appropriate movements eg the big paddling arms of a boatman cf writhing 'wriggler'. The colour of the costume matched the food preferred and helped them choose whom to eat: plant-eaters (green), other creature eaters (red); eaters of dead things (white). These costumes have had a half a dozen uses and most are still going. The effects of the loss of the plants had as great an impact on this age as it did with older children, and helped them recognise that plants in the local pond were important.

SALINITY SIMULATIONS

Salinity is a huge issue in the lower Wimmera especially along the river, hence many of my simulations concern salinity. My Salty Wimmera River Simulation adds proportions of water and salt into a bucket, checked for salinity levels after each addition, to mimic the River as it flows downstream. The instructions for this were in my workshop paper for the 2005 National Waterwatch Conference [2] and so I will introduce some other simulations this time.

Examples 13/14: Salinity tolerance for plants simulation

Children have been growing seeds in Science classes for a long time. In this simulation, I combine two visual effects of salinity: seed growth and salty liquid to salt crystals via evaporation. They can be done as two separate simulations – I used to. But when joined, they have a greater impact in showing that salt is in water that affects the growth of plants.

Demonstrates:

- Effects of salt and salinity on the growth of plants
- Salty water evaporates and leaves salt crystals
- Different tolerances of plants
- If all crops fail … it was probably in too cold or too dark a place.
- Setting up an experiment with a minimum of variables.
- Higher salinity levels contained more salt crystals when evaporated

Materials:

- At least 500 ml of water of a specific salinity for each group- labelled, of a range of salinities
- Salinity scans
- A small container for each group to put water in for evaporating
- A low container for each group to grow seeds in
- Cotton wool for each seed bed
- Seeds – barley is good
- Labels
- textas
- Record sheet –group based or class based?
- Space where there is sun and warmth,
- Time to sit and grow (about 3 weeks)

Creating the materials:

- Choose re-use materials where possible eg empty bottles, cleaned margarine containers
- (13) Make up to water samples to desired salinity levels to mimic local water sources. (If local water samples are used there may be other differences in the water which could contribute to differences in growth.) An example of a set of samples might be:
    - No salinity rainwater (10 EC),
    - Low salinity Dimboola townwater (600 EC),
    - moderate salinity other towns water (1413 EC),
    - high salinity often farm dam water (2760EC),
    - almost saline river water at Dimboola (5000 EC),
    - saline Lochiel (10000 EC),
    - almost sea salinity Antwerp (25,000 EC),
- (14) Shopping for other materials eg seeds of one type, cotton wool

Basic Procedure:

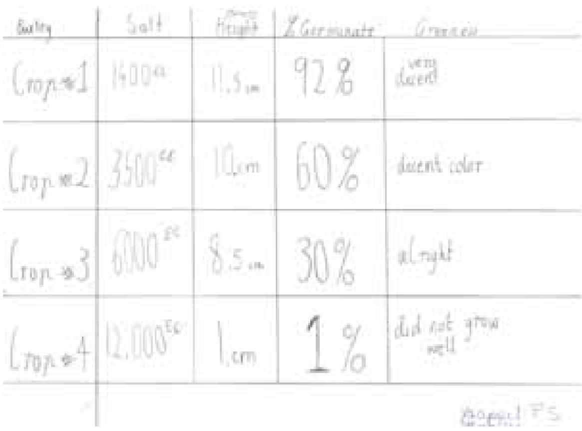
(13) Setting up the evaporation containers:

- Discuss how we know how much salt is in water.
- Divide into groups
- Issue water samples to be tested and each group marks their names on it.
- Test the salinity and mark that on the bottle.
- Discuss how we could see how much salt is in the water. (via evaporation)
- Issue to each group, a container for evaporating and sticky labels to identify this.
- Pour a little from the sample bottle into its container to a low position (eg first line on a margarine container).

(14) Setting up the barley growing trays:

- Discuss what plants need to grow (Sunlight, warmth, water, ‘soil’, time)
- Discuss how we can keep this experiment so only water varies between the samples.
- Issue the materials to set this up: 1 tray per group; Cotton wool for soil; wet the cotton wool with the sample water already given; place Barley seeds onto moist cotton wool;
- Issue labels to stick onto containers with group names and salinity levels.
- Place evaporation container and seed tray in a warm, light place to germinate and grow (see Fig 13 below)
- Check daily and record of progress of the seeds and evaporating water (see Fig 14 below)
- Share the results between the groups.
- Identify the level of salinity at which barley grew best (nb it is a salt tolerant crop)
- Discuss the container results: higher salinity, more salt crystals

Fig 13: Stages in the Salinity Tolerance for Plants Simulation: left - set up complete for this group at Yaapeet Primary School; right - Beulah Primary School’s completed experiment. (The barley didn’t grow in 13,000 EC water, but did best at about 2000 and 2500 EC.)



Barley	Salt	Height	% Germinate	[illegible]
Crop #1	1400 EC	11.5 cm	92 %	very decent
Crop #2	3500 EC	10 cm	60 %	decent color
Crop #3	6000 EC	8.5 cm	30 %	alright
Crop #4	12,000 EC	1 cm	1 %	did not grow well

Fig 14 : Yaapeet Primary School’s record sheet showing that the barley grew well on a moderate level of salinity. This was an expected result.

A DIVERSION: MY SIMULATION DEVELOPMENT PROCESS

Before my last example, I will describe how I develop my simulations.

- **Identify the need** (processes or facts),
- **Develop the simulation,** by considering
  - the background of the target group: age, abilities, background knowledge,
  - potential materials to show the process or facts,
  - cost, safety, re-usables, shopping, on site or brought with me, transportability, durability, sustainability, 'home-made' or manufactured via tender.
  - Trial the draft simulation at home to ensure it works the way I want it to.
    - If not, modify it til it does. (see Fig 15 below)
  - Develop any teacher reference material and student worksheet that would enhance its use.
- **Use it,** get feedback from teachers.
  - Modify it to make it more suited to other groups or needs so it can be used again.
  - Consider any other processes, concepts, facts that it could be linked to.

Many of my simulations have started from the need to demonstrate something in a classroom setting for a National Water Week, World Water Day or Saltwatch session. They use simple, cheap household materials. This makes them very portable, and I try to be an example in the wise use of resources by choosing re-use materials wherever possible.

Example 15:"River increases in salinity after rain event" simulation

This is my most recent simulation, and it is still being developed. The need for it arose when the Jeparit salinity readings for the Wimmera River did not respond as students and adults expected (ie go down) after what seemed like a good rain event ('One inch' of rain fell over the previous weekend). Instead they rose by about 20,000 EC's to about 70,000 EC's.

Demonstrates:

- Rain dissolving salt crystals
- evaporation of salty water leaves salt crystals,
- downward movement of salty water in the ground,
- upward movement of salty water in the ground.

Materials:

- salt
- river water
- rain water in jar
- 4 new sponges
- 4 clear plastic containers
- 4 sticky labels

Creating the materials:

- Most were available at the school, including the river water sample after testing
- The containers were a re-use material from home from cheese slices
- Only sponges had to be bought, when the packet at school was found to be empty!

Basic Procedure:

- Discuss if the raised salinity was expected and the reasons for this simulation
- Issue sponges to go in each plastic holder.

- Label plastic containers as:
- 1 Puddle –'rain' (sprinkle rain water – students will enjoy this more than just tipping and it can be shared around more) water on one sponge til it is soaked up by the sponge and has filled the container up half the depth of the sponge
- 2 River - fill the sponge and container up to the same depth as the Puddle one. 'Rain' a little on top.
- 3 Bank –put a layer of salt on top of the sponge. 'Rain' on top, watching the salt dissolve, until the salt crystals have all 'gone' and there is at least some water on the bottom of the container
- 4 Ground water – Remove the sponge and put a layer of salt underneath the sponge. 'Rain' on the salt and watch to ensure all the salt dissolves. 'Rain' enough so that there is a layer of water on the bottom of the container. Replace the sponge.
- Put all containers into a sunny, but sheltered, position and leave for them for a few days (depending on weather) to evaporate. (see Fig 15)
- Discuss the results and how it explains why the river's salinity rose after rain. (Rain dissolved the salty white crust on the banks. This could only go down into the river.)
- Can lead into where the salinity comes from here (salty Parilla Sandstone layer - underground water, and evaporation of salty river water with no flow in the drought.)

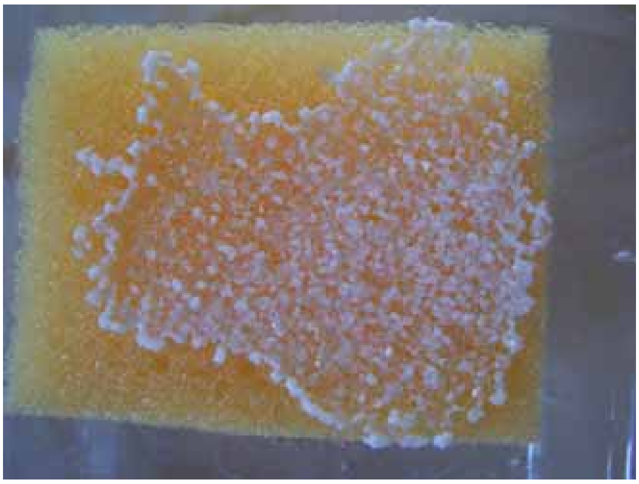


Fig 15 Salt crystals reformed after being dissolved by rain water in a couple of days. (Most did not soak into this fine sponge - a coarser sponge was needed to show infiltration better.)

CONCLUSION
Simulations and demonstrations can show simply what we want them to, becoming a valuable key to understanding specific facts and sometimes providing a pathway to monitoring and other ways to care for our environment. I enjoy creating them and seeing people respond to using them. I hope you will too.

References

1. Sale, C.J. & Sale, M. E. *World, Water and Environment.* Sydney, Shakespeare Head Press. page 87 (1973)
2. Clark, Jeanie. 'Simply Simulating: Waterwatch simulations for the classroom.' *Paper in the Proc of 4th National Waterwatch Conference: Navigating the Rapids.* Melbourne 2005

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