



Middle School SEED: Understanding ‘Tragedy of the Commons’ and Using ‘Carrying Capacity’

(Submitted by Martin Spreckley, 2018, while serving as Science and SEED Teacher at UWCSEA, Singapore)

Tool(s) used:	<ul style="list-style-type: none"> • Sustainability Compass • Systems Iceberg • Behavior Over Time Graphs (BOTG) • Causal Loop Diagrams • Systems Mapping
Purpose of using tool:	<ul style="list-style-type: none"> • Generating Questions • Synthesizing Thinking • Guiding Discussion <p>Overview:</p> <p>As part of the SEED course we introduce a range of Systems thinking tools to better support our students and help them understand the bigger picture behind a range of local and global issues.</p>
Context of lesson/case study:	SEED Class
Participants (# and description):	SEED is for all middle school students- I teach a range of Grade 7 and 8 classes (6 classes- approximately 140 students)
Topic, Theme, or Key Understanding of unit/project:	Current unit is understanding 'tragedy of the commons' and using 'Carrying Capacity' and Behaviour Over Time Garphs
Length of unit/project:	3-4 lessons (80 mins each)
Resources/materials & setting required:	<p>Lesson 1 begins with the Harvest Game (from Systems thinking Playbook)</p> <p>PDF copy of presentation</p>
Lesson Plan/Description of the Project:	
<p>PDF copy of the presentation is included above.</p> <p>Lesson 1 sees students playing the Harvest game in 5 groups. After running this lesson a few times with different groups, I put together the following notes for other SEED teachers:</p> <p>To play this game with a class of 20-24 students you will need (all these materials are already prepared and should be together with Martin or in B410 SEED room):</p> <ul style="list-style-type: none"> • 5 boats • 5 fishing company cards (detailing the type of fishing company for each group) • A few hundred laser cut fish • This tally chart to record #fish each season • Instructions (from the Systems thinking playbook) <p>Before the lesson: Read the instructions and familiarise yourself with the rules!</p> <p>What worked for me:</p> <ul style="list-style-type: none"> • Split the group into 5 teams and assign each team with a card (they read their own but don't talk to 	





other groups)

- Introduce the term 'Carrying Capacity'
- Tell the students that the 'Carrying Capacity' of the ocean they will fish in is '50'
- Tell the students that they won't know how many fish are in the ocean to begin, but that they know the ocean is in a fairly healthy state
- Begin with 40 fish in the ocean (don't tell them!)
- Let them know they can fish any number between 0 and 6 fish per year

Begin the game:

- After round 1, complete the projected tally chart so all groups can see how many fish were collectively taken from the ocean.
- If 20 fish were taken in total, then we're down to 20 in the ocean - repopulate (less than 25 means you double the number, so now we're back to 40).
- If more than 20 were taken then it's the start of a slippery road (although they don't know this yet...)
- Let play continue for a few years - expect the ocean to be dead within a few years.

Discuss with the class and plot the BOTG

Introduce the term 'Tragedy of the Commons'

Play again - this time they can collaborate, and try and improve on their total from the first game.

If you want to introduce new factors during the game (because they have been fishing sustainably for a number of years) you could:

- Increase the maximum to 8 (they have been successful for a few years so have made enough profit to invest in 'improved' fishing techniques, bigger nets, larger boats)
- If this doesn't tempt any group to over fish, then you, master of the seas, could secretly remove a number of fish from the ocean - this is mean, as the students continue to do what was working but it brings about disaster. This is what happens when an event occurs that changes fish population (disease, for example)

Lesson 2: begin with a quick HW review and reinforcement of the terms and vocab. Followed by discussion of the Compass points from the different perspectives of the various fishing companies. (i.e. the different social impact for the local fisherman that will need to relocate or change industry after the fish stocks are depleted vs the multinational that moves on and repeats the damage elsewhere).

Students then compass the issue in their small groups (photo linked). Subsequent lessons introduce Causal Loop Diagrams (older students have seen this in Grade 7) and we use Loopy to look at reinforcing and balancing loops before working collectively to create a Causal Loop Diagram of the 'Harvest' game.

Reflection

Plusses:

Excellent understanding of the range of systems vocab and terms. Student were engaged in the game and the series of lessons included a nice blend of group and individual work.

Challenges:

Students that have not previously used Causal Loop Diagrams will need more time and simpler examples of the different types of loops before mapping the Harvest game as a whole class - It's easy for students to let others contribute if they are unsure and these could slip through the net.

Suggestions for other practitioners and educators:

When compass mapping the fishing game, students tend to focus on the N and E and struggle as little with points S and W. This might need teacher input and class discussion: loss of culture and history of fishing industry, government intervention etc.





Evidence and Resources:

