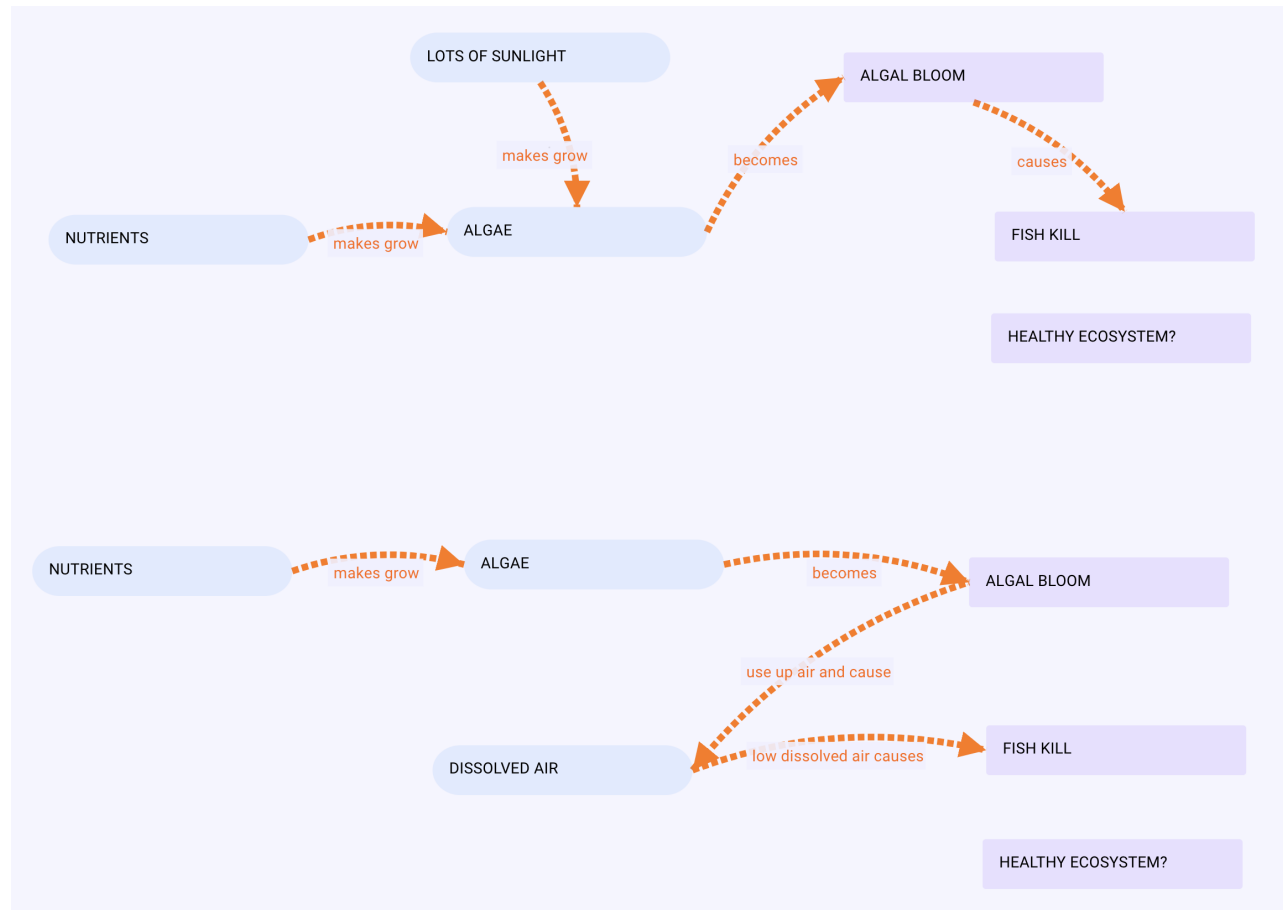


SEEDS Y3 Overall Plan

Initial model 1 & 2:



Coordination of evidence and models:

E set 0	Description	What we want students to see (conclusion)	How will students change the model as a result	Notes
Our ideas	A placeholder of sorts to allow students to include other ideas that they know from home / before ...	That we can use prior knowledge at times, but also should be open to discussing when / how.	This would allow them to connect evidence to ideas they bring. Thus we can encourage them to have at least one link on every element of the model. No other changes expected.	
Description of video	A summary of the key ideas from the video so that it doesn't need to be re-watched to be referenced.	That there was fish die-off when lots of "green" during the key months under study.	No changes expected. Though possibly ruling out some changes.	
E set 1	Description	What we want students to see (conclusion)	How will students change the model as a result	Notes
E1-0 The Story	Sets up the phenomena: there are two ponds, Orange and Blue. Description and graphs detail how many fish are	Understand the phenomena that more fish are dying in Orange pond, which poses the question: why are the fish dying?	No changes	NA

	dying and when they are dying in each pond			
E1-1 UV	Bar graphs showing the average amount of daily sunlight (UV) from April to October at Orange and Blue Pond. The months in which fish are dying are shown on the bars.	Shows no difference in amount of sunlight between ponds which suggests that sunlight is not a causal factor	Rules out the sun explanation (model A) because it empirically shows that the amount of sunlight is essentially the same in both ponds	Sunlight evidence set 1 potential conflict with simulation in set 2. The simulation includes light as a variable and it increases algae growth. However, E1-UV suggests light does not matter.
E1-2 Nutrients and algae	Line graphs to show the amount of algae in Orange and Blue pond from April to August and how the amount of algae increases after rainfall.	Shows that the level of nutrients and algae in both ponds is the same. Thus nutrients are the initial cause for the bloom in both ponds.	This supports the existence of nutrients in the causal mechanism but suggests it is not a reason for the difference between the ponds as both models have nutrients.	None
E1-3 Dissolved oxygen generic (tanks)	Table and graph to show how much dissolved air fish need to be healthy (swimming rate) and how much is too low (generic)	Shows that fish need oxygen and without dissolved air in the water the fish will become ill.	Supports model B but doesn't rule out model A	
E1-4 Dissolved oxygen in Blue and Orange ponds	Bar graphs to show the amount of dissolved oxygen in Orange Pond and Blue Pond from April to August	Shows that in our specific ponds there is a difference in the amount of dissolved oxygen. Orange pond has less dissolved oxygen.	Supports model B but doesn't rule out model A	Needs to be interpreted alongside E1-3, in order to conclude that the levels of dissolved oxygen in Orange pond dip below the level that can support fish (based on E1-3)

E set 2	Description	What we want students to see (conclusion)	How will students change the model as a result	Notes
Simulation	Shows relationship between nutrients, dissolved air, fish, algae, circulation, light	The variables create certain conditions in the pond. For example, more nutrients mean more algae and less dissolved air. We want students to see that more fish die when there is less dissolved air and circulation increases the amount of dissolved air.	Incorporate the role of dissolved oxygen and circulation into their model (based on model B)	This somewhat counters the ruling out of B because sunlight does matter (except it's not relevant in this case). This supports the dissolved air as well and supports potential role of circulation- but what impacts circulation is unclear- problematizes need for evidence about circulation in actual ponds
E set 3	Description	What we want students to see (conclusion)	How will students change the model as a result	Notes
E3-1 Landscape photos	Shows photographs of the ponds and the features in the surrounding area, such as plants, steepness of bank, and importantly fountain/no fountain	We want students to attend to the different features of the pond, one of which is a fountain (hidden, not explicit)	Doesn't explicitly support either model. Implicitly supports circulation component in revised model B.	Possible link between circulation in E2 simulation and fountain. However, this is an inference students may not make yet.
E3-2 Fountain and dissolved oxygen	Shows the amount of dissolved oxygen in an artificial pond (pool) with a fountain. Compared levels of dissolved oxygen when	The amount of dissolved oxygen is lower in Orange Pond, the pond without the fountain, than Blue Pond, the pond with the fountain.	Supports model B that dissolved oxygen is a factor. Students should be adding fountain to the model and linking it to dissolved oxygen.	At this point we expect students to link fountains and oxygen levels and connect that to the fountain in Blue pond. Begin to see the fountain as the causal agent.

	fountain is turned on versus off.			
E3-3 Water circulation	A diagram shows water circulation in an artificial pond with a fountain.	Water circulation is greater in the pond with a fountain, highlighting the relationship between dissolved oxygen and circulation	Supports model B that dissolved oxygen is a factor. Possibly add circulation in model.	Taken together E3-2 and E3-3 suggest that the fountain churns water and adds oxygen. Neither evidence includes this explicitly but the inference can be made (and strengthened) when looking at them together.

Overview of Instructional Sequence and General Approach

Summary- The anchoring phenomenon is eutrophication in two ponds resulting in a fish kill event. Briefly, an influx of nutrients results in an algal bloom which subsequently depletes the water of dissolved oxygen leading to mass death of fish. One pond is more severely impacted because it lacks a fountain and therefore water circulation in it is reduced and it has less dissolved oxygen. The second pond fairs better because the fountain in it aerates the water resulting in less oxygen depletion. Students will be provided with two alternative models- 1) an increase in sunlight (in addition to nutrients) causes the bloom and the bloom itself causes the fish to die; 2) the bloom uses up the dissolved oxygen and that kills the fish. Students will also have access to evidence (in three sets) that include both empirical reports and a simulation. Using the evidence students will determine which model is better and continue to revise it given the evidence.

- Motivation- students will be told that they need to figure this problem and suggest a solution to a fictitious mayor who needs to decide what to do about this issue. The mayor has two competing accounts from two local scientists who live in the town. The students' job is to figure out who is right.
- The instructional design follows a storyline approach in that it begins with a larger driving question and as pieces of the puzzle are figured out they raise new questions and open the space for more inquiry.

There will be 6 sessions in the clubs organized as follows:

Session 1- Scenario and Models

The Scenario (anchoring phenomenon)- Can be done through a role play scenario- see motivation above

There are two ponds: Orange and Blue. In the summer around July, fish started dying in both ponds. However, many more fish died in Orange pond and they died for a longer period of time. In Orange pond, many more fish died in July and the death rate only goes down in September. In Blue pond, fish start dying in July but fewer died that month and only died until August. Note, ponds were stocked with the same number of fish at the start. Include Fresh.org script as well.

- Present the two competing models-
 - Model A: Sunlight is stronger in the Orange pond causing blooms which kill fish
 - Model B: Dissolved air is lower in the Orange pond causing the fish to die
- MEME
 - Introduce the basics and how to use it: how to add/remove outcome, entities and processes

Session 2- Evidence Set 1 (empirical reports)

- Criteria for good models discussion- present students with a comparison of two models (from our criteria list activity of last year, or modified) that can spark discussion about which is better and why in order to help students understand the idea of criteria. Then we will provide a list of 6-7 criteria and they can select the 4 most important that will serve as class criteria for the club. These criteria will help students in their coordination of evidence and models and their revision of models.
- Introduce Evidence set I
 - This evidence set includes 4 pieces of evidence (and the scenario as E0). The evidence suggests that light was not a factor and that low dissolved oxygen is a factor. This information should rule out model 1 and support model 2 (taken together the evidence set is diagnostic, ruling out one model while supporting the other).
 - UV- Shows no difference in the amount of sunlight (UV index) between ponds which suggests that sunlight is not a causal factor
 - Nutrients- Shows that there is an influx of nutrients after a rainfall but that the level of nutrients in both ponds is the same. This supports the existence of nutrients as the causal mechanism but suggests it is not a reason for the difference between the ponds as both models have nutrients
 - Dissolved air generic (tanks)- Shows that fish need oxygen and without dissolved air in the water the fish will not be healthy.
 - Dissolved air in Blue and Orange ponds- shows that in our specific ponds there is a difference in the amount of dissolved oxygen over the course of the summer. The aim of this evidence is to strongly support model 2 and the explanation that dissolved air is the cause.
 - Students will work with this evidence in groups and decide how it relates to the models
- Whole group discussion of how the evidence relates to the models- anticipated outcome is to rule out model 1 and position model 2 as the more accurate model. As well as to raise the question of- why is there low oxygen in the ponds and why is it lower in Orange pond?

Session 3- Evidence Set 2 (simulation)

- Introduce Evidence set 2- the simulation- The simulation shows relationship between nutrients, light, dissolved air, fish, algae, and water circulation -- This is a simulation of a generic/typical pond not any of the specific ponds in question.
 - This simulation presents an interesting context for evidence-evidence and evidence-model coordination because it somewhat counters the ruling out of the first model as sunlight in the simulation does matter (except it's not the agent of change in this case). The simulation does support model 2 and highlights the potential role of circulation. Thus it problematizes the need for evidence about circulation in actual ponds (ground truthing).
- Students will revise the leading model based on the simulation
- Review club criteria for good models
- They will prepare the models for a gallery walk in the following session

Session 4- Gallery Walk (critique)

- Review club criteria for good models and prepare for gallery walk (instructions)
- Each student group will review the models of 2 other groups and will also receive two sets of reviews.
- Groups will review the critiques they received and revise their models

Between sessions we will also provide additional critique from us.

Session 5- Evidence Set 3 (empirical reports)

- Groups will continue their revision of the models- addressing critique
- Introduce Evidence set III- this set provides information that connects the circulation variable students identified as relevant in the simulation and the actual ponds (blue pond has a fountain and fountains increase circulation and hence dissolved oxygen). This evidence essentially provides ground truthing of the simulation by showing what is increasing circulation in the actual ponds. The set includes:
 - Landscape photos- shows photographs of the ponds and surrounding area- shows that Blue pond has a fountain and Orange pond does not
 - Fountain and dissolved oxygen- shows the amount of dissolved oxygen in an artificial pond with the fountain turned on or off- there is more oxygen when the fountain is on
 - Water circulation- shows water circulation in the pond with a fountain

Session 6- Finale

- Groups present their final models to the mayor (role play). This can double as a consequential task and as post-interview. Each group will present to a representative of the mayor's council and will be "grilled" on their model and why it is good (how they know what they know).
- Games- while groups are presenting other groups can play our concept cartoon games that get at criteria, evidence, and other epistemic aspects through playing.