Learning about Viral Epidemics through Engagement with Different Types of Models

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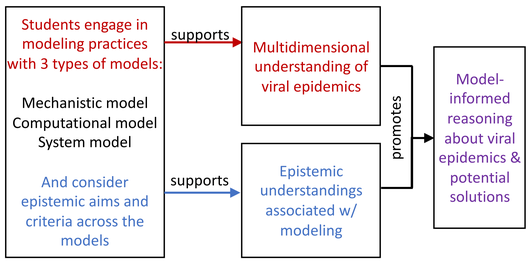
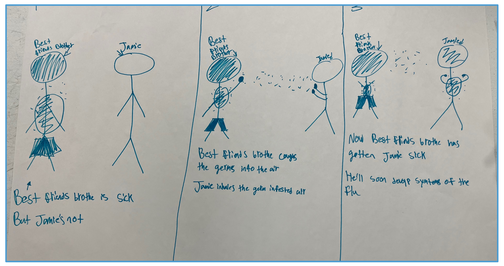
Project Overview

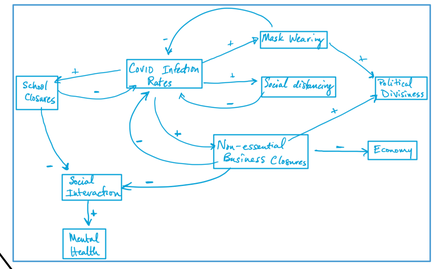
- Early Phase Design & Development in the Learning strand
- **Major Assumptions**
  - Viral diseases, their spread & impact on communities are multidimensional and complex (i.e., Socio-scientific Issue-SSI)
  - Models can support learner sense-making about complex phenomena & SSI
  - A single model is necessarily limited in terms of how it helps learners to understand an issue
  - Limited understanding of how learners use different types of models in the context of complex issues
- **Aim**: *Investigate how students make sense of different types of models for understanding viral epidemics and application of those findings to develop model-oriented curriculum materials to support learning about viral outbreaks and strategies for mitigating their spread.*
- **Goals**
  - I. Promote student learning about viral epidemics through engagement in modeling practices across different types of models.
  - II. Research student modeling practices and learning about viral epidemics and explore optimal ways to support student engagement with different types of models.
- **Research Questions**
  1. How do students make sense of viral epidemics through engagement in modeling practices across different types of models?
  2. How should opportunities to engage in modeling practices across different types of models be scaffolded and sequenced for optimally supporting student learning about viral epidemics?
  3. Tow what extent do students learn about viral epidemics (including conceptual understandings, model-informed reasoning, and epistemic understandings) through engagement in modeling practices across multiple models?
- **Theory of Change**

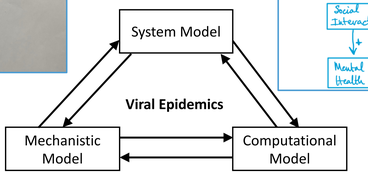


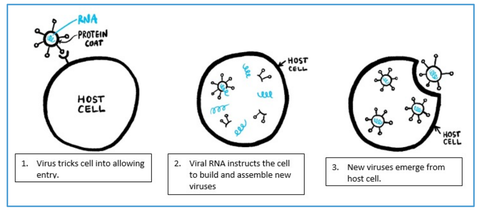
- **Design-Based Research**
  - **Phase 1.** Iterative testing of student learning experiences with various models. Study contexts have included lab studies with pairs of students, afterschool programs with small groups, and science classrooms.
  - **Phase 2.** Testing of three models embedded within a curriculum in an idealized teaching situation (summer camp.
  - **Phase 3.** Collaborate with teachers to design a model-based curriculum and implement in classrooms. Collect data on implementation and student learning.

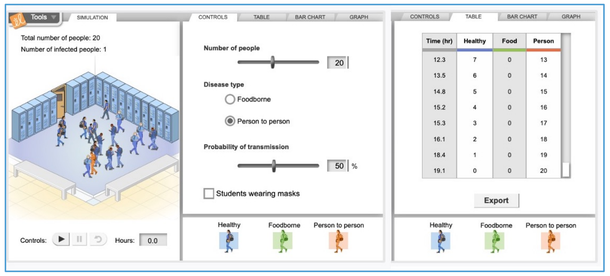
Sense-making with Multiple Models





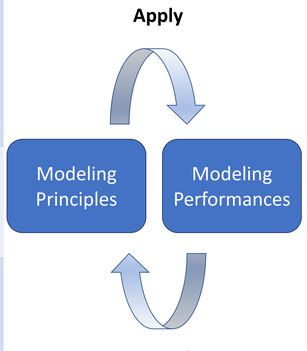






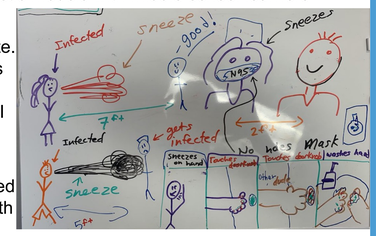
Framework for Modeling Principles and Performances

Modeling Consideration	Modeling Principle	Modeling Performance
Representation	• Models represent key features (e.g., conditions, components, processes) of system/phenomenon/issue • Models don't replicate reality • There are multiple representational forms of models	• Construct and use models to identify/represent/simplify key features of system/phenomenon/issue in their models • Move flexibly between different representational forms of models
Mechanism	• Models are used to explain system/phenomenon/issue • Models can be used to make predictions (based on the mechanism)	• Construct and use models to explain system/phenomena/issue • Construct and use models to predict system behaviors/scientific phenomena/issue dynamics
Communication	• Models are communication tools for conveying understanding/knowledge • Models are communication tools for supporting arguments.	• Construct and use models to communicate understanding
Justification	• Models should align with relevant evidence • Models are revised based on new evidence obtained.	• Construct/Revise/Evaluate models based on evidence • Select among models based on their evidentiary support
Limitation	• Different models have different merits and limitations • Multiple models combined could better represent/explain/predict system/phenomena/issue	• Recognize the merits and limitations of single models • Compare and evaluate the merits and limitations of multiple models

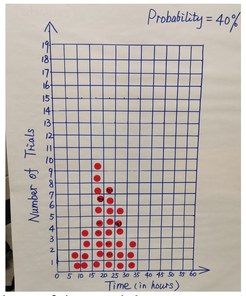


Early Findings

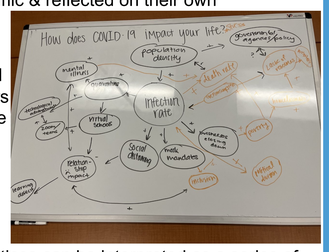
- Lack of attention to viral epidemics in the biology standards (state & NGSS) is a significant constraint for teachers. As a result of these concerns, we moved the project from high school biology to 8th grade.
- Testing of mechanistic models with middle school learners
  - Students can effectively create and use models to better understand viral transmission.
  - Creating these models prompted engagement with representation, limitation, and justification (from the project framework).
  - When considering mechanisms and limitations, students ground ideas in representational dimensions.
  - Students struggle to transition from the specific details of a particular situation that is being modeled to abstract representations that could represent a range of situations.



- Testing of computational models with middle school learners
  - A multi-variable agent-based simulation proved difficult for students to understand, but students were successful with a simpler model that focused on one variable.
  - Working with computational models created opportunities to consider probability and randomness as aspects of systems.
  - Students were able to able identity affordances and limitations of the models



- Testing of system models with multiple age groups
  - System modeling provided opportunities to articulate complex understandings rooted in their own experiences and reflect on the boundaries of their own knowledge.
  - Students demonstrated empathic concern for others impacted by a pandemic & reflected on their own positionality.
  - With a worked example as a scaffold middle school learners can effectively explore SSI through system models.



  - System modeling serve as a tool to support epistemic practices. These practices can be interpreted as a series of epistemic operations: proposing knowledge through factors, explanations, correlations and societal implications.
- Testing of learning experiences for middle school students with multiple models
  - Using different models highlighted model limitations for many learners.
  - Some students spontaneously used models as problem solving or knowledge construction tools, but most students needed scaffolds for model use.
  - Many students use surface features and details included as criteria for evaluating the quality of models.

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Refer to our project website for updates and materials:
https://tarheels.live/seel/projects/multiple-models/

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