Introduction to Complex Systems

Based on template by Jeremy Peacock, Northeast Georgia RESA

Lesson to Redesign or Plan

- Students can explain what a complex system is and find an example of a complex system from their own previous experiences with biological topics.
- Students can make predictions of how variables can change the outcome of a complex system, using a simulation model, as well as their own biological example

(NOTE: I am thinking this would be a great beginning of the year activity…)

Motivating Phenomenonl

https://www.youtube.com/watch?v=V4f_1_r80RY

This is a video clip of just the flock of birds moving together (as a system) to create that amazing movement. It would be shown (there is no talking in the video, just bird sounds) with the following questions to attempt to ask while watching (on a dry-erase board)

- How are the birds able to move in those patterns?
- Can you find a leader? Is there a leader? How can you tell who is in charge?
- What happens if one bird goes a different direction; a direction opposite of the general movement of the birds?
- How will the motion stop? Start up again? Change directions?
- Any other thoughts on the birds 'movements that you are thinking about?

Core Ideas: What are the Disciplinary Core Idea components you want to cover in this lesson?

-LS2.D: Social Interactions and Group Behavior
-LS2.C: Ecosystem Dynamics, Functioning and Resilience

Science & Engineering Practices:
List the specific elements of 1-2 practices the lesson will emphasize.

-asking questions and defining problems
-developing and using models
-use mathematics and computational thinking
-analyzing and interpreting data

How will you support students in developing understandings about the practice(s)?

(From the lesson plan):

1. Students will watch the following video on what a complex system is (same video used in our coursework):

Crosscutting Concepts:
List the specific elements of 1-2 crosscutting concepts the lesson will emphasize

-systems and system models
-patterns
-cause and effect

How will you support students in developing understandings about the crosscutting concepts?

(From the lesson plan):

1. Students will watch the following video on what a complex system is (same video used in our coursework):

https://www.youtube.com/watch?v=g5evD6AQeCQ&t=317s. With a partner, they will create a list of what features make up a system 2. With same partner, the students will come up with a real life, biologically based example of a complex system that they can come up with or have experienced (for example: diet and impacts on body, getting sick and impact on body, lack of sleep, drug/medication/alcohol use, polluting the environment (their own trash disposal, plastic use), etc.)	https://www.youtube.com/watch?v=g5evD6AQeCQ&t=317s. With a partner, they will create a list of what features make up a system 2. With same partner, the students will come up with a real life, biologically based example of a complex system that they can come up with or have experienced (for example: diet and impacts on body, getting sick and impact on body, lack of sleep, drug/medication/alcohol use, polluting the environment (their own trash disposal, plastic use), etc.)
How will you engage students in applying the practices(s) to make sense of the phenomena and/or design solutions to problems? (Continued from lesson plan): 3. Students will use the StarLogo Nova simulation on complex systems (set up like we did in class) to practice manipulating parts of a system and how it might impact the outcome of the entire system (this video first, then StarLogo Flock of Birds) https://www.youtube.com/watch?time_continue=460&v=g5evD6AQeCQ&feature=emb_title 4. After playing with the simulation, students will apply the same ideas to the biological example they came up with and try to answer the following questions to share on a dry-erase board: a. What is the desired outcome of the complex system?	How will you engage students in applying the crosscutting concept(s) to make sense of the phenomena and/or design solutions to problems? (Continued from lesson plan): 3. Students will use the StarLogo Nova simulation on complex systems (set up like we did in class) to practice manipulating parts of a system and how it might impact the outcome of the entire system (this video first, then StarLogo Flock of Birds) https://www.youtube.com/watch?time_continue=460&v=g5evD6AQeCQ&feature=emb_title 4. After playing with the simulation, students will apply the same ideas to the biological example they came up with and try to answer the following questions to share on a dry-erase board: a. What is the desired outcome of the complex system?

b. What are the smaller parts to the larger system? c. Give an example of what would happen to the larger system if one of the smaller parts was changed...try to be specific d. Who or what is controlling the actions or behaviors of the smaller parts? Can that be changed? e. Now that you have gone through this, can you think of even more biological examples of systems? 5. Answers would be shared out as a whole class in some format (sharing with whole class verbally, on a Google Form, lots of variations here	b. What are the smaller parts to the larger system? c. Give an example of what would happen to the larger system if one of the smaller parts was changed...try to be specific d. Who or what is controlling the actions or behaviors of the smaller parts? Can that be changed? e. Now that you have gone through this, can you think of even more biological examples of systems? 5. Answers would be shared out as a whole class in some format (sharing with whole class verbally, on a Google Form, lots of variations here
Integration: Explain how the three dimensions will work together to support students in making sense of the phenomena and/or in designing solutions to the problem By following the lesson plan flow as stated above, students will first be introduced to the topic of systems and system behavior through the phenomena. Next, they will explore simulations that allow them to test out and manipulate changes to a system and collect data so they can arrive at some type of concluding statement about systems and system behavior. They will be working in collaborative groups and sharing out ideas and discoveries with each other and the class as a whole..	