|  |  |
| --- | --- |
|  | Concept Assignment 9  PLTW Computer Science CSP Core Training |

# Models and Simulations

|  |  |
| --- | --- |
|  | Learning Objectives |

LO9.1 While working through activities in Lesson 4.1, the teacher will:

* Become familiar with the working environment and models of NetLogo.
* Learn how NetLogo models and simulates various phenomena.
* Create a NetLogo Behavior Space Experiment in NetLogo.
* Practice parameterizing a simulation in NetLogo.

LO9.2 While working through activities in Lesson 4.2, the teacher will:

* Explore the concept of emergent behavior.
* Experiment with the stochastic and deterministic behaviors.
* Modify a simulation’s assumptions to observe new behaviors.

|  |  |
| --- | --- |
|  | Introduction |

### Overview of Model Abstraction and Emergence

A model is a simplification of a real phenomenon. A simulation uses a model to predict, understand, or communicate ideas about the real phenomenon. Many models break time into discrete “ticks” of a clock and break space into discrete cubes with no variation inside the cube. For example, climate models break the atmosphere and oceans into 3-D meshes. A model typically retains some details (like one temperature and one pressure for the cube), while abstracting other details (like ignoring variation within the cube or ignoring dust in the air).

Seymour Pappert, founder of the LOGO languages, and his student Mitch Resnick, creator of Scratch, argued for the importance of having children work with computer models. Resnick, in his book *Turtles*, *Termites*, *and Traffic Jams* argues that a central reason to teach computing in early grades is to stimulate decentralized thinking. Centralized thinking by a problem solver causes them to overlook distributed explanations or solutions. Very complex behavior can emerge from a collection of simple agents. When students experiment with a collection of agents, each programmed by a simple algorithm, the real phenomena being simulated are more easily understood. The emergent phenomenon may be unexpected based on the agents’ algorithms, but seeing the model produce the simulated phenomenon is convincing: complex phenomena *can* exist without central control.

|  |  |
| --- | --- |
|  | AP CSP Enduring Understandings (EU) and Learning Objectives (LO) |

Specific concepts that are addressed include:

* Parameters provide input to a function or model and make the function or model more general. EU5.3 through LO5.3.1 [P3].
* Models can be used to explore and understand real phenomena. EU2.3 through LO2.3.1 [P3] and LO2.3.2 [P3]; and EU3.1 through LO3.1.1 [P4].
* Surprisingly complex behavior emerges from simple but highly parallel models. EU2.3 through LO2.3.1 [P3] and LO2.3.2 [P3].

|  |  |
| --- | --- |
|  | Part 1: Using NetLogo |

Parametrization of a model involves identifying and defining the parameters and their values required to create a relevant and accurate model of an object or behavior. Models and simulations in NetLogo have certain parameters defined that can be adjusted to manipulate the behavior of the simulation. Familiarize yourself with NetLogo as a tool for exploring parameterized simulation.

1. Work through Activity 4.1.3 Introducing Simulation Part 1.
2. Complete Activity 4.1.4 Varying Parameters.

|  |
| --- |
| Submission Item |
| 1. Activity 4.1.4: Complete Part 3 Challenges. |

1. Work with the Vants model in Activity 4.2.1 to investigate the phenomenon of emergent behavior and the difference between stochastic and deterministic behavior. Complete Parts 1 and 2.

|  |
| --- |
| Submission Item |
| 1. Activity 4.2.1: Submit a screen capture of the Vants simulation after the modifications described in Part 2. |

1. Work through Activity 4.2.2 to explore the Neural Net model.
2. Every model is a simplification, or abstraction, of the real subject. When creating a model, decisions need to be made about what will be abstracted and what details will be specified. Some phenomena are either ignored completely or generalized as to who they impact or what is being modeled. This is referred to as the model’s assumptions. By modifying a model or simulation’s assumptions, you can change the observed behavior of the model or simulation. Complete Project 4.2.3 Modifying a Simulation’s Assumptions.

|  |
| --- |
| Submission Item |
| 1. Prepare a presentation as described in Project 4.2.3. |

|  |  |
| --- | --- |
|  | Part 2: Considering Classroom Implications |

1. NetLogo has models and simulations that bridge into countless other disciplines, such as biology, social sciences, ecology, public health, and many more. Discuss with a partner or small group ways that you could leverage NetLogo to facilitate cross-curriculum collaboration.
2. Creating a model or simulation requires identifying which elements of the original are to be incorporated in the model. Choose a topic for a model or simulation in NetLogo and discuss what details and assumptions would be appropriate to include and which ones would be appropriate to ignore.

|  |
| --- |
| Submission Item |
| 1. Write a reflection about the things you learned today. Consider highlighting new things you learned, items you need to consider for implementing this in your classroom, and ideas and suggestions you heard from others. Use the questions in Part 2 of the assignment as prompts, but don’t feel limited or constrained by just those questions. |

**Trademark Attribution** PLTW, Project Lead The Way, and the PLTW logo are registered trademarks of Project Lead The Way, Inc. All other brand names, product names, or trademarks belong to their respective holders.