MC Matter Cycles at a Glance (approximately 3 traditional class days):

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| Seg | Model Move | Est Time  (min) | Overview | Resources | What did we figure out? |
| 1 | **P🡪Q** | 10-15 | **Students observe an ecosphere and begin to identify what they notice.** The class generates a list of what they notice and wonder about following observation of an ecosphere. Students can individually write on a doodle sheet before sharing ideas in small groups and/or the whole class. Along with asking students what they notice, ask them what they are wondering about. The intent is to have students recognize that the organisms inside the ecosphere are somehow getting what they need to survive, but it appears that nothing can get in or out. | * MC Doodle Sheet | We observed the phenomenon that organisms within an ecosphere survive even though it is completely sealed [\*see notes]. We agreed on a driving question such as “How do organisms within an ecosystem get the matter and energy they need to survive?” |
| 2 | **Q🡪M** | 35-40 | **Students generate model ideas about how matter and energy move through the ecosphere.** Based on their prior knowledge, students work both individually and in groups to generate an initial model that can explain how the organisms within the ecosphere are getting the matter and energy needed to survive. Students typically go straight to photosynthesis and respiration in their ideas; however the idea of waste (presence of nitrogen) is oftentimes not yet included. To deepen their understanding of model ideas and/or to extend the model, students participate in structured readings about cycling of matter (the carbon cycle and the nitrogen cycle). | * MC Doodle Sheet * MC Carbon Cycle Reading * MC Nitrogen Cycle Reading | In this segment, students generated a model that can help explain interdependence in ecosystems. More specifically, they have developed an understanding of how matter is cycled throughout an ecosphere. |
| 3 | **M🡪P** | 40-45 | **Students apply their model to a new phenomenon/question: what would will happen if we remove organisms from the ecosphere?** Now that students understand the concepts of interdependence and cycling of matter, we ask them to consider what might happen if we could remove one of the organisms from the ecosphere. The goal here is for students to use their model as a means for making a prediction. After making their prediction, they return to Isle Royale and consider how removing an organism relates to the moose, wolves, and food availability on the island. | * MC Doodle Sheet | Organisms within an ecosystem rely upon movement (cycling) of matter in order to survive. If there is a disruption in the cycle–an organism in the ecosystem is removed, for example–then that could cause a population of organisms to either increase or decrease, depending upon matter (food) availability. If the population increases, they could reach their carrying capacity, eventually causing the population size to decrease. |
| 4 | **P🡪M** | 20 | **Students return to their original model and consider what their understanding means for the Earth and not an idealized ecosystem.** Students have been exploring a simple, small ecosphere, and have generated ideas about how the organisms inside can survive, but what does this have to do with larger ecosystems? | * MC Doodle Sheet | We learned that Earth is closed with respect to matter, yet the sun is continuously supplying energy. Students should now have a model that they are satisfied with. |
| 5 | **M🡪Q** | 10-15 | **Students go back to their initial question and use their model to provide a final explanation that answers the question about the phenomenon.** | * MC Doodle Sheet | Students used their model to answer the driving question and further applied their understanding of matter cycling to the phenomenon of increasing carbon dioxide on Earth. |