Quick Guide to Using EcoChains Arctic Crisis ™ In Your Middle School Classroom

EcoChains Arctic Crisis is an educational card game developed to engage players in learning about the impacts of climate change on the marine Arctic food web, and includes adaptation & solutions.

Using Games in Teaching & Learning: Games offer active and engaging methods of introducing new concepts and reinforcing instruction. Emerging research is showing that concepts introduced through gameplay are more enduring than concepts introduced through more traditional instruction. In using games in the classroom be sure you allow time for dialog and debriefing with the students after play. Additionally, encourage breaks during gameplay to encourage discussion between the players on topics such as the development of ecosystem energy cycling, predictions from changes to the physical or biological elements in the ecosystem, or a discussion on maintaining biodiversity in the Arctic.

Extension: One way to expand game learning is to encourage the students to modify game play, designing their own variant of the game. Students should report back to debrief on the specific learning objectives they included and how their game design improved learning.

Learning Goals: Students will understand the nature of the marine Artic food web and the impact of a warming climate.

Note: Sea ice is a critical base for the Arctic food web. Depending on your class you may wish to introduce the role of sea ice in the Arctic prior to the students playing the game. Alternatively, in order to encourage critical thinking in your students, you might wish to play the game without an introduction, allowing them to arrive at their own understanding of the role of sea ice during the de-brief.

Objectives: The students will be able to:

1) Classify organisms by their roles in the food chain (primary producer versus consumer);
2) Organize a list of organisms into a food chain;
3) Predict how an event at one level of the food chain will impact the entire chain;
4) Recognize the dependence of the marine Arctic ecosystem on sea ice;
5) Describe the impact on the Arctic ecosystem from human choices.

Classroom Tips:

Space: This game builds out into a large web, so allocating enough space is critical. Students will not be able to play it at their desks unless multiple desks are pushed together; a lab table is ideal if available.

Time: The game can be played in a 40-minute class period. We recommend you allocate 10 minutes for directions and game set up, 20 minutes for play and 10 minutes for debriefing with the students after game play.

Players: Game play can be structured with 2 to 4 players.

Connecting to Curriculum:

Middle School science includes a wide-ranging rotation of topics, with EcoChains fitting comfortably into areas covered in *ecology, biodiversity, food webs, energy flow and climate.*

CONNECTING TO NGSS

DISCIPLINARY CORE IDEAS	
Standard MS-LS2.A: Interdependent Relationships in Ecosystems	
MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	Through EcoChains students build a web of predator prey relationships. They must look for food availability in order to place their cards; if the food is not available their webs will not develop and their species will need to migrate.
MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	There are marine and terrestrial inputs into the Arctic food web that the students are building. Humans form the major input from the terrestrial ecosystem in this activity. They can cause both the collapse of, or can contribute to the rebuilding of, parts of the food web. Building this into the discussion can add another layer to how students can learn from playing EcoChains.
Standard MS-LS2.B: Cycle of Matter and Energy Transfer in Ecosystems	
MS-LS2-3 Lesson Plans: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	The building of a marine food web in the Arctic that requires sea ice allows students to develop a model for cycling matter and energy flow that incorporates both living and nonliving components. This can be an inherent learning component of using the card game or it can be a more deliberate addition to the activity by asking students to generate an ecosystem model based on their food web.
Standard MS-LS2.C: Ecosystem Dynamics, Functioning, and Resilience	
MS-LS2-4 Using empirical evidence, construct an argument that changes to physical or biological components of an ecosystem affect populations.	The most obvious changes to physical and biological components come from changes in sea ice cover and impacts from the Actions and Event cards that students draw; however, the way that individual players construct their food chains also demonstrate effects on different species.
MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	Through the development of a variety of non-ice dependent ecosystem, ones that are heavily ice dependent, or ones that have a balance of sea ice and non-sea ice dependence, students will see how each impacts biodiversity.
Standard MS-ESS3.C: Human Impacts	
MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	Students will note that humans in the game eat the most widely of any of the species cards, taking advantage of multiple opportunities in the food web. The card game is constructed with a limited number of humans so that the game will not end too quickly. Students can take the card game and map out the number of cards in each spaces and species type in the deck in order to get a better sense of the intricate balance of producers and consumers in the food web, and the uneven hand that humans can have in the ecosystem.
Standard MS-ESS3.D: Global Climate Change	

MS-ESS3-5 Ask questions to clarify evidence of the factors that have contributed to the rise in global temperatures over the past century.	The Event cards in the game are the entry point for this discussion with the students.
ALIGNMENT WITH SCIENCE & ENGINEERING PRACTICES	
NOTE* - The after-gameplay debriefing works well with the *NGSS Practices	
Constructing Explanations and Designing Solutions	The players in the game are constantly finding solutions to changes in the food web due to shifts in sea ice, available species to incorporate into the food web, and to deal with events that appear suddenly in the game play.
Obtaining, Evaluating and Communicating Information	Each card carries information on predator/prey, their roles in the ecosystem and species requirements and information that players are evaluating as they build their web. As events impact the food web, players will need to communicate with each other in order to plan for successful migration of any displaced species.
Engaging in Argumentation from Evidence	Students can debate the role of humans and energy use, energy efficiency, whether sea ice is critical for the continuation of the Arctic food web, alternative energy, geo-engineering, and the role of migration in survival.
CROSS CUTTING CONCEPTS	
Cause & Effect	Cause and effect are visible in the changes in sea ice (both loss and gain) from both manmade and natural events.
Systems and System Models	The entire game is built as a system model. The Marine Arctic food web is a system that links together physical and biological impacts, with changes in one part of the system directly impacting other parts of the system. EcoChains is a very visual way to teach system science.
Stability and Change	The food web can be relatively stable without outside influences, but impacts from human initiated events, or changes in the number of top predators in the system (which students could experiment with by testing small changes to the deck) bring about immediate instability and change.
Influence of Engineering, Technology and Science on Society and the Real World	The Action and Event cards introduce the influence of engineering, technology and science in the Arctic marine ecosystem. Each one introduces a new technology or influence which provides an opportunity for discussing such topics as geo-engineering, energy use and production and sustainability.