Quarrybrook
EXPERIENTIAL EDUCATION CENTER

Program Title: **Energy Transfer and Ecosystems**

Audience: 6th-8th grade students

Program Theme: Energy, originating from the Sun, is transferred between species through an ecosystem's trophic pyramid.

Program Goals: This journey investigates the nutrient cycle and the flow of energy in an ecosystem. Through a group challenge students will demonstrate how energy dissipates as it moves through a trophic pyramid. Student sub-teams will then explore our ecosystem, each team studying an organism in a different trophic level, such as a producer, a primary consumer, a secondary consumer, or a decomposer, etc. Next, sub-teams will be rearranged to include an "expert" on each of the trophic levels. The new teams will be asked to design a scientific model to explain the relationships between their organisms. Student teams will become "published scientists," each creatively presenting their trophic model to the full group, in the form of a broadcast skit, journal article, poster, etc.

Next Generation Standards:
MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
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.

Objectives:

- **What are the objectives?** Students will know the structure and function of a trophic pyramid. Students will understand how energy is being both transferred and dissipated amongst species in an ecosystem. Students will work cooperatively on the research and design of a scientific model. Students will practice public presentation skills.
- **How will they be measured?** Student sub-teams will conduct observations on specific organisms in different trophic levels, and record their data to share with the other teams. Students will design a scientific model to explain how all of the organisms studied are connected. Students will "publish" their work by presenting their model in a creative way to the full group.

Program Outline:
Activity 1: WATER TRANSFER RELAY (15 min.) – This activity is designed to illustrate the transfer of energy in an ecosystem. Photons from the sun are transformed into chemical energy by plants. As that energy progresses through the rest of the food chain, some of it is lost along the way due to the metabolic processes of the different organisms within that chain. Using water to represent this energy, students will engage in a transfer activity that will help them connect with the concept before we

observe it in the physical environment. Students will be divided into sub-teams for a relay race. Each team will be given a predetermined amount of water in a cup, spoons for each member of the group, and an empty cup. Students will measure the water in their cup before they begin to pass the water down their team's line, from spoon to spoon, into the empty cup. At the end of the race, students will measure the amount of water that has been added to the empty cup and subtract that from what they began with. Inevitably, teams will have lost water as they were trying to move it from spoon to spoon. This represents the energy that does not get transferred to the next trophic level in an ecosystem. Our group discussion will set the stage for the rest of the day's investigations.

Teachers will be asked to split students into sub-teams. Quarrybrook instructors will explain the activity to the group. It will be helpful for teachers and adults to assist students with measuring their water before and after the transfer. Teachers are welcome to interject with connections related to energy transfer and what the students have been learning in the classroom.

Activity 2: SPECIES SPECULATION (75 min.) – This activity provides students with an opportunity to explore the ecosystem and discover the relationships between species. Each sub-team will study an organism in a different trophic level, such as a producer, a primary consumer, a secondary consumer, or a decomposer, etc. They will conduct a survey and inventory of their organism present in a specified area. Every student will record all of their group's findings on their own datasheet. Once all of the sub-teams have had time to develop their organism profile and inventory count, we will gather together for a discussion of the different trophic levels studied. As the sub-teams share, a teacher will record the information on a master list. We will then take a look at the larger picture together and encourage students to try to identify any relationships between the different species based on the field data collected. As we begin to identify connections, students will be introduced to the idea of scientific models and asked to work together to design a model (diagram, flow chart, etc.) they think will illustrate what they are observing.

PLOT TWIST! Before we set the students on this design project, we will create new sub-teams consisting of one member from each of the original teams, so that the new teams will have a representative "expert" from each trophic level studied. Equipped with data from each level, the new teams will be given time to brainstorm and design a model that explains any connections being identified. Students will be shown a trophic pyramid diagram that illustrates the energy flow through the different species of this ecosystem. We will also discuss the nutrient cycle and how energy cannot be created or destroyed, only changed in its form.

Teachers will be important in helping to guide the sub-teams through their field studies, and are encouraged to pose thought-provoking questions. Some groups may need more assistance than others in finding and counting the organism in their trophic level. It will be important for each student to have their own complete datasheet when we move into the model design activity.

Conclusion/Wrap-up:

Activity 3: PUBLISHED SCIENTIST (30 min.) – This will be an opportunity for students to practice "publishing" their work. Once a scientist completes their research, they find creative ways to present their information to the public. Student sub-teams will have a choice of several different ways to present their findings to the entire group. Examples could include a Discovery Channel segment (a skit with a script and a visual aid), a professional journal article (a summary write-up), a scientific poster, or another creative way of announcing their findings.

Teachers and Quarrybrook instructors will be available as support and content resources as the students need. This is a time for students to be creative and explore various ways to present information. If time does not allow for this activity, teachers are encouraged to continue this discussion and wrap-up back in the classroom.