

# The Ecology and History of Onondaga Lake: Exploring Haudenosaunee and Scientific Perspectives

## Middle School Curriculum

This curriculum was developed by Tom Mackey, with input from ESF and SU faculty. It is intended to be used in conjunction with at least one field trip to the Skä·noñh -- Great Law of Peace Center. Teachers may elect to cover one lesson or multiple lessons, depending on time and interest.

*Although the information in this document has been funded wholly or in part by the U.S. Environmental Protection Agency under assistance agreement **NE96276115** to **Syracuse University** it has not gone through the Agency's publications review process and, therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred.*

### Lesson 1: The Thanksgiving Address

**Location:** Skä·noñh -- Great Law of Peace Center

**Grade Levels:** 6-8 (Intermediate)

<p><b>Theme:</b> There are different ways of knowing something including both scientific ecological knowledge and traditional ecological knowledge. By studying the Haudenosaunee thanksgiving address, students can learn to use these different ways of knowing to consciously act in relationship with the environment.</p>	<p><b>Program Description:</b> This lesson is intended to be utilized in combination with other middle school lessons from this curriculum. It is completed first and introduces students to the notion that there are multiple ways of knowing, which is the guiding theme of this entire curriculum. Students will distinguish scientific ecological knowledge (called 'school science' here) from traditional ecological knowledge (called 'experience science' here) by first defining them both, and then applying each to diverse situations. Students will then learn about the Haudenosaunee Thanksgiving address and work with a section of it in order to find the ecological knowledge that comes out of this expression of gratitude. Finally, students will create mini-projects that express their own experience knowledge about something in their environment.</p>
<p><b>Objectives:</b> SWBAT orally give examples of (differentially) traditional and scientific ecological knowledge by writing about their life and presenting mini-projects that display both types of knowledge.</p>	
<p><b>Applicable School Content:</b></p> <ul style="list-style-type: none"><li>▪ Defining Science</li><li>▪ Social Studies- Cultural ways of Knowing</li><li>▪ Multiple means of expression (ELA and Art)</li></ul>	

## **School Standards:**

### **Science (NYS P-12 Science Learning Standards for Board of Regents' Consideration, 2016):**

- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms in a variety of ecosystems.
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and protecting ecosystem stability.

### **Social Studies/History (NYS Learning Standards for Social Studies 1996):**

- Intermediate 1.2: Important ideas, social and cultural values, beliefs, and traditions from New York State and United States history illustrate the connections and interactions of people and events across time and from a variety of perspectives.
- Intermediate 1.3: Study about the major social, political, economic, cultural, and religious developments in New York State and United States history involves learning about the important roles and contributions of individuals and groups.
- Intermediate 2.1: The study of world history requires an understanding of world cultures and civilizations, including an analysis of important ideas, social and cultural values, beliefs, and traditions. This study also examines the human condition and the connections and interactions of people across time and space and the ways different people view the same event or issue from a variety of perspectives.
- Intermediate 5.4: The study of civics and citizenship requires the ability to probe ideas and assumptions, ask and answer analytical questions, take a skeptical attitude toward questionable arguments, evaluate evidence, formulate rational conclusions, and develop and refine participatory skills.

### **ELA (NYS Common Core Learning Standards for English Language Arts & Literacy: Anchor Standards, 2016):**

- Reading 6-12.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- Writing 6-12.11. Develop personal, cultural, textual, and thematic connections within and across genres as they respond to texts through written, digital, and oral presentations, employing a variety of media and genres.
- Speaking and Listening 6-12.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- Speaking and Listening 6-12.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

## **Background:**

TEK/SEK: Scientific ecological knowledge (SEK, also called *school science* in this lesson) is a term used to describe the types of environmental understanding that are produced by western science and are based in observation, empiricism and statistical trends. Traditional ecological knowledge (TEK, also called *experience science* here) is the kind of understanding that comes from centuries of experience and survival within a particular environment. It is also based on observation but is validated by its applicability over generational time.

Thanksgiving Address: The TEK of the Haudenosaunee revolves around the gratitude and reciprocity that come from relationships to the natural world. For example, whereas SEK allows us to treat plants as coincidental objects that humans can utilize, TEK allows us to see them as beings that help us survive, so we reciprocate through gratitude and care. The thanksgiving address is an Haudenosaunee oral tradition that expresses gratitude to a

<p>number of significant natural entities and is delivered at the beginning and end of most gatherings. Many communities and individuals see the exclusive use of one kind of knowledge as detrimental to planet. Instead, we advocate the intelligent use of both SEK and TEK.</p>	
<p><b>Pre-Activities:</b>  Note: Many of these activities, especially the mini-projects, can be started as pre-activities and extended to produce much more enriched content.</p> <p><b><i>Pre-Activity #1: Starting with Gratitude (5-10 min.)</i></b>  Students will briefly pre-assess their conception of gratitude by filling out the gratitude questionnaire found in the appendices of this curriculum.  <i>Materials: Copies of the environmental gratitude survey</i></p> <p>AND/OR  Students will be asked to compile a list of 10 things that they are grateful for.</p> <p><b><i>Pre-Activity #2: Introduction to Thanksgiving (20-30 min.)</i></b>  The teacher will explain the function of the thanksgiving address to the Haudenosaunee. Efforts to clearly distinguish this thanksgiving from the November holiday should be made (although comparisons are encouraged). Students will then practice their understanding of gratitude to the environment by visually representing a place (i.e. drawing a point of view picture, drawing a map) that they see everyday and brainstorming labels to certain objects or entities in that environment that display reasons to be grateful for that object, and how they might reciprocate to that object.  <i>Materials: Pencils, markers, or crayons; paper</i></p>	<p><b>Assessment:</b></p> <p><i>Students fill out questionnaire</i></p> <p><i>Students create a picture of an appropriate environment and explain why they are grateful for several entities in the picture.</i></p>
<p><b>Program Outline</b></p> <p><b><u>Introduction</u></b></p> <p>1) The teacher will tell the students that there are different ways of knowing something and that today we are going to practice using two of them.</p> <p>2) The teacher will ask students to describe a place that they know about and share it with a partner (this could be somewhere they know about but never visited, or somewhere they inhabit everyday). This description could be done in writing, through a picture or orally, depending on</p>	

<p>teacher preference. The teacher will then ask students to explain how they came to know that place. For some of the students, they came to know it through personal experience, others through people that they know, and still others through books, television or maps. The teacher will explain that these are all different ways of knowing something.</p>	
<p><b><u>Activity #1: School-science vs. Experience-science (25 min.)</u></b></p> <p>1) The teacher will draw a t-chart on the board or poster paper with the name of a field of science that is applicable to the content of the class (e.g. biology, chemistry, earth science) or simply the phrase ‘school science’ written on one side. The teacher will ask students how a scientist knows something (e.g. through experiments, testing hypotheses, by reading the research of other scientists; for higher level students: reason, data) and will write these ideas on this side of the t-chart. The teacher will then write the term ‘experience science’ on the other side and explain that this is a way of knowing that is just as important and that the Haudenosaunee have used for centuries to know the environment in Onondaga County. The teacher will ask how a person knows something through experience (e.g. through personal interaction, by being passed down from generations, by being taught it, through art) and will write these ideas on this side of the t-chart.</p> <p>2) Individually or in small groups the students can then practice using both of these ways of knowing to answer questions in writing on the Ways of Knowing worksheet. Students will have to answer every question with both school-science knowledge and experience-science knowledge.</p> <p><i>Materials: Chalk/dry-erase board, copies of the ways of knowing worksheet.</i></p>	<p><b>Assessment:</b></p> <p><i>Student volunteers offer appropriate examples of school science and experience science.</i></p> <p><i>Students complete the worksheet (included at end of curriculum) and offer appropriate explanations of school science and experience science.</i></p>
<p><b><u>Activity #2: The Thanksgiving address (30-40 min.)</u></b></p> <p>1) The teacher will explain how the thanksgiving address, or “words before all else,” is(are) used by the Haudenosaunee. The teacher should emphasize that in this perspective, these aspects of the thanksgiving address are not simply objects but entities, and our relationship to them is similar to that which we might have with family. Efforts to clearly distinguish this thanksgiving from the November holiday should be made (although comparisons are encouraged).</p>	<p><i>Students identify all entities in the thanksgiving address</i></p>



<p>environment that is meaningful to them (e.g. houses, trees, sports fields, streetlights, gardens, pets, computers) about which they will compiled a mini-report.</p> <p>3) Students will then choose a manner of expressing their relationship to that aspect of their environment. This can be a story, a poem, a drawing, a painting, a collage, a video, or any creative combination for which there are appropriate materials. Students should create these projects keeping in mind that they will have to present them by pointing out:</p> <ul style="list-style-type: none"> <li>- The experience-science knowledge</li> <li>- The school-science knowledge</li> <li>- How any of this knowledge allows us to express gratitude for the environmental subject.</li> </ul> <p>4) Students will present their projects to small groups, or if the class is small, each student can present these projects to the class.</p> <p><i>Materials: Project supplies may include magazines, scissors, glue, paper, pencils, markers, crayons, video recording equipment (phones), clay</i></p>	
<p><b>Conclusion:</b></p> <p><b><i>Concluding Activity #1: Environment as Family (25 min)</i></b></p> <p>1) Students will practice thinking about the comparison of the thanksgiving address entities to family members. They will pick several entities of the environment from the thanksgiving address and briefly explain their relationship to them in writing (i.e. how they impact the entity and how they impacted by the entity). They will then compare each relationship to a kind of family member and explain their choice in writing (e.g. the trees are like an older sibling because they protect me from rain and the sun). They can share their thoughts with a partner or with the class.</p> <p><i>Materials: Pencils and paper</i></p> <p><b><i>Concluding Activity #2: Thanksgiving Address Memory (15 min)</i></b></p> <p>1) The teacher will remind the students that there are multiple ways of knowing and that using multiple ways of knowing can help us better answer important questions.</p> <p>2) Students can sit in a circle. Starting with one student and moving clockwise around the circle, each student will try to</p>	<p><i>Students draw a comparison between some beings in the thanksgiving address and family members.</i></p> <p><i>Students can name most entities in the address and give reasons for gratitude towards many.</i></p>

<p>name an aspect of the thanksgiving address that wasn't said by another student. When all the aspects are named, each student must then give one reason to be grateful for one entity of the thanksgiving address that wasn't mentioned by another student.</p>	
<p><b>Special Sites Extensions:</b>          To gain inspiration for their projects and to learn about how industry interacts with our ecology, the teacher can take students to the Honeywell visitor center. Here students can get a wonderful view of the lake as well as talk to the guides about how industry changed the lake and what the future might look like. The teacher will need to arrange to visit the Honeywell center: <a href="http://www.lakecleanup.com/public-engagement/onondaga-lake-visitors-center/">http://www.lakecleanup.com/public-engagement/onondaga-lake-visitors-center/</a></p>	
<p><b>Post-Activities:</b>  <b><i>Post Activity #1: Ending with Gratitude (10-15 min)</i></b>          Students will return to the gratitude questionnaire taken at the beginning of class. They will take the survey again, and then compare their thoughts before and after learning about the thanksgiving address.  <i>Materials: Copies of the gratitude questionnaire</i>          AND/OR          Students can revisit their list of 10 things that they are grateful for. How many of them show up in the Thanksgiving Address? They should be encouraged to add items and categories that they might not have thought above before studying the thanksgiving address.</p>	

## Lesson 2: The Plants

(Trees, Berries, Three Sisters, Medicine Plants, Small Plants/Grasses)

**Location:** Skä-noñh -- Great Law of Peace Center

**Grade Levels:** 6-8 (Intermediate)

<p><b>Theme:</b> We live in relationship with and depend upon the Trees, Berries, Three Sisters, Medicine Plants, and Small Plants/Grasses. Using the thanksgiving address, students can develop knowledge and responsibility associated with this relationship.</p>	<p><b>Program Description:</b> In this program, students will develop their understanding of ecological gratitude by looking at specific local plants. Students will first individually describe an individual plant on the property so that other students may locate it. In groups, students will then research a specific plant, locate it on the property, and present their knowledge to the class. Finally, students will build mechanisms to distribute and care for seeds of diverse native plants.</p>
<p><b>Objectives:</b> SWBAT show gratitude and reciprocate to the plants by observing and creating reports about a plant on the Skä-noñh property in small groups, and then completing a project to repopulate diverse native plants in their neighborhoods.</p>	
<p><b>Applicable School Content:</b></p> <ul style="list-style-type: none"><li>▪ Plant ecology</li><li>▪ Social studies: Cultural worldviews</li></ul>	
<p><b>School Standards:</b></p> <p><b>Science (NYS P-12 Science Learning Standards for Board of Regents' Consideration, 2016):</b> 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-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms in a variety of ecosystems. MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and protecting ecosystem stability.</p> <p><b>Social Studies/History (NYS Learning Standards for Social Studies 1996):</b> Intermediate 1.2: Important ideas, social and cultural values, beliefs, and traditions from New York State and United States history illustrate the connections and interactions of people and events across time and from a variety of perspectives. Intermediate 2.1: The study of world history requires an understanding of world cultures and civilizations, including an analysis of important ideas, social and cultural values, beliefs, and traditions. This study also examines the human condition and the connections and interactions of people across time and space and the ways different people view the same event or issue from a variety of perspectives. Intermediate 5.4: The study of civics and citizenship requires the ability to probe ideas and assumptions, ask and answer analytical questions, take a skeptical attitude toward questionable arguments, evaluate evidence, formulate rational conclusions, and develop and refine participatory skills.</p> <p><b>ELA (NYS Common Core Learning Standards for English Language Arts &amp; Literacy, 2016):</b> Reading 6-12.1 Read closely to determine what the text says explicitly and to make logical inferences from it;</p>	

cite specific textual evidence when writing or speaking to support conclusions drawn from the text.  
 Writing 6-12. 4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  
 Writing 6-12.11 11. Develop personal, cultural, textual, and thematic connections within and across genres as they respond to texts through written, digital, and oral presentations, employing a variety of media and genres.  
 Speaking and Listening 6-12.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.  
 Speaking and Listening 6-12.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

**Background:**

SEK/TEK: Scientific ecological knowledge (SEK, called *school science* in previous lessons) is a term used to describe the types of environmental understanding that are produced by western science and are based in observation, empiricism and statistical trends. Traditional ecological knowledge (TEK, called *experience science* in previous lessons) is the kind of understanding that comes from centuries of experience and survival within a particular environment. It is also based on observation but is validated by its applicability over generational time.

Thanksgiving Address: The TEK of the Haudenosaunee revolves around the gratitude and reciprocity that come from relationships to different parts or entities of the environment. The thanksgiving address is an Haudenosaunee oral tradition that gives gratitude to a number of significant entities of the environment and is delivered at the beginning and end of most gatherings.

Plants: While in western classification, the plants comprise a single diverse kingdom, in most Haudenosaunee knowledge systems, plants are instead composed of five distinct entities: the trees, berries, three sisters, medicine plants, and small plants/grasses. Each of these is addressed separately in the thanksgiving address, with distinct reasons for gratitude and reciprocation. From a traditional ecological perspective, many plants are our elders in that they pave the way for our survival.

**Pre-Activities:**

***Pre-Activity #1: Plant Knowledge (10-15 min)***

Students will take a few minutes to list as many different kinds of plants as they know. This can be made into a friendly competition to see who can name the greatest number. Students should then be asked to choose their favorite plants from their list and brainstorm, either in writing or orally to other students, why they should be grateful for that plant.

*Materials: Pen and paper*

***Pre-Activity #2: Plant Grouping (30-40 min)***

Students who have studied taxonomy can build on their knowledge of plants by thinking about how and why plants get grouped by humans. Several recognizable leaf or fruit specimens are given to individuals or groups of students. Students must then organize

**Assessment:**

*Students produce a classification system for the leaves that is justified in an accompanying text.*

<p>them either into groups or into a phylogeny by looking at their taxonomic species classification. The teacher should emphasize that this classification is based on evolutionary relatedness. Students should then re-group the organisms based on the functions the plant serves in the environment. This may require research but the students should be encouraged to use their observations as well. This classification can be drawn or the specimens can be pasted on a poster. The uniting functions of each grouping should be explained in writing either on the poster or on a separate sheet. The teacher can then review the Haudenosaunee organization of plants (i.e. Trees, Berries, Three Sisters, Medicine Plants, and Small Plants/Grasses).</p> <p><i>Materials: Pencils/pens, paper/poster-paper, plant research materials, plant specimens, print-outs of the specimen taxonomies</i></p>	
<p><b>Program Outline:</b></p> <p><b><u>Introduction</u></b></p> <p>1) The teacher will ask the students what gratitude is. The teacher will explain that in Haudenosaunee tradition, different parts of the environment deserve our gratitude for our relationship to them. The teacher will then explain that the Haudenosaunee practice this gratitude by giving a thanksgiving address at every meeting. The teacher may ask students to share anything they give gratitude to on a daily basis (e.g. saying grace before meals).</p> <p>2) The teacher will explain that in the thanksgiving address, the plants are often broken up into these different categories: rees, Berries, Three Sisters, Medicine Plants, Small Plants and Grasses. The teacher will then explain that the plants are each treated as beings that deserve our gratitude.</p>	
<p><b><u>Activity #1: Plant Observations (25-35 min)</u></b></p> <p>1) The teacher should point out that the place where we all now live grows several wild plants that were here long before us or the Haudenosaunee and that the Haudenosaunee have significant knowledge about many of these plants. The teacher should explain that the gratitude that we hold for something can come from knowing that entity. Much Haudenosaunee knowledge comes from centuries of careful observation and knowing.</p> <p>2) To practice this kind of gratitude observation, students will be brought either outside, or to a window place where they can observe a variety of wild plants. Each student will choose an individual plant that they see. Students must write as many</p>	<p><i>Each student produces a text that describes several specific details of one individual plant</i></p>

<p>descriptors of the plant as possible either in a list or in prose.</p> <p>3) Students will then be partnered up. One partner will read the description they wrote to the other. The second partner will have to do their best to observe the surroundings and identify that plant. The student who wrote the description will verify. The partners can then switch roles.</p> <p>4) The teacher should ask students volunteers to name new things they learned about a plant or things they noticed about that plant that they hadn't before.  <i>Materials: paper, pen/pencils</i></p>	
<p><b><u>Activity #2: Gratitude Project (40-50 min)</u></b></p> <p>1) Students will be broken into small groups of 2-3. Each group will receive a small packet of information about one plant that is found on the Skä noñh property. Students must first do their best to locate a specimen of this plant on the property. Teachers may need to assist students.</p> <p>2) Each group will have to sift through the information and create a small poster on a piece of construction paper. This poster should include:</p> <ul style="list-style-type: none"> <li>- The name of the plant</li> <li>- The thanksgiving address category in which it fits (i.e. trees, medicine plant, etc.)</li> <li>- A picture (either cut out and colored or drawn).</li> <li>- How the plant helps us.</li> <li>- How the plant helps other parts of the thanksgiving address</li> <li>- How we can help the plant</li> </ul> <p>3) Students groups will then present their posters to the rest of the class, either next to a wild member of that species, or in the center near a window through which that plant is visible.  <i>Materials: Research materials, poster paper, coloring/drawing utensils</i></p>	<p><i>Student groups produce a poster that includes an appropriate section for all the requirements.</i></p>
<p><b><u>Activity #3: Reciprocate to Plants (30-40 min) Note: This might best be done back in the classroom, since the plantable paper takes a day to dry.</u></b></p> <p>1) The teacher will remind students that part of knowing about something is both being able to use that thing, but also having to show respect and care for the being. The teacher should ask students volunteers to name ways we can repay plants for what they give us.</p>	<p><i>Students produce plantable paper and explain why this is an act of reciprocation.</i></p>

<p>2) The teacher will then point out that one way we can reciprocate, is to plant in a way that respects all the different kinds of plants that are in our environment. Students will then make native plantable paper. Each student or student group will be assigned one of the following: berries, medicine plants, three sisters, or small plants and grasses. Each group or student will be given a handful of native seeds from their assigned category. Students will then sort and identify the seeds (using the guide from the <b>appendix</b>), take paper pulp (shredded newspaper that is soaked for 50 min. and then blended) and mix their seeds into it. This mixture can then be spread out thinly onto a screen to dry. Students can either make different pieces of paper for different species or do research to determine which species can grow near each other. Students should take a piece of paper and label their project with their names. The teacher will need to arrange to pick up the paper when it dries.</p> <p>3) The teacher should then review how and where to plant and take care of this paper.</p> <p>4) The teacher should either ask student volunteers to explain, or have each student write a small accompanying text explaining how these plantable papers reciprocate to plants.  <i>Materials: Indigenous seeds, paper pulp (shredded paper soaked in water), screens for drying, research guides</i></p>	
<p><b>Conclusion (5-10 min):</b>  Students will choose one category of plant (Trees, Berries, Three Sisters, Medicine Plants, and Small Plants/Grasses) or come up with their own plant category and individually write their own thanksgiving address for that entity. Volunteers should be allowed to read their addresses.</p>	<p><i>Students write/read a statement of gratitude to a plant category.</i></p>
<p><b>Special Sites Extensions:</b>  Instead of observing plants at the Skä-noñh center for the reports, the teacher can take the students to Long Branch park, where there is high plant diversity on the lake.</p>	
<p><b>Post-Activities:</b>  <b><i>Post-Activity #1: Observation Journals (10-20 min repeated over several days)</i></b>  To practice the development of more personal knowledge, students can pick a plant that they see everyday and keep a journal about it. The teacher can determine the timeframe and the frequency of entries. Each entry should describe key features of the plant at that moment in time, as well as questions and thoughts about how the plant has changed since previous entries. Trees</p>	<p><i>Students produce journals that regularly document the changes in specific details of a plant.</i></p>

make the best choices for year long observation while smaller shrubs or garden plants can yield detailed one-season journals.

**Post-Activity #2: Classroom Plants**

Students will care for potted herb plants using a gratitude lens. The teacher can select plants that do well in potted internal environments (herbs like basil, lavender; native plants like wild garlic) and have individual or small groups of students take turns taking care of the plants for a timeframe (day or week).

Accompanying assignments may include a one page report or a presentation on student understanding of the plant health, personal reflection on plant care, and a brief section on how the plant supports humans/other environmental beings.

**Safety Concerns:**

The teacher should be aware of insect allergies among the students as well as of the dangerous plants in our area (Giant hogweed, poison ivy) so as to prevent student injury.

# Lesson 3: The Sun, Moon and Stars

**Location:** Skä-noñh -- Great Law of Peace Center

**Grade Levels:** 6-8 (Intermediate)

<p><b>Theme:</b> We live in relationship with and depend upon the sun, moon and stars. Using the thanksgiving address, students can develop knowledge and responsibility associated with this relationship.</p>	<p><b>Program Description:</b> In this program, students are first introduced to the notion of Haudenosaunee gratitude and asked to compare it to other kinds of gratitude. Students then play a game that reveals many truths about the relationship of sunlight, starlight, and moonlight to other aspects of our environment. Students then use traditional scientific ecological knowledge (SEK) to build a small diorama of the solar system. Students will then edit the diorama to include Haudenosaunee gratitude. Students can then think about how they can reciprocate the entities to which they give gratitude.</p>
<p><b>Objectives:</b> SWBAT utilize both science and Haudenosaunee gratitude to describe the cosmos by building a gratitude model of the solar system and its surrounding stars.</p>	
<p><b>Applicable School Content:</b></p> <ul style="list-style-type: none"><li>▪ Earth science</li><li>▪ Astronomy</li><li>▪ Ecology</li><li>▪ Social studies- Cultural worldviews and the Scientific Revolution</li></ul>	
<p><b>School Standards:</b></p> <p><b>Science (NYS P-12 Science Learning Standards for Board of Regents' Consideration, 2016):</b> MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system. MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.</p> <p><b>Social Studies/History (NYS Learning Standards for Social Studies 1996):</b> Intermediate 1.2: Important ideas, social and cultural values, beliefs, and traditions from New York State and United States history illustrate the connections and interactions of people and events across time and from a variety of perspectives. Intermediate 2.1: The study of world history requires an understanding of world cultures and civilizations, including an analysis of important ideas, social and cultural values, beliefs, and traditions. This study also examines the human condition and the connections and interactions of people across time and space and the ways different people view the same event or issue from a variety of perspectives. Intermediate 5.4 The study of civics and citizenship requires the ability to probe ideas and assumptions, ask and answer analytical questions, take a skeptical attitude toward questionable arguments, evaluate evidence, formulate rational conclusions, and develop and refine participatory skills.</p> <p><b>ELA (NYS Common Core Learning Standards for English Language Arts &amp; Literacy: Anchor Standards, 2016):</b> Reading 6-12.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</p>	

Speaking and Listening 6-12.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

**Background:**

SEK/TEK: Scientific ecological knowledge (SEK, called *school science* in previous lessons) is a term used to describe the types of environmental understanding that are produced by western science and are based in observation, empiricism and statistical trends. Traditional ecological knowledge (TEK, called *experience science* in previous lessons) is the kind of understanding that comes from centuries of experience and survival within a particular environment. It is also based on observation but is validated by its applicability over generational time.

Thanksgiving Address: The TEK of the Haudenosaunee revolves around the gratitude and reciprocity that come from relationships to different parts or entities of the environment. The thanksgiving address is an Haudenosaunee oral tradition that gives gratitude to a number of significant entities of the environment and is delivered at the beginning and end of important meetings; Three of these elements are the stars, moon, and sun.

**Pre-Activities:**

***Pre-Activities: Text Comparisons (20-30 min)***

1) To support the introductory activity of this curriculum, students will be reminded about multiple worldviews by reading different short texts about the stars including: a) a school science explanation of a star, b) a Haudenosaunee gratitude expression of the stars, c) at least one other text from another culture (examples provided at end of curriculum). These texts are short enough to be read out loud together or individually.

2) In small groups or pairs, students will then fill in a three way Venn diagram to compare and contrast the knowledge presented in each text. Students should be encouraged to put at least one thing in each space. A template of the Venn diagram as well as an example of important ideas to put in the Venn diagram are at the end of the curriculum.

3) The teacher can have students share their findings in any way that is deemed appropriate (e.g. compiling responses from different groups in a large Venn diagram on the board, having groups compare their Venn diagrams to other groups, or a roundtable discussion). The teacher should take care to show that all this knowledge had been created in different places around the world and in different cultural contexts.

*Materials: Three different texts about stars; Venn diagrams; paper, pencil/pen*

**Assessment:**

*Each space in the Venn diagram is filled in with an idea that points out a similarity or difference in the knowledge of each text.*

**Program Outline**

**Introduction**

- 1) The teacher will ask the students what gratitude is. The teacher will explain that in Haudenosaunee tradition, different parts of the environment deserve our gratitude for our relationship to them. The teacher will then explain that the Haudenosaunee practice this gratitude by giving a thanksgiving address at every meeting. The teacher may ask students to share anything they give gratitude to on a daily basis (e.g. saying grace before meals).
- 2) The teacher will explain that in the thanksgiving address, the sun, moon, and stars are each treated as beings that deserve our gratitude.

**Activity #1: Personal Gratitude (15-20 min.)**

- 1) Students will then break off into small groups (2-3) and each group will be placed somewhere different at the Skä-noñh Center or outside where they can sit and look up at the sky. In a three columned t-chart with the sun, the moon, and the stars as column labels, they will brain-storm some reasons we should show gratitude for each of these entities.
- 2) The teacher will then collect all these groups back into the classroom. Each group will pick a spokesperson and share their thoughts. On a whiteboard or poster paper, the teacher will fill in new ideas that each group presents. The teacher should then write in some Haudenosaunee gratitude rationales from the Thanksgiving Address and compare them to the ones the students found.
- 3) The teacher will highlight the role of survival in kinds of knowledge cultures create. The teacher can have students circle all of the items from the class-wide three columned t-chart that help the students or their communities survive.  
*Materials: 3-columned t-charts, pencil/pens, list of Haudenosaunee gratitude rationales*

**Assessment**

*All groups have at least one reason in each of the three columns.*

**Activity #2: The gift of light (20-30 min.)**

- 1) The teacher will remind students that the sun sends light and heat waves out into space and some come to the earth and others are reflected off the moon and may come back to the earth. The stars also send out light but we receive much less of it because they are so far away.
- 2) Students will play the “Light” game outside.
  - Some students will be the sun and must remain in a rope circle.
  - Others students are the earth and must remain in another rope circle that is about 20 ft. from the sun.
  - Other students are the stars and are scattered about 30-40ft

<p>from the earth, but they also cannot move from their position.</p> <ul style="list-style-type: none"> <li>- Finally one student is the moon, who is allowed to run in a circle around the earth, outside the rope circle.</li> <li>- The sun and the stars have beanbags representing light and heat. The stars and the sun will toss beanbags to members of the earth who will try to catch it in a bucket or bag. If a beanbag is not caught, it must be left on the ground. When a beanbag is caught, it must remain in the bucket/bag of the student who caught it.</li> <li>- The moon may go around and catch beanbags from both the sun and the stars and hand them or “reflect light” back to select members of the earth.</li> <li>- The object of the game is to get every member of the earth to have 4 bean bags each.</li> </ul> <p>3) The teacher may allow multiple rounds of this, letting students take on different roles or adding challenges like increasing distance or increasing the number of beanbags, allowing students to strategize.</p> <p>4) The game should be wrapped up with a review of what this game teaches us about light as well as how we are in a relationship with siblings sun, moon, and stars. This can lead to a discussion of student opinions about what can happen when we start to take the gifts of light and heat for granted (possibly reference how greenhouse gases trap and reflect heat).  <i>Materials: 20-30 ft. of rope tied in a circle, bean bags, buckets</i></p>	<p><i>Students can verbally explain how the sun, moon and stars play a role in giving light to earth.</i></p>
<p><b><u>Activity #3: Gratitude models (35-45 min.)</u></b></p> <p>1) The teacher will hand out or present a ‘correct’ scientific diagram of the solar system. Students will be given a random assortment of materials (beads of varying color, cardboard, string, glue, paper) and asked to make a ‘accurate’ scientific model of the solar system by choosing objects to represent the planets, the moon, and the sun. Students should be encouraged not to decorate or fill the page just yet.</p> <p>2) Students will then edit the model so that it reflects gratitude knowledge from the three columned t-chart list that was compiled in the first activity. These edits may include labels, arrows showing the movement of light or heat, or more artistic interpretations of any of these entities. The teacher can show students a model that is kept at the center with some simple edits like an inclusion of other stars, a label showing that the sun is the perfect distance to keep us warm, the moon shining light</p>	<p><i>All groups create a model where all the celestial bodies of the scientific drawing can be identified.</i></p> <p><i>All groups present at least three edits that are linked to something from their original 3 columned t-chart.</i></p>

<p>on a dark earth.</p> <p>3) Each group will then have a chance to present their models to the group and explain their choices.  <i>Materials: craft supplies to build a model of a solar system, glue, paper, coloring utensil, sample model, 'scientific' diagrams of the solar system</i></p>	
<p><b><u>Conclusion (10-20 min):</u></b>  Students will choose the sun, moon, or stars and individually write their own thanksgiving address for that entity. Volunteers should be allowed to read their addresses.</p> <p><b>Special Sites Extensions:</b>  The teacher can take the students to Onondaga lake park to allow students to get a good view of the sky while completing activity #1. At the park, there are also good fields for running around in activity #2.</p>	<p><i>Each student writes an address that contains their knowledge of the sun, moon, or stars through gratitude.</i></p>
<p><b>Post-Activities:</b></p> <p><b><i>Post-Activity #1: Gratitude and Survival (20 min)</i></b>  To review the concepts of gratitude through environmental dependency, students will be asked to think about how different places and peoples might interact with the sun, moon, or stars differently in light of that people's survival needs. Students will read a short passage on the way a community from a different climate or historical time rely on the sun, moon, or stars (examples provided at end of curriculum). In a Venn diagram, students will compare the ways they rely on the sun, moon, or stars to that of the community presented in the piece. Students should be guided with the idea of what is needed to survive. Students should also be encouraged not to think of people's 'use' of these entities but of their relationship to them.  <i>Materials: copies of text, copies of Venn diagrams, pen/pencil</i></p> <p><b><i>Post-Activity #2: The Sun, Moon, and Stars Ecology (10-20 min)</i></b>  Students will choose either the sun, moon or stars. In the table provided, students will fill in how the sun, moon, or stars supports at least five other beings in the thanksgiving address.  <i>Materials: copies of table, pen/pencil</i></p> <p><b>Modifications:</b>  - The teacher can raise the grade level by asking the students to, either individually or in a group, draw the solar system from</p>	<p><i>Students complete a Venn diagram that identifies several similarities and differences between their own relationship to the sun/moon/stars and that of the people from the passage.  Each student is able to write down how the sun, moon, or stars supports five other beings.</i></p> <p><i>Students write appropriate connections in at least five boxes.</i></p>

memory before they are given the 'correct' scientific model. - The teacher can lower the grade level by choosing text with simpler sentences. - The teacher can allow for multiple means of production by allowing students to sketch their ideas for the gratitude t-chart instead of writing sentences.	
---	--

**Safety Concerns:**

Students should be warned not to stare directly into the sun when they observe the sky.

## Lesson 4: The Thunderers and the Four Winds

**Location:** Skä·noñh -- Great Law of Peace Center

**Grade Levels:** 6-8 (Intermediate)

<p><b>Theme:</b> We live in relationship with and depend upon the sun, moon and stars. Using the thanksgiving address, students can develop knowledge and responsibility associated with this relationship.</p>	<p><b>Program Description:</b> In this program, students will build upon their understanding of traditional ecological knowledge and gratitude by thinking about the role of weather, precipitation and climate as created by the Thunderer and four winds. Students will first participate in a questionnaire or treasure hunt that heightens their observational knowledge of the clouds, sky, and precipitation. Students will then use this knowledge to organize ecological connections between the Thunderers/ fourwinds and several other entities of the environment. Finally students will create a brochure or poster that delineates some individual, neighborhood, community, and region based actions that reciprocate in relationship to the thunderers and four winds.</p>
<p><b>Objectives:</b> SWBAT use knowledge of the Thunderers and Four winds to express gratitude and reciprocate to these entities through observation, playing a game that draws connections between facets of the environment, and creating a brochure that details how to reciprocate to these two entities.</p>	
<p><b>Applicable School Content:</b></p> <ul style="list-style-type: none"> <li>- Weather</li> <li>- The water cycle</li> <li>- Ecology</li> <li>- Social studies- Cultural worldviews</li> </ul>	
<p><b>Incorporated School Standards:</b></p> <p><b>Science (NYS P-12 Science Learning Standards for Board of Regents' Consideration, 2016):</b> MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity. MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p><b>Social Studies/History (NYS Learning Standards for Social Studies 1996):</b> Intermediate 1.2: Important ideas, social and cultural values, beliefs, and traditions from New York State and United States history illustrate the connections and interactions of people and events across time and from a variety of perspectives. Intermediate 1.3: Study about the major social, political, economic, cultural, and religious developments in New York State and United States history involves learning about the important roles and contributions of individuals and groups. Intermediate 2.1: The study of world history requires an understanding of world cultures and civilizations, including an analysis of important ideas, social and cultural values, beliefs, and traditions. This study also examines the human condition and the connections and interactions of people across time and space and the ways different people view the same event or issue from a variety of perspectives.</p> <p><b>ELA (NYS Common Core Learning Standards for English Language Arts &amp; Literacy: Anchor Standards, 2016):</b> Writing 6-12. 4 Produce clear and coherent writing in which the development, organization, and style are</p>	

appropriate to task, purpose, and audience.

Writing 6-12.11 11. Develop personal, cultural, textual, and thematic connections within and across genres as they respond to texts through written, digital, and oral presentations, employing a variety of media and genres. Speaking and Listening 6-12.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Speaking and Listening 6-12.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

### **Background:**

SEK/TEK: Scientific ecological knowledge (called *school science* in previous lessons) is a term used to describe the types of environmental understanding that are produced by western science and are based in observation, empiricism and statistical trends. Traditional ecological knowledge (called *experience science* in previous lessons) is the kind of understanding that comes from centuries of experience and survival within a particular environment. It is also based on observation but is validated by its applicability over generational time.

Thanksgiving Address: The TEK of the Haudenosaunee revolves around the gratitude and reciprocity that come from relationships to different parts or entities of the environment. The thanksgiving address is an Haudenosaunee oral tradition that gives gratitude to a number of significant entities of the environment and is delivered at the beginning and end of important meetings; two of these elements are the thunderers and four winds. The thunderers are the weather beings in the sky and may be thought of as the cloud themselves, or as beings governing the clouds. The four winds are the beings that blow from different cardinal directions.

### **Pre-Activities:**

#### ***Pre-Activity #1: The Water Cycle Game (20-30 min)***

Students will play a game inspired by an activity in the Project WET curriculum (<http://portal.projectwet.org>). Each student will represent a water molecule/droplet in the Onondaga lake watershed. Around the room or outdoor area are stations representing one of the following places where the water droplet could be in the watershed: Onondaga lake, clouds, groundwater, the Seneca river, Onondaga creek, Nine mile Creek, the Syracuse sewer system, and the Syracuse wastewater treatment facility. Each station has a 6-sided die specific to that station and reflects the probabilities for water at that location (printouts of the die included at end of curriculum). Students can pick any station at which to start. They must then roll the die to determine the next station they will go to. At each station, students may pick up a bead with a color specific to that station and put it on a pipe cleaner or string bracelet. The teacher can add a level of competition to the game by telling the students they are racing against each other to attend every single station at least once (be

### **Assessment:**

*Students can explain why water spends so much time in one part of our watershed and so little time in others.*

<p>careful, it is easy to get trapped in the lake!). Afterwards, the students should be asked to think about and explain the patterns that they see in bracelets.</p>	
<p><b>Program Outline</b>  <u><b>Introduction:</b></u>  1) The teacher will ask the students what gratitude is. The teacher will explain that in Haudenosaunee tradition, different parts of the environment deserve our gratitude for our relationship to them. The teacher will then explain that the Haudenosaunee practice this gratitude by giving a thanksgiving address at every meeting. The teacher may ask students to share anything they give gratitude to on a daily basis (e.g. saying grace before meals).   2) The teacher will explain that in the thanksgiving address, the thunderers are the weather beings in the sky like clouds, and the four winds are the beings that blow from different cardinal directions. The teacher will then explain that the thunderers and four winds are each treated as beings that deserve our gratitude.   3) To get students thinking about their knowledge of the thunderers and four winds, the teacher might ask students to explain how they know when it is going to rain, snow, or any other kind of weather.</p>	
<p><u><b>Activity #1: Observations (20-30 min.)</b></u>  1) The teacher will first lead students in the use of the sun or a map to identify the cardinal directions based on where they stand (i.e. south is looking at the lake, north is with your back to the lake, east is towards the mall and the hills, west is towards the flat end of the lake). This can be accomplished outside or from an indoor observation point.   2) In small groups or individually, students will be given a set of observational questions about the thunderers and four winds. They will then be brought outside or to a location where they can observe the sky where they answer these questions. The questions include:</p> <ul style="list-style-type: none"> <li>▪ Feel the wind/look at the trees. What direction is the wind blowing?</li> <li>▪ Which direction are the clouds moving?</li> <li>▪ How high do you think the closest cloud is?</li> <li>▪ How many different types of clouds do you think you see?</li> <li>▪ If a raindrop were to fall directly on top of you right now, give a step by step description of how it would flow into the lake (i.e., which hills and ditches would it go through)?</li> </ul>	<p><i>Students provide an appropriate answer to all questions.</i></p>

<ul style="list-style-type: none"> <li>▪ If lightning were to strike something in or around the lake, what would it hit?</li> </ul> <p>AND/OR</p> <p>2) The teacher can set up a four-winds treasure hunt. In this activity, some of the same questions from before are used to create a set of geographical directions for student groups. For example:</p> <ul style="list-style-type: none"> <li>▪ First walk 20 paces in the direction the clouds are moving.</li> <li>▪ Then walk 10 paces in the direction rain would flow if it hit the ground right where you stand (downhill).</li> <li>▪ Then walk 30 paces in the direction the wind is blowing.</li> <li>▪ Etc.</li> </ul> <p>In the end, the treasure may be a small prize.</p> <p>3) The teacher will then collect the student's back into class and review the answers with them. The teacher should ask what students learned from these close observations.</p> <p><i>Materials: copies of the treasure directions, a prize</i></p>	<p><i>Students navigate the treasure hunt by making appropriate inferences from the directions.</i></p>
<p><b><u>Activity #2: Supporting Statements (15-20 min.)</u></b></p> <p>1) Students will race against each other to think through thanksgiving address connections. Small groups of students will be given a set of ways that the four winds and thunderers support other beings in the thanksgiving address (see supporting materials at end of curriculum). Around the room or in a field are bins labeled with each aspect of the thanksgiving address (besides the four winds). The group may send out one representative at a time with one supporting statement to place in the correct bin. Either the teachers or some volunteer students will stand next to the bins and be in charge of verifying that the groups are putting the statements in the correct bin (answer sheet provided). If not, the student has to return to the group before going out to a different bin. The group who completes all answers first may win a prize.</p> <p>2) Student groups can then collect their responses and glue them together to make a visual representation of these supporting connections using the web template provided.</p> <p><i>Materials: strips of paper with the statements printed on them, copies of the answer sheet, bins</i></p>	<p><i>Students match statements to appropriate environmental entities and orally explain their choices.</i></p>
<p><b><u>Activity #3: Reciprocating to the Thunderers and Four Winds (20-30 min.)</u></b></p> <p>1) Now that students have an understanding of how the thunderers and four winds support other aspects of the world including us, students will think about how to reciprocate. First the</p>	

teacher will review how clouds can form around particles in the air, how rain can absorb chemicals in the air and how water returns to the air from oceans and lakes in preparation for the next step.

2) In small groups, students will think about all the things that humans do that use the help of the thunderers and four winds, but hurt them when done too much. After a few minutes, the teacher can ask for volunteers to share their thoughts and compile a list on the board. Possible answer may include:

- Polluting the air with cars
- Polluting the air with chemicals from factories (acid rain)
- Polluting the air with smoke (greater cloud formation)
- Cutting down trees that put oxygen back into the air and take out carbon
- Large cattle farming (be careful to validate students from agricultural communities)
- Changing the flow of rivers and stopping the flow of rain (Onondaga lake is much lower it is historically was)
- Draining wetlands (reducing evaporation)

3) Students will watch drone footage of the lake or city (in the possession of the Skä noñh staff). They should be encouraged to imagine themselves taking on the perspective of the thunderers and four winds. As they watch, they must quietly note every thing they see that looks like it might damage the movement of water and weather in Syracuse based on the answers provided from the previous step. If preferred, the students can watch the footage one time through without writing down anything, and then watch it a second time writing down their thoughts. The teacher can then ask for answers and go over this list on the board.

4) In small groups, students will then think about what what us residents of the Onondaga region can do to give back to the winds and the thunderers. Each group will be assigned either the individual, the neighborhood, the city/town, or the region as a level of action. Groups will compile a list of things that their level of action can do and create a small poster or brochure that includes:

- A title
- Descriptions of strategies
- Drawings of strategies

And any other requirements that the teacher chooses.

5) Students groups will present these to the others.

*Materials: pencils/pens, paper, drone footage of lake, poster/ construction paper, coloring utensils*

*Students produce a poster or brochure with appropriate responses to all the requirements.*

<p><b><u>Conclusion (10-20 min):</u></b> Students will choose either the thunderers or four winds and individually write their own thanksgiving address for that entity. Volunteers should be allowed to read their addresses.</p> <p><b>Special Sites Extensions:</b> To increase visibility for the observations in Activity #1 as well as to give more play space for Activity #2, students can be taken to Onondaga Lake Park.</p>	
<p><b>Post-Activities:</b> <b><i>Post Activity #1: Observation Journals (10-20 min repeated over several days)</i></b> Students can practice the use of their own observations to create gratitude through knowledge by keeping a weather observation journal. Each day, students should be given a few minutes to look at the sky and complete a descriptive entry. These entries should not just use 'weather channel' language like sunny, rainy, or cloudy, but attempt to describe some details about the colors and shapes of things they observe in the sky. After a few days or weeks of keeping this journal, students can try to formulate research questions or present patterns they see in the observations (i.e., noticing that clear skies make for colder days in the winter).</p> <p><b>Modifications:</b> - To support all writers in Activity #3, the teacher can allow the students to watch the drone footage without writing anything once, and then complete the written part of the activity on the second watching of the footage.</p>	<p><i>Students produce journals that regularly document the changes in specific details of a the weather.</i></p>
<p><b>Safety Concerns:</b> Students should be warned not to stare directly into the sun when they observe the sky.</p>	