Solution Oriented Learning Storylines are designed to support classroom teachers as they implement integrated, locally relevant education addressing climate science.

Overview:

Teaching climate science can be a daunting task. The message so often given through climate science education is one of pessimism. The actual science often gets muddled with sensationalistic media messages of fatalistic disasters. Solution oriented learning storylines offer teachers a way to engage students in an evidence- based, scientific learning that focuses on solutions to climate related issues. Imbedded in each storyline are Indigenous connections, hands on scientific explorations to elicit student curiosity, and age-appropriate action that can be taken to implement solutions. The storylines pair beautifully with two key tenets of environmental and sustainability education; local relevance and integrated learning. This is accomplished by introducing learners to phenomenon. Students engage because their learning helps them explain the phenomenon, implement a solution or design an innovation. Our storylines are designed not only to empower students by giving them choice in their class-based learning but also to give them voice in their communities with a focus on authentic and locally relevant questions, problems, issues and opportunities.

Why Climate Science? The Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change, provides governments at all levels with scientific information that they can use to develop climate policies. With each report the information published makes it more and more difficult to ignore the need to drawdown the amount of greenhouse gases in the atmosphere. In Washington State, legislators agree that it is imperative to ensure citizens understand the science behind climate change. The legislature has dedicated funding, through the ClimeTime initiative, to provide professional learning for educators to support instruction of climate science as a critical component of developing scientifically literate citizens.

The Pacific Education Institute has developed storylines for some of the most important climate science topics in and for Washington state. Topics include Forest Management for Carbon Sequestration, Fire Management, Food Waste, Regenerative Agriculture for both Eastern and Western Washington, Urban Forestry, and Renewable Energy: Solar. Each of these storylines is written for specific grades from K through 12 to address specific Washington state science standards. At each grade, the sequencing and the activities are relevant and scientifically vetted to assure that students at every age are learning the best science society can currently offer. Each storyline is a living document in that the links offer the most up to date information. The storylines are written with educators who know first-hand of the challenges in the classroom. Therefore, teachers can be assured these storylines will offer students some of the best, locally relevant, inclusive education in climate science available today.

Each Solutions Oriented Learning Storyline includes the following guiding principles:

- Strategies to work with local tribes to center Indigenous ways of knowing;
- 3-D NGSS content alignment and assessment tools to demonstrate student growth;
- Strategies and tools for formative assessment to strengthen inclusive teacher instruction for all learners;
- Locally relevant, place-based topics;
- Lessons to calculate emissions of greenhouse gases, implement solutions to draw down greenhouse gases or address environmental justice;
- Strategies to elevate student voice.

A deeper dive into the six guiding principles:

1. **Strategies to work with local tribes to center Indigenous ways of knowing:**

Connecting climate science education to local Indigenous ways of knowing and inviting Tribal perspective into the classroom gives students the opportunity to see that people have lived in the region Since Time Immemorial and that Tribes actively contribute to the well-being of the community. When young learners see multiple perspectives in a classroom being honored, they are more likely to feel included, appreciated, and respected by peers and teachers for their different abilities, cultures, gender, and interests.

In each storyline, resources and suggestions are provided to imbed Indigenous ways of knowing about the topic into the lessons. Local tribal communities often have members who would be interested in making this storyline more locally relevant and impactful for the students by sharing their perspective on land use through stories and experiences. These connections are powerful ways to engage students. Building relationships with tribal communities will help students realize that there are other ways of knowing how to live sustainably in addition to the traditional western scientific approach.

Resources:

Washington OSPI Office of Native Education

Indigenous Education Brief: Culturally Responsive Classroom Management for Native Learners

STEM Teaching Tools #10: Teaching STEM in Ways that Respect and Build Upon Indigenous Peoples' Rights

2. 3-D NGSS content alignment and assessment tools to demonstrate student growth:

The storylines at each grade are aligned with relevant Next Generation Science Standards (NGSS) performance expectations. The NGSS were adopted by OSPI as the Washington Science Learning Standards (WSLS) and guide the progression of science learning from the K to 12 so that students are exposed to the same topic with increasing complexity in order to develop deeper understanding. Each storyline includes activities that make direct progress towards the noted performance expectations. The

pre and post assessments are also aligned with at least one of the performance expectations and are presented as a 3-D assessment (incorporating science practices, with cross cutting concepts and disciplinary core ideas) when possible. The pre-assessment is intended to give educators an idea of prior knowledge and skills. The pre and post assessments are the same or similar so that growth can be easily evaluated. Some of the assessments are project based to be more appropriate for a particular grade.

Resource(s):

STEM Teaching Tools #18: How teachers can develop formative assessments that fit a three dimensional view of science learning

Three- Dimensional Instruction: Using a New Type of Teaching in the Science Classroom

3. Strategies and tools for formative assessment to strengthen inclusive teacher instruction for all learners:

In addition to the pre and post assessments, the learning sessions of the storyline provide multiple strategies to access students' prior knowledge and use it to strengthen confidence and engagement in learning. Recognizing that students with a variety of backgrounds, learning modalities, and abilities have different needs, the learning sessions provide tools to reach all students. For example, whenever possible, outside activities are included in the learning sessions to ground all learners with a topic aligned experience from which they can speak. Learning in the outdoors is a high priority for PEI because research shows it is a tool that includes all students in a rich learning experience while providing added benefits related to social, emotional and physical health.

Resources:

STEM Teaching Tools #26: How can assessments be designed to engage students in the range of science and engineering practices?

4. Locally, relevant, place-based topics:

Place-based education is an approach that connects learning and communities. The topics chosen by Pacific Education Institute are ones that are relevant to Washington state. For example, coastal hazards is a storyline topic directly relevant to many students living on the west side of the state. The primary goal is to increase student engagement in their learning by using experiences familiar to them and topics for which they have a vested interest. Anchoring the phenomena in experiences elicits wonder and curiosity. As the storyline progresses, students are exposed to the problems and potential solutions to climate related issues in their community. Therefore, when they are ready to develop their own action plan, they can work on solutions that are relevant and can have real impact on their communities.

In addition to the storylines, Pacific Education Institute works with the Community Cafe Collaborative to build relationships to co-design with communities leading to partnerships in the storyline work.

Community Cafes are a series of conversations that are planned and led by members of a neighborhood who are dedicated to building communities where all children thrive in safe, stable and loving families, and where individuals commit to inclusion, respect and compassion pursuing policies and systems rooted in equity and justice for all. Family members planning Cafés think about the customs, art, foods, music and other culturally relevant ideas to create a welcoming, safe space. Meaningful relationships develop as parents and community partners participate as equals in dialogues that value reciprocity and honor everyone's contributions. Through these conversations, social change happens. PEI recognizes that social change is one of the most important changes necessary to decrease the impact of climate change on the world.

Resources:

Seeing and Reasoning about Complex Socio-Ecological Systems in the Early Grades ological

STEM Teaching Tool #20: Getting their hands dirty: Engaging learners in authentic science practices outside the classroom

STEM Teaching Tool #28: Qualities of a Good Anchor Phenomena

STEM Teaching Tools #57: How place-based science education strategies can support equity for students, teachers, and communities

5. Lessons to calculate greenhouse gases, implement solutions to draw down greenhouse gases or address environmental justice

Drawdown is the point in time when the concentration of greenhouse gases in the Earth's atmosphere begins to decline on a year-to-year basis. PEI's solution oriented learning storylines are all grounded in the solutions proposed by Project Drawdown. Project Drawdown is a nonprofit research organization and coalition of scholars, scientists, entrepreneurs, and advocates from across the globe that is mapping, measuring, modeling, and communicating about a collective array of substantive solutions to global warming, with the goal of reaching drawdown. Project Drawdown reviews, analyses, and identifies the climate solutions that will most effectively address drawdown of greenhouse gas in the atmosphere. Project Drawdown will continue to update and expand the scope of its research, and publish and disseminate new content through online platforms, programs, and future publications. In addition to lessons on drawdown, there are lessons in the Coastal Hazards storylines that are specific to environmental justice; for example, students will design a solution and how it impacts the people most affected.

Resources:

Drawdown Framework Climate Change Education: Essential Information for Educators

Focusing Science and Engineering Learning of Justice Centered Phenomena across Pk-12

6. Strategies to elevate student voice

Embedded in the middle school and high school storylines are strategies for students to develop their own solutions within their communities that will address greenhouse gas drawdown. For example, students design buildings that utilize the passive energy of the sun in the Renewable Energy: Solar storyline. Students learn the science behind the problem and then are given the opportunity to explore existing solutions or to develop a unique solution for a given issue. Working on solutions includes the elementary levels as well. However, rather than working individually, the class as a whole participates in exploring solutions to community problems such as food waste, or fire hazards. The goal of all these solutions is to draw down greenhouse gasses or to prevent the emission of such into the atmosphere.

Resources:

STEM Teaching Tools #12: Scientific literacy involved understanding global climate change and what people can do about it

Student Voice: How Young Scientists Are Changing the World

Spokane Edible Project: Reproduce 81

Sequencing in the Storylines:

All storylines follow a similar format. The first learning session introduces the topic through Indigenous Ways of Knowing/Connections. Then the anchoring phenomenon is presented through an experience to orient the students to the learning that will be happening, activate prior knowledge and reduce test anxiety/stress. Students are then given a pre-assessment; this order leads to more meaningful pre-assessment data.

Following the pre-assessment, the learning sessions introduce the science behind the topic's relevance to climate change through experiments, activities, and demonstrations. In each learning session, there are links to resources for students and educators. Indigenous knowledge is referenced throughout the learning sessions. Towards the end of the learning sessions, solutions are explored and students work towards solutions individually or as a class. A post assessment is given at the end of each storyline. There are possible extensions for each storyline as well as career connections.

Addressing the needs of multilingual learners:

Several storylines are now available in Spanish and more are being translated. Bilingual staff at PEI

Contributions

PEI's project is a collaborative project made of many individuals. Abby Ruskey, Kathryn Kurtz, Jen Lebret and Polo Hernandez of Braided Education, Cinnamon Bear and Laura Tucker formed the first lead team

in 2018 and provided much appreciated guidance to the project. In subsequent years Michelle Townshend, Hattie Osborne, Shelley Stromholt, Lourdes Flores, Megan Rivard and Molly Grffiths have played key leadership roles. In addition, hundreds of educators, community partners and Tribal partners have contributed to and helped shape our project. We are grateful to each person who has provided creative and critical feedback; storyline writers are credited at the end of each storyline.

We especially want to recognize all the teachers across Washington state that have implemented these storylines, shared their experience, and continue to inspire our work.

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