

## **Climate Crisis: a Storyline Exploration**

*Bijal Makadia*

*William D. Kelley Elementary School*

### **Abstract**

This unit utilizes the Scottish Storyline Method to provide students with a hands-on, cross-curricular learning experience to develop understanding of Renewable Energy Schemes and the realities of the Climate Crisis. Students will role play as Engineers encountering complex environmental, social, and technological problems. They will construct knowledge relating to the sources and usage of energy, the impacts of the fossil fuel industry, and the human perspective on environmental challenges.

### **Content Objectives**

#### **Problem Statement:**

My 4th Grade students at William D. Kelley had a year of substitute teachers in their developmentally crucial 3rd Grade year. Students were impacted with disparity in academic achievement and foundational skills they could've otherwise cultivated with proper support as well as disillusionment with the processes of schooling and their intellectual identity.

“Rich kids get taught, poor kids get tested.” This quote by Dr. Cornel West resonates with me as a person who experienced suburban schools growing up as a student, and my experiences as an educator in economically and racially oppressed urban communities across the country. I am struck with the reality that for myself and many of my majority middle-class students in Portland, Oregon, creative, project-based learning and student voice were the norm throughout their school experience. Many of these students could imagine themselves as future Engineers. In contrast, in the poorer immigrant, Latinx, and Black communities I've taught in, these school buildings have a far more dominant culture of disjointed curriculum materials and academic tasks designed for mastery of isolated skills that come up during high stakes data collection. In my experience, these schools had a far greater emphasis on “textbook” work that often lacks meaningful connection and open-ended inquiry.

My anecdotal experience of various school cultures aligns with Jean Anyon's research which concluded “that fifth-graders of different economic backgrounds are already being prepared to occupy particular rungs on the social ladder.” (Anyon, 2010) In this study, it was found that children of working class communities are more exposed

to rote memorization and mechanical procedures as opposed to more affluent school children whose work was fueled by independence and creativity with a greater emphasis on constructing knowledge.

### **Climate Crisis Unit Overview**

This study of renewable energy aims to develop student identity as a STEM leader through constructivist pedagogy. The unit can support students to build integrated academic skills through an engaging cross-curricular unit of study. Engagement with this seminar knowledge is crucial in creating future leaders equipped to critically research, dialogue, and innovate in response to the realities of our global climate crisis. Students will develop a critical consciousness by examining the social and environmental impacts of consumer culture and fossil fuel industry. Furthermore, they may add to the hope of collective solidarity for environmental justice as well as the landscape of rapidly innovating technology.

Students will learn about the social and environmental impact of climate change and fossil fuels, along with the processes involved in renewable energy sources including solar (photovoltaic) energy, wind (aeolic) energy and hydroelectric Energy. They will learn about the basic principles of energy and how all energy used on earth comes from the Sun. Students will identify ways that issues of climate change disproportionately affect Black, Indigenous, and Latinx communities but also the complex ways in which these issues threaten the collective altogether, in present time and within the coming decades.

### **Teaching Strategies**

This unit utilizes the Scottish Storyline Method involving students in an extended role play as Researchers and Engineers. Students will interact with the subject matter through teacher-facilitated elements of story: characters, setting, and various teacher directed “episodes” through the storyline.

Scottish Storyline Method is an instructional structure that has been used and developed throughout Europe since the 1960's. Storyline begins with teacher directed questions to develop a setting and characters. This storyline begins with the following questions: Who are engineers and researchers? What are they like? What kind of work do they do? What could a Research Laboratory be like? Students will create portraits of imagined characters and develop a “frieze” background for the setting. This can look like a 2D collaboratively created poster of a Laboratory or a 3D model of a Laboratory using shoe boxes and recycled materials. Teacher directed incidents in the form of “Mysteries” occur which involve the characters gaining new information, reflecting, responding to, and solving problems. The Storyline concludes with a celebration or event.

“Storyline has at its core the ‘human element’ described by Harkness (2007:20), as it enables pupils to explore topics through the eyes of the characters, empathising and understanding worlds which are not their own. Use of Storyline gives context to the learning, makes the learning purposeful and gives ownership to the pupils.” (Mitchell-Barrett).

The method is further articulated here: “In the Storyline process, the teacher designs the ‘line’ which ensures that all necessary content and curriculum aims are met. The line is a systematic approach, which is developed by the teacher who has designed the Storyline topic. The line involves a sequence of episodes and these episodes can be compared to the chapters of a book (Bell and Harkness, 2006 as cited in Mitchell-Barrett, 2010)

This method employs a Constructivist approach to building and applying new knowledge: “In understanding new knowledge and facts, we are constructing our own version of it.. In this model, learning is not viewed as a linear procedure but rather as a complex, non-linear process (Twomey Fosnot and Perry, 2005 as cited in Mitchell-Barrett 2010)

Each episode of the Storyline will present leveled non-fiction media and text sources primarily through the current events resource Newsela, opportunities for creative, investigative, and persuasive writing, hands-on science lab experiments or demonstrations, and discussion of the topic. Students will react and move through new learning as their imagined Engineer character. The episodes will be presented as “Mysteries” in the form of a Secret Mission File containing a letter explaining the key questions, non-fiction text resources, applicable media (videos, songs, etc.) and journal questions. Students will document learning through reflective journaling from the point of view of their constructed Engineer character.

### **Classroom Activities**

After characters and setting are developed using imagination and background knowledge, incidents and “episodes” to begin exploring the subject matter can begin. The episodes in this Storyline will be framed as STEM mysteries for the class team of Engineer Researchers to gather information and create reflective solutions. Examples of episodes included in the Appendix are as follows: Mystery at the Landfill, Mystery at the Coal Plant, Mystery at the Solar (Photovoltaic) Power Plant.

The early episodes are designed to expose students to the following content questions: where does our Energy come from and how do we use energy? What are fossil fuels? What are the Cause and Effect relationships involved in Climate Change? How are global eco-systems and communities affected by our current system of producing and

burning fossil fuels? Students will receive case studies highlighting voices from the margin of these issues.

For example, after building background knowledge on fossil fuels, they will receive the “Mystery at the Coal Plant” case file. In this lesson, they will read a text describing the largely Mexican-immigrant community in Little Village, Chicago. They will read [Non Renewable Energy](#) along with a primary source from the Little Village Environmental Justice Organization describing the impacts of the Crawford coal power plant. Students will track cause and effect in the text tracking information on how burning coal led to health impacts of people living around the coal plant. Students will watch the Crawford Power [Plant Demolition](#) Video and see the impact and toxicity of what was inside the Power Plant.

The next episode will bring the Engineers to a parallel story in Louisiana’s “Cancer Alley” and Gulf of Mexico. Students will explore the devastating reality that Black Americans in this community are facing vastly disproportionate health issues relating to pollution and amplified by Covid-19. Students will again track the information and personal stories presented in terms of Cause and Effect.

In researching and discussing these two stories, I hope for students to begin to gather evidence of disinvestment and disproportionate environmental toxicity found in poorer Black, Latinx, and Indigenous communities. The texts and student journal questions are highlighted here: [Coal Plant Shutdown Text and Reflection Activity](#) and [Cancer Alley Text and Reflection Questions](#).

In both of these Episodes, there is opportunity for students to engage in community activism and building solidarity with those affected. As students develop questions, write letters, and possibly even organize informational video call meetings with environmental organizers in these places and locally, they can experience the power of grassroots networks, the power of people, and exchange stories and wisdom.

Students will continue to grow their experiences and background knowledge through each episode moving through topics including oil spills, environmental racism, consumerism, plastic waste, carbon, and the greenhouse effect.

Students will create thought bubbles and quote bubbles and will add them to their characters’ portrait display as another way to process and construct meaning after each Episode in the Storyline.

Maintaining hope, creativity, innovation, and joy is also a crucial part of developing students’ identity as an Engineer and intersectional environmental activist. Episodes including Mystery at the Solar Energy Power Plant and Wind Energy Power Plant will highlight the alternatives to a world on fire. Students will gather information

for each topic as much as possible through expert primary resources, interviews with experts, virtual and real field trips, and experiential learning.

For the Episode, Mystery at the Solar Power Plant, students will read [How Solar Cells Work](#), research and interview experts including [Bright Solar Futures High School Program](#). They will create a concept map and journal to answer the question “How do Solar Panels work?” Students will learn about Watts as a measurement of Power and how our everyday appliances and activities utilize energy to “work.” Students will research how many watts of energy our school and homes use. Another advantage of Storyline Method is the opportunity for cross-curricular skill building. In this mystery, students will apply their knowledge of multiplication, area, and perimeter to explore content related math story problems. For example, if a solar panel can provide 200 Watts of energy, how many Solar Panels would we need in our school to offset our energy use? Students will also tackle math problems involving designing a Solar Panel that will maximize Area using Length and Width.

### **Constructing Knowledge through Invention**

*“For the emergence of knowledge, there must be invention and hopeful inquiry.” - Paulo Freire*

As highlighted, the Scottish Storyline Method will provide the structure for students to construct meaning, inquiry, and knowledge about the Climate Crisis and Renewable Energy Schemes from a variety of resources and experiences. In such a learning format, I am prepared to extend lessons beyond the structure laid out in the Appendix materials. I am prepared to adapt and build onto this work as our group’s questions, research, and connections with the material deepens and possibly travels in different directions than I may originally anticipate. Teaching in this way requires a certain extent of letting go of expected outcomes. I am prepared to be open to what information resonates with my students and how the Episodes will be filtered through the unique schema of our class. I will be open to varied forms of student expression and learning.

The use of Concept Maps in this unit is also a learning routine where new knowledge and connections can be explored and presented by students through open-ended thinking. We will build the skill of making Concept Maps together, through modeling and guided practice. The first lessons will explore the steps of highlighting a topic and idea followed by brainstorming related categories, facts, numbers, symbols, illustrations, and connections to create a Concept Map.

Lastly, the Unit Plan in the Appendix is just a stepping stone of inquiry into the complex social, environmental, and technological implications of the Global Climate and

Energy Crisis. There are many stories, both local and globally that can deepen this exploration: from the collapse of the Texas electric grid to the Standing Rock protests and Dakota Access Pipeline, to also the growing strength of youth climate voices like Greta Thurnburg who are fighting to inherit a healthy earth for our collective survival and future. In implementation of this unit, I anticipate learning alongside and from my students. I hope to generate a seed of hope, that we can heal our connection to the earth and invent and imagine a new world through the possibilities of community interdependence, environmental justice, and innovative technology.

## **Appendix**

### **Elements of Scottish Storyline Method**

The six key principles of Storyline developed by the original EED group are as follows:

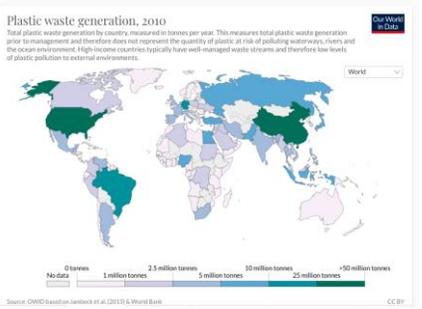
1. The Principle of Story: providing a meaningful context and a predictable structure, through the use of story.
2. The Principle of Anticipation: using anticipation to engage the pupils in the Storyline and ask the key question: What will happen next?
3. The Principle of the Teacher's Rope: in a Storyline, the teacher holds the rope that represents the planned Storyline but it is flexible to allow pupil control.
4. The Principle of Ownership: the Storyline is built upon the pupils' prior knowledge and acknowledges this, allowing the Storyline learning to become a shared experience between the teacher and pupil.
5. The Principle of Context: the context of the Storyline gives the pupils a reason for learning and as Storyline represents real life, the context is recognisable to the pupils and has meaning to them.
6. The Structure Before Activity Principle: the pupils decide what it is they need to know in order to complete the Storyline and in doing this they create their own questions. However, it is the teacher who provides the structure to find this information or write the biography, by providing formats so that the pupils do not have to accomplish the tasks on their own. (Creswell, 1997)

### Climate Crisis Storyline Unit Overview, Timeline, and Resources

Episode	Learning Goal	Activity	Resource
Characters	I can describe what an Engineer does.	<p><b>Storyline Set Up:</b> Build Characters for STEM Research Team</p> <p><b>Hook:</b> Letter invitation from Principal to join a Secret mission to build a School STEM Research Team</p> <p><b>Guided Discussion</b> Who are engineers? What are researchers like? Capture ideas on Anchor Chart.</p> <p><b>Student Activity:</b> Create mixed material portraits of an invented character to build the School Research Team of Engineers. Students will create a biography card for their character describing their personality, interests, and area of STEM expertise.</p> <p>Give students a Storyline Journal for this unit. Encourage students to take on the voice and point of</p>	<p>Media: <a href="#">What is Engineering?</a></p> <p>Vocabulary: Engineer Research</p>

		<p>view of their STEM Researcher character for their first journal entry.</p> <p><b>Journal Reflection #1:</b>          What do you like about STEM and researching?          What qualities help you to be a good scientist, engineer, and mathematician?          What is your life story?</p> <p>Encourage students to step into a role and be creative when writing a short biography on an index card about the characters, including the following questions:</p> <ul style="list-style-type: none"> <li>- What do you like to do for fun?</li> <li>- Who is in your family?</li> <li>- What is your job as a STEM Researcher like?</li> <li>- What is your role on the team and area of expertise?</li> <li>- What are your strengths and weaknesses?</li> <li>- Where are you from?</li> </ul>	
Setting	<p>I can describe an Engineering Research Laboratory.</p> <p>I can describe procedures to stay safe during hands-on science lessons.</p>	<p><b>Storyline Set Up:</b>          Build a Setting: Create the “Frieze” and backdrop for the unit.</p> <p><b>Guided Discussion:</b>          What is an Engineering Research Laboratory like?          What objects and tools should be inside?          How do we stay safe in a STEM</p>	<p>Media:  <a href="#">Lab Safety</a></p> <p><a href="#">How to Make Concept Maps</a></p> <p>Vocabulary:          Engineer          Research Laboratory</p>

		<p>work space and during experiments?</p> <p><b>Student Activity:</b>          Create a 2D or 3D depiction of an Engineering Research Laboratory</p> <ul style="list-style-type: none"> <li>- Collage, build out of cardboard and recycled materials, draw posters, create floor plan to build ideas and engagement with the setting</li> <li>- Create an Electric Car to use to travel to Secret Mission Locations (sketch, design, or 3D model from recycled materials)</li> </ul> <p>Create a Concept Map for the idea: “How to stay safe in the Lab” Teacher model and guided practice with Learning Routine of Making Concept Maps</p>	
Episode 1	<p>Learning Goal: I can describe human-made impacts on the environment.</p> <p>I can describe the impacts of consumer culture around the world.</p>	<p><b>Incident: Mystery at the Landfill</b>          Jakarta, Indonesia</p> <p><b>Hook:</b> <a href="#">Story of Stuff</a> Video (highlight this as an example of Concept Mapping using illustrations, words, numbers, facts, connections)</p> <p><b>Student Activity:</b>          Utilize whole group and small group facilitation to read the texts “Landfill Community” and <i>Ada’s Violin</i> by Susan Hood.</p>	<p>Vocabulary:          Landfill          Scavenging          Recycling          Consumer Culture</p> <p>Student Texts:  <a href="#">Landfill Community</a></p> <p><i>Ada’s Violin</i> by Susan Hood</p> <p>Media:  <a href="#">Story of Stuff</a>  <a href="#">Plastic Pollution Data</a></p>

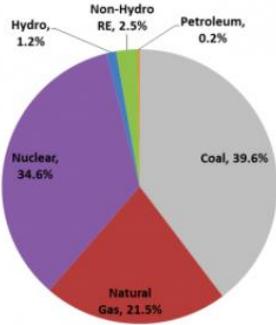
		<p><b>Journal Reflection #2:</b></p> <ol style="list-style-type: none"> <li>1. What is Consumer Culture and Planned Obsolescence?</li> <li>2. What are the challenges people living in a Landfill Scavenging Community face?</li> <li>3. How are developed nations taking responsibility for their share of environmental problems such as plastic waste and landfills? Should certain countries be required to do more?</li> </ol>  <p>Source: <a href="#">Plastic Pollution Data</a></p>	<p>Science Lab:  <a href="#">Products from Petroleum</a></p>
<p>Episode 2</p>	<p>Learning Goal:  I can identify the processes to show how all of earth's energy comes from the Sun.</p>	<p><b>Incident: Mystery at the Fossil excavation Site</b></p> <p><b>Hook:</b> Gallery Walk of Pictures of Energy Sources: Sun, Solar Plant, Coal Plant, Dam, Windmill Farm, Oil Distillery (<a href="#">Science photographs</a>). Students can add a post-it of an observation and question for each photo.</p>	<p>Vocabulary:  Fossil Fuels  Carbon  Energy</p> <p>Student Text:  <a href="#">Where did Fossil Fuels come from</a></p> <p><a href="#">Coal Study Guide from U.S. Energy Dept.</a></p> <p>Media:</p>

		<p><b>Journal Reflection #3:</b>  How do the Sun, Animal and Plant fossils lead to the creation of Fossil Fuels?  Where does our Energy come from?  What do we use energy for?  How much energy do we use each day?</p>	<p><a href="#">What are fossil fuels?</a></p> <p>Science Lab:  <a href="#">National Renewable Energy Laboratory</a></p>
Episode 3	<p>Learning Goal:  I can describe human-made impacts on the environment.</p> <p>I can describe the social impacts of Environmental Racism.</p>	<p><b>Incident: Mystery at the Coal Plant</b>  Little Village, Chicago</p> <p><b>Hook:</b> Crawford Power <a href="#">Plant Demolition</a> Video</p> <p><a href="#">Coal Plant Shutdown Text and Reflection Activity</a></p> <p><b>Journal Reflection #4:</b></p> <ol style="list-style-type: none"> <li>1. What are the impacts from the Coal Plant in this community? Use the Cause and Effect organizer to gather your evidence.</li> <li>2. How does your opinion on using Coal and Fossil Fuels for Energy change after hearing this point of view? What do you think is the perspective of the Coal Company?</li> <li>3. What do you suggest for Next Steps and Solutions to the Mystery? How</li> </ol>	<p>Vocabulary  Fossil Fuels  Toxic emissions  Solidarity  Community  Environmental Justice  Non-Renewable Energy</p> <p>Student Text:  <a href="#">Non Renewable Energy</a></p> <p><a href="#">Little Village Environmental Justice Organization</a></p> <p>Media:  Crawford Power <a href="#">Plant Demolition</a> Video</p>

		<p>would you solve the problem?</p> <p><b>Student Activity:</b> Write a letter to the Little Village Environmental Justice Organization or ideally arrange a Video Call Conference:</p> <ul style="list-style-type: none"> <li>- Exchange questions and ideas about their work and the coal plant in their community.</li> </ul>	
Episode 4	<p>Learning Goal: I can describe human-made impacts on the environment.</p> <p>I can describe the social impacts of Environmental Racism.</p>	<p><b>Incident: Mystery in Louisiana and Gulf of Mexico</b> New Orleans, Louisiana</p> <p>Hook: <a href="#">"Our Town, Our Fight" video</a></p> <p><a href="#">Cancer Alley Text and Reflection Questions</a></p> <p><b>Journal Reflection #5:</b> Create a concept map to show the Cause and Effect relationships between fossil fuels, environment, communities, and oil.</p> <ol style="list-style-type: none"> <li>1. What are the impacts from the Fossil Fuel Industry in this community? Use the Cause and Effect organizer to gather your evidence.</li> <li>2. How does your opinion on using Coal and Fossil Fuels for Energy change after hearing this point of view? What do you</li> </ol>	<p>Vocabulary Fossil Fuels Toxic emissions Solidarity Community Environmental Justice</p> <p>Student Texts: <a href="#">Oil Spill Impact on Wildlife</a></p> <p><a href="#">Social Impact of the Gulf Oil</a></p> <p><a href="#">Systematic Racism in Cancer Alley</a></p> <p><a href="#">Community Activism in Cancer Alley</a></p> <p>Science Lab: <a href="#">Oil Spill Simulation</a></p>

		<p>think is the perspective of the Coal Company?</p> <p>3. What do you suggest for Next Steps and Solutions to the Mystery? How would you solve the problem?</p> <p><b>Student Activity:</b> Write a letter to the <a href="#">Rise St. James</a> organization about their work in fighting environmental racism in Louisiana and ideally arrange a Video Call Conference:</p> <ul style="list-style-type: none"> <li>- Exchange questions and ideas about their work and the problems/solutions in their community.</li> </ul>	
Episode 5	<p>Learning Goal: I can describe human-made impacts on the environment.</p> <p>I can describe the impact of Carbon in our environment.</p>	<p><b>Incident: Mystery at the Laboratory</b></p> <p><b>Journal Reflection #6:</b> What is Carbon? How can you create a Concept Map to show the Carbon Cycle?</p> <p><b>Student Activity</b> <a href="#">Mystery of the Three Scary Numbers</a> from <i>A People's Curriculum for the Earth</i> edited by Bill Bigelow and Tim Swineheart</p>	<p>Vocabulary Carbon Cycle Green House Effect</p> <p>Student Text: <a href="#">Can Scientists use Carbon to Make Things?</a></p> <p><a href="#">Carbon Dioxide Data</a></p> <p>Science Lab: <a href="#">The Green House Effect</a></p>
Episode 6	<p>Learning Goal: I can explain how solar (photovoltaic) cells work.</p> <p>I can fluently multiply multi-digit whole</p>	<p><b>Incident: Mystery at the Solar Energy Power Plant</b></p> <p><b>Journal Reflection #7:</b> How do Solar Cells Work?</p>	<p>Vocabulary: renewable energy offsets watts photovoltaic power</p>

	numbers using the standard algorithm	<p>Create a Concept Map to show the processes.</p> <p>Student Activity:</p> <ol style="list-style-type: none"> <li>1. How can we find out how many watts of energy our school uses?</li> <li>2. If a solar panel can provide 200 Watts of energy, how many Solar Panels would we need in our school to offset our energy use?</li> <li>3. Design a Solar Panel that will maximize Area using Length x Width</li> </ol>	<p><a href="#">Bright Solar Futures High School Program</a></p> <p>Student Text: <a href="#">How Solar Cells Work</a></p> <p>Science Lab: <a href="#">Make your Own Solar Heater</a></p> <p><a href="#">How do Solar Cells Work Lesson Plans</a></p>
Episode 7	<p>Learning Goal: I can explain how Wind Farms create energy.</p> <p>I can describe sources of renewable energy.</p>	<p><b>Incident: Mystery at the Wind Energy Power Plant</b></p> <p><b>Journal Reflection #8:</b> How does Wind Energy work? Create a Concept Map to show the processes.</p>	<p>Vocabulary renewable energy offsets watts</p> <p><a href="#">ACUA Jersey-Atlantic Wind Farm</a></p> <p>Text: <a href="#">Generating Energy from the Wind</a></p> <p><i>The Boy Who Harnessed the Wind</i> by William Kamkwamba</p> <p>Science Lab: <a href="#">Make a Windmill</a></p>
Episode 8	<p>Learning Goal: I can explain how power travels through the Electric Grid.</p>	<p><b>Incident: Mystery at the Electric Company</b></p> <p><b>Student Activity:</b></p>	<p>Vocabulary electric grid Renewable vs. non-renewable energy</p>

	<p>I can describe sources of non-renewable and renewable energy.</p>	<p>Investigate and Research PECO and where our electricity comes from in Philadelphia.</p> <p>Write a Persuasive letter to PECO and the Governor with questions, concerns, and ideas about using Renewable Energy sources and Fossil Fuel Energy.</p>  <p><i>Pennsylvania's Electricity Generation Mix in 2013: Light on Renewables, but Growing. (Source: EIA)</i></p> <p><b>Journal Reflection #9:</b> How much electricity do you estimate we use at school and at home? How could you find out? Conduct some research. What is the Electric Grid?</p>	
		<p><b>Culmination/Celebration</b></p> <p><b>Ideas:</b></p> <ol style="list-style-type: none"> <li>1. Class Outdoor Healing Hike: connect with nature, create poetry and intentions for healing</li> <li>2. Field Trip to visit a College Engineering Lab</li> <li>3. Presenting new knowledge to school community through a</li> </ol>	

		Museum/Display	
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## Resources

### Bibliography for Teachers

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### Reading List for Students

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### **Classroom Materials**

[Coal Plant Shutdown Text and Reflection Activity](#)

[Cancer Alley Text and Reflection Questions](#)

[Climate Crisis Storyline Unit Overview, Timeline, and Resources](#)