



Sustainable Transportation

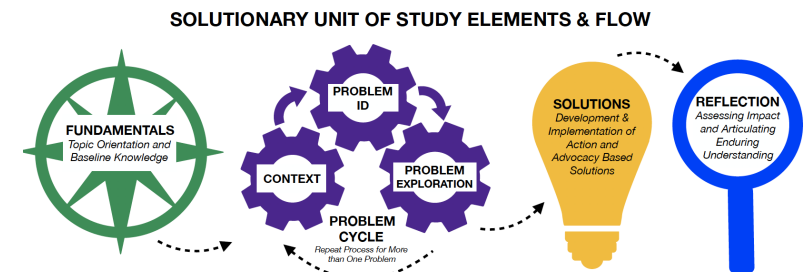
Solutionary Teaching and Learning Segments and Activities

Resources Developed by San Mateo County Of Education's (SMCOE) Environmental Literacy and Sustainability Initiative (ELSI)
Designed in 2019 - Last Updated May 2022



Overview to Solutionary PBL: Solutionary Teaching and Learning is a student-centered (but teacher-led) learning experience that provides the opportunity for students to analyze real-world environmental and social justice issues, and develop solutions that seek to mitigate these problems. A Solutionary Unit is built around four elements that take students from understanding basic contextual knowledge about a topic to diving deep into the associated problems and issues, then culminating with designing and implementing solutionary action and advocacy. These units can come in the form of a “mini-unit” or learning sequence that explores one problem within the larger topic and may take 1-2 weeks. Or Solutionary units can be full-length units that explore multiple problems before students move into solutions and action.

Either way, at the conclusion of a solutionary design challenge, students will be invited to pause and reflect. This reflection will center on evaluating impact, reflecting on enduring understandings, and celebrating personal and academic growth. The framework couches this learning process in a larger story-arch, one about a problem that must be solved by the main characters, the students themselves. *To learn more about the Content-Driven Solutionary Unit of Study Framework visit: [Solutionary Teaching and Learning Resources](#).*



Overview to the Transportation Unit: This document contains a guiding blueprint that includes essential and guiding questions, as well as corresponding statements and concepts that combine to capture the broader “story of transportation.” The document also organizes these concepts into a series of standards-aligned solutionary learning segments and activities that teachers can “take-and-teach.” However, it must be noted that this is not a fully scripted unit plan - as it is meant to be flexible and customized to meet the local context for each teacher (i.e. local problems and issues, adopted instructional materials, other supplemental resources, field trips, guest speakers, etc.). *It should also be noted that the sample learning segments include activities that are appropriate for both distance and on-site learning.*

The rest of this document provides the architecture for the unit and includes the following:

- **Section A - Transportation Solutionary Unit Example Blueprint:** The blueprint provides the general storyline of concepts for the four different elements of the unit, with a sample essential question at the top, and sample enduring understanding at the bottom.
- **Section B** - This section provides a high-level overview of the **standards and design considerations for differentiation**.
- **Section C - Concept and Activity Map:** This section provides detail for each concept in the blueprint (i.e. standards, teaching strategies, and activity titles) for each grade band level.

Section A: Transportation Solutionary Unit - Example Blueprint

Essential Question: In what ways does the transportation system have negative impacts on the planet and humans, and what might be done to make this system more sustainable?	Enduring Understanding: The transportation system is an incredibly complex and currently unsustainable system. However, it is possible to develop and transition to a fully sustainable transportation system that will benefit humans and the planet
---	--

FUNDAMENTALS SEGMENT: *The purpose of this learning segment is to provide a basic understanding of what transportation is and why it matters. All concepts are required.*

Driving Question: <i>What is transportation?</i>	• The purpose of transportation is to move goods, people, and information. • Humans have found various ways to transport themselves throughout history. • There are many different methods of transportation that have different inputs and outputs. • Transportation methods require different types of infrastructure.
---	--

PROBLEM SEGMENTS: *The transportation system has at least four core problems that could be identified and explored; however, it is only required that a teacher covers one of the problem segments below. The general **Driving Question** for the problem segments is the following: What are the primary and secondary problems associated with the transportation system? How have these problems developed, and what are the impacts?*

Problem Segment: Fossil Fuels: The transportation system is over-reliant on fossil fuels, which is an unsustainable energy source.	
• Fossil fuels are a non-renewable (finite) resource that cannot sustain a growing human population. • Extraction and production of non-renewable energy sources are harmful to the planet and to people. • The burning of fossil fuels causes air pollution and noise pollution, which has negative impacts on human health. • The burning of fossil fuels for transportation contributes to an imbalance in the global carbon cycle and contributes to climate change.	
Problem Segment: Built Landscape: The design of transportation infrastructure has largely been built on unsustainable and inequitable human-centric principles.	
• The infrastructure for the transportation system (roads, railroads, shipping routes, air routes, etc.) has been driven by a mental model that the human-built landscape is more important than animal ecosystems, and that some humans' lives are less important than others. • Urban planning and transportation infrastructure in the United States have deprioritized walking and rolling as a common form of transportation. • The transportation of goods takes place in a complex global economy that is largely driven by mental models of a consumer culture	

Problem Segment: Inequities and Danger: Transportation methods can be inequitable and dangerous.

- In many places, transportation infrastructure and methods are insufficient to provide efficient and equitable mobility across the region.
- In many places, access to safe and reliable transportation is inequitable, which exacerbates socio-economic divides and contributes to public health inequities
- There are many dangers associated with the transportation system such as accidents.

Problem Segment: Transportation of Information: The transportation of information has changed significantly in the past 50 years, which has had unintended consequences.

- Historically the transportation of information was reliant on vehicles that had a significant time delay.
- The use of the internet for the transportation of information contributes to global greenhouse gas emissions.
- The transportation of information through the internet is vulnerable to hacking/cyber attacks

SOLUTIONS: *No matter if it is a full-length unit of study or a mini-unit, solutionary teaching and learning must include time for students to design (and ideally implement) solutions that are relevant to their local problems and challenges. The requirement for the solutionary phase is completing one design challenge.*

Driving Question: How can we create a sustainable transportation system?

- 1) Introduction to Solutionaries and solutionary thinking around transportation
 - *Solutionaries* develop solutions that are healthy for people, animals, and the environment.
 - Solutions for a sustainable transportation system are happening at all different scales.
- 2) Solutionary Design Challenge: Complete one or more solutionary design challenges

REFLECTION: *Reflection and assessment are an integral part of the learning process during and at the completion of a unit. It is required that teachers complete at least one assessment, and at least one reflection process.*

Driving Question: *What did we learn in this unit?*

- 1) Instructors will integrate formative and summative assessments throughout the unit to check for understanding.
- 2) Instructors will provide a thoughtful reflection process at the end of the unit for students to identify their enduring understanding, as well as reflect on their growth as a learner. *It is also recommended that students reflect on the extent to which their implemented solution helped remedy the original problem(s).*

Section B: Overview to Standards and Differentiation Strategies for Environmental Literacy Integration

Standards Overview: These are the California standards references that can be used for thematic and integrated PBL units, and for entry point connections for integrating the [Environmental Principles and Concepts](#) (EP&Cs).

Subject Area	Standards Connections	Reference Resources
Next Generation Science Standards (NGSS)	Although there are many different parts of the CA Next Generation Science Standards (NGSS) that could be referenced, it is recommended to specifically show the connections in the curriculum to the Disciplinary Core Idea (DCI), as these show connections to the content.	San Diego COE NGSS - reference by DCI
CA History Social Studies	The EP&Cs show up in Appendix G of the CA History-Social Studies Framework, which shows specific connections to content and themes. However, when referencing in the curriculum it is recommended to show two specific alignments: • Show connections to specific universal problems, questions, and themes in Appendix B • Show how activities connect directly to Civic Engagement (outlined in Appendix E), which recommends that students have opportunities to participate in civic engagement at every grade level. This includes studying relevant problems and developing solutionary action and advocacy initiatives to solve these problems.	Appendix G - EP&Cs Appendix B - Themes Appendix E - Civic Engagement
CA Health	The health education standards are organized into six health content areas that are recommended for the grade band levels K-5 (different for each grade level), 6-8, 9-12. When developing an integrated curriculum it is useful to show connections to show where the curriculum aligns to these content areas.	Health Overarching Standards and Content Areas
CA Common Core Literacy	The literacy standards connections for integrated thematic teaching are generalized across the Common Core Literacy. Based on the teaching strategies students are either reading, writing, listening, and speaking. For each activity or lesson, it is good to be able to reference which of these literacy skills will be covered. If you can get more specific on types of reading (i.e. fiction, non-fiction, etc.) or writing (persuasive, expository, descriptive, etc.) that is useful.	CA Common Core Literacy
CA Common Core Math	Mathematical reasoning is often embedded in a number of activities and lessons. Therefore, it is recommended that the curriculum references the CA Common Core Math Practices If lessons can point to specific applied math skills then it is recommended to use the Standards by Domain .	Common Core Math
CA Visual and Performing Arts	With VAPA, it is often useful to reference how activities connect to the philosophical foundations and goals (creativity, communication, etc.), and/or disciplines (music, art, dance, etc).	CA VAPA Framework
Career Technical Education (CTE)	Career connections are very common in thematic integrated teaching, and it is recommended to show CTE connections such as specific sectors, and/or connections to Career Ready Standards.	CTE Standards & Practices

Note about differentiation to support ALL learners: In order to ensure high-quality Tier 1 instruction for all students, it is important that teachers make the following considerations for students who are English Learners and students with Special Education needs.



English Learner Considerations

English Learners have a wide range of language strengths and areas to grow - [see overview in ELD standards](#). What supports could you provide your English Learner students? Who will you connect with to learn about ways you can support your students?

Determine the level of supports: substantial/moderate/light

Scaffold examples: Language frames, Visuals, Realia, Total Physical Response (TPR), previewing vocabulary, sentence stems, graphic organizers, etc.

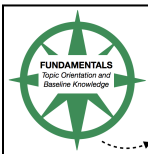


Special Education Considerations

Students with IEPs have areas that require specialized planning. Who might you need to connect with to learn more about the students with IEPs in your class? What are some of the needs you might consider? What supports, scaffolds or specific accommodations could you use in order to support the students' learning in your classroom? What assistive technology or tools would you need to support your students with IEPs?

Section C: Sustainable Transportation Solutionary Concept Map with Sample Learning Segment Activities

Overview: This section provides detail for each concept in the Section A Blueprint and Section B Standards, including [solutionary teaching strategy](#) recommendations, sample activities and lesson plans for each grade band level (K-2, 3-5, and 6-12), and connections to integrating trauma-informed practices, solutionary thinking, and assessment.



FUNDAMENTALS LEARNING SEGMENT

→ *Quick Guidance for Teachers on Fundamentals: It is highly recommended that any solutionary learning about the transportation system begin with attention to the fundamentals on the topic to establish a shared baseline of background knowledge before studying problems and solutions.*

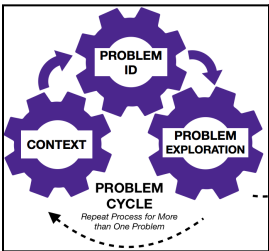
→ [Example Slide Deck for Fundamentals](#)

Overview: The purpose of this learning segment is to provide a basic understanding of the basics of transportation and why it matters. The learning segment opens with the history of transportation and the different methods of transportation, including inputs and outputs.

Concept	Standards	Strategies	K-12 Sample Activities	Teacher Notes
Transportation methods move goods, people, and information.	• CA CC Literacy • CA History and Social Studies: Science Technology and the Environment	Engage and Explain Discussion, Direct Instruction	Overview and Resources: Students will be able to define and/or identify the purpose of transportation (i.e the purpose of <i>transportation</i> is to move goods, people, and information). Useful background resources for teachers include: What is transportation? And National Geographic Resources. K-12 Recommended Activities and Materials: • Watch the Transportation 101 video • Engage students in an inquiry-based discussion about the purpose of transportation. • Identify different categories of things that get transported. K-2 Recommended Activities and Materials: • Read Transportation in My Neighborhood by Shelly Lyons	
Humans have found various ways to transport themselves throughout history	• CA-NGSS DCIs: LS1-1, PS2-1, PS2-2 • CA VAPA Framework (Arts Integration) • CA History and Social Studies: Science Technology and the Environment	Engage and Explain Discussion, Categorizing	Overview and Resources: Students describe the history of travel and compare historical means of travel to those used today with an emphasis on the type or source of energy used. K-12 Recommended Activities and Materials: • Watch video overviews of transportation throughout history. ◦ Smithsonian: America on the Move ◦ An Animated History of Transportation ◦ The History and Development of Transportation in America • Note the importance of the invention of the wheel. Categorize this history into larger chunks of time that are dominated by different types of transport. (Teacher may summarize for younger learners.) • Possible Extension: Have students examine primary source artifacts of ancient transportation methods. See example in the New York Transit Museum	
There are many different methods of transportation that have different inputs and outputs	• CA-NGSS DCIs: LS1.C, PS2.A • CA CC Literacy • CA VAPA Framework (Arts Integration) • CA History and Social Studies: Science Technology and the Environment	Explore Discussion, Modeling, Simulation	Overview and Resources: This lesson provides an important framing for identifying different methods of transportation and how they vary in the degree of input. Additionally, the lesson is a jumping-off point for later problems and issues that will be explored. K-12 Recommended Activities and Materials: • Students identify different methods of transportation (i.e. walking, rolling (scooting, skating, biking), cars, bus, train, etc.). It is useful to have them draw (K-5) [or find images (2-5)] of all the ways (modes of transportation) that people can use to get to and from school or around town.. • Students diagram the methods of transportation noting different inputs (human energy, fossil fuels) and outputs (sweat, noise/air pollution, etc) ◦ Can use Autodraw if learning is virtual or asynchronous. ◦ K-5 Video - Magic School Bus Revving Up ◦ 3-12 Video - Science Please! The Internal Combustion Engine	

	• CA Health: Nutrition and Physical Activity, Injury Prevention and Safety			
Transportation Methods Have Different Infrastructure	• CA CC Literacy • CA History and Social Studies: Science Technology and the Environment	Explore and Explain Discussion, Modeling, Mapping, Simulation	Overview and Resources: This lesson rounds out the basic fundamentals by introducing the concept of transportation infrastructure. How are streets, roads, and avenues different? Highways and traffic congestion Activities Description: • Students will define terms related to routes and infrastructure, as well as identifying which methods of transportation use which infrastructure. • For younger learners, this can be prompted with a visual stimulus that students have to match to categories. • Draw or write all the different ways students/staff get to school (Modes of transportation) and the surfaces used (infrastructure - sidewalks, roads, tracks, etc) • Look at age-appropriate maps (paper or virtual) of the area around the school to see what types of roads, sidewalks, etc. are around the school. • Ask students to observe the infrastructure during their trips to/from school (stoplights, stop signs, crosswalks, pedestrian-only zones, etc) • Students can map or draw this in their notebooks	
Additional Resources and Considerations	By the end of the fundamentals learning segment, students should be able to accurately explain to someone else the fundamental basics of transportation. Formative and summative evaluation tools for this learning segment are recommended in the Assess and Reflect section .			

PROBLEM LEARNING SEGMENTS OVERVIEW



Overview: Any given topic likely has at least 1-5 problems that could be identified and explored. In order to identify something as a problem, students may need additional context from which they can then make observations of social and scientific phenomena, and follow a cycle of inquiry using evidence and systems thinking. This process of context - problem ID - problem exploration, is repeated for each problem. Depending on grade level and time constraints teachers may choose to select only 1-2 problem learning segments to explore with students, and/or teachers may go from problem to solution, and then go back and explore another problem and solution. This phase of learning is meant to be flexible and meet the interests and development level of students.

Each problem segment below has an additional row at the end of the table that reminds instructors (teachers) to integrate different teaching strategies and tools such as [Solutionary PBL Teaching Strategies](#), [Trauma-Informed Practices](#), [Assessment and Reflection](#), and [Solutionary Activities and Resources](#).

PROBLEM Segment: Fossil Fuels

→ Quick Guidance for Teachers on this program segment: This particular problem cycle is unique as it provides a root cause for many of the other problems that are to come. It is highly recommended that this problem be paired with at least one other problem when learning about sustainable transportation.

Overview: The transportation system is overly reliant on fossil fuels, which are an unsustainable energy source.				
Concept	Standards	Strategies	K-12 Sample Activities	Teacher Adaptations and Notes
Two key concepts: - Fossil fuels are a non-renewable (finite) resource that cannot sustain a growing human population. - Extraction and production of non-renewable energy sources are harmful to the planet and to people.	• CA CC Literacy • CA CC Math: Operations and Algebraic Thinking • CA History and Social Studies: Patterns of Population, Science Technology and the Environment • CA-NGSS DCIs: ESS3.A, ESS3.D • CA Health: Injury Prevention and Safety, Mental, Emotional, and Social Health, Personal and Community Health • CA VAPA Framework (Arts Integration)	Engage and Explore/ Explain Categorizing, Student-Directed Research, Direct Instruction, Simulation, Discussion	The heart of the transportation problem is understanding the concept that fossil fuels are a limited (finite) resource. Modern humans have become reliant upon these fossil fuels for transportation. As the human population grows, our reliance upon fossil fuels becomes more and more unsustainable. Here is a slide deck with solutionary resources from the 2020 SMELC Teacher Fellowship. K-5 Recommended Activities and Materials: This is a complex problem for K-2. There are not many published resources for this age group. However, students can understand when there are not enough resources for everyone. Use classroom examples. • Natural Resources for Kids video How people lived (HSS K.6, 1.4) • GenerationGenius natural resources video (NSTA) • PBS Learning The Future of Energy (Video, Discussion (Doc) or Google Form, and Background Reading) • Resource Musical Chairs Simulation 3-12 Recommended Activities and Materials: • Transportation and Population Growth 5E Lesson plan	
The burning of fossil fuels causes air pollution and noise pollution, which has negative impacts on human health.	• CA-NGSS DCIs: ESS3.C and ESS3.D • CA History and Social Studies: Patterns of Population, Science Technology and the Environment	Explore, Explain, and Elaborate Modeling, Direct Instruction, Discussion, Experiment, Student-Direct	In this section, students will explore case studies involving pollution caused by transportation: air pollution and noise pollution. • Air Pollution WebQuest (Recommended that elementary teachers select out a few resources for this activity) • Noise Pollution Hyperdoc K-12 Recommended Activities and Materials: • Air and Noise Pollution (5E Lesson Plan)	

	• CA Health: Mental, Emotional, and Social Health, Personal and Community Health • CC Math : Measurement and Data • CA CC Literacy • CA VAPA Framework (Arts Integration)	ed Research, Trauma-Informed Practice	→ Trauma-Informed Practice - Medical Art • Honor your “injured or assaulted” body part by drawing it and making an art piece • See slides for ideas or lesson here on page 26 (focus on lungs and/or ears) Extension: study the history of anatomical sketches and how art has been an essential tool in medicine/science	
The burning of fossil fuels contributes to an imbalance in the global carbon cycle and contributes to climate change.	• CA-NGSS DCIs: ESS3.D • CC Math: Measurement and Data • CA CC Literacy • CA VAPA Framework (Arts Integration)	Explore and Explain Experiment Student-Directed Research and Discussion, Trauma-Informed Practice	Overview and Resources: This learning segment concludes with an exploration of how the burning of fossil fuels contributes to global warming. K-12 Recommended Activities and Materials: • Discuss Global Climate Change basics with students, using age-appropriate images and data (see slides 63-69). • Students investigate the basic concept of global warming using a gamified simulation or similar online activity - NASA Climate Kids games (K-5) - Play OFFSET ◦ 6-12 Students can discuss the simulations for realism and usefulness in teaching the concept of climate change. • Students do a trauma-informed practice that asks them to spend time outside journaling in nature, and connecting their emotions and feelings with the content they just learned. Choose one from this list. K-5 Recommended Activities and Materials: • Read and discuss: Seymour Simon’s Global Warming or Jeanette Winter’s Our House is on Fire or similar. • Watch and discuss: What is Climate Change? (Think of local examples.) 3-5 Recommended Activities and Materials: • Students utilize K-5 friendly resources (and these) from the Climate Change WebQuest to identify the impacts of climate change and discuss the impacts in small groups and with the whole class. (K-5 teachers will want to modify this resource to only include resources for kids - i.e. EPA Climate for Kids, NASA Climate Kids, Bill Nye) → Teacher information: Consider capturing thinking in a chart and the connection between KLEWS and Claims-Evidence-Reasoning, especially for 3rd graders. KLEWS 101, CER Rubric 6-12 Recommended Activities and Materials: • Students can code their own simulation using Scratch. • Students utilize the Climate Change WebQuest to identify the impacts of climate change and	

			discuss these impacts in small groups and with the whole class.	
Additional considerations: Teaching Strategies Trauma-Informed Practices, Assessment, and Solutionary Activities.	As instructors develop and plan this unit, it is critical to integrate different teaching strategies and tools such as: • Solutionary PBL Teaching Strategies: Each learning segment should blend a mix of strategies • Trauma-Informed Practices: Especially for content and activities that have emotional engagement and ethical reflection • Assessment and Reflection: Learning segments should include and/or end with formative assessment and reflection • Solutionary Activities and Resources: <i>Often when examining problems, students will naturally want to find ways to solve these problems at the individual or collective scale. Depending on the grade and social and emotional development, it may be appropriate for teachers to spend time examining some aspects of solutions after each problem segment. However, to support solutionary thinking that gets at root causes, it is also recommended that students be exposed to all problem segments that a teacher plans to include in a unit of study (or mini-unit) before completing a solutionary design challenge.</i>			

PROBLEM Segment: Built Landscape

→ Quick Guidance for Teachers on this problem segment: This particular problem cycle focuses on how transportation and built landscapes impact natural landscapes, and is great to explore with all grade levels. This problem also lends itself well to connect with Community-Based Partners such as transit and county agencies for in-person or virtual field trips, and/or is great for school communities to partner with Safe Routes to School.

→ [Example slide deck for Built Landscape](#)

Overview: The design of transportation infrastructure has largely been built on unsustainable and inequitable human-centric principles.				
Concept	Standards	Strategies	K-12 Sample Activities	Teacher Adaptations and Notes
The infrastructure for the transportation system (roads, railroads, shipping routes, air routes, etc.) has been driven by a mental model that the human-built landscape is more important than animal ecosystems.	• CA-NGSS DCIs: ESS2-2, • CA CC Literacy • CA Math: Measurement and Data • CA History and Social Studies: Physical and Human Geographic Features, Science Technology and the Environment • CA Health Standard	Explore and Explain Discussion and Seminar, Student-Directed Research	In this section, students will be able to define and distinguish between the natural and built landscape. Students will identify that transportation takes place on the built landscape and that the built landscape from human transportation has an impact on ecosystems. Students will explore habitat fragmentation caused by built landscapes used for transportation. The infrastructure for the transportation system (roads, railroads, shipping routes, air routes, etc.) has been driven by a mental model that the human-built landscape is more important than animal ecosystems, and that some humans' lives are less important than others. K-12 Recommended Activities and Materials: • Natural vs, Built Landscape Lesson Plan	

	2: Analyzing Health Influences			
Urban planning and transportation infrastructure in the United States have deprioritized walking and rolling as a common form of transportation.	• CA-NGSS DCIs: ESS3.C, LS4.D, ESS2.A • CCSS Math: Data & Measurement, Geometry • CA Health: Nutrition and Physical Activity, Injury Prevention and Safety, Mental, Emotional, and Social Health	Explore and Explain Discussion and Seminar, Mapping/ modeling	K-5 Recommended Activities and Materials: Mapping: Students will be able to distinguish between a neighborhood and community, and then model their school and surrounding community at different scales. Students will be able to identify built and natural landscapes in their community as well as identify what type(s) of transportation are in their community. Activities Description: • 5E Community Mapping Lesson • Students watch a video on types of communities. 6-12 Recommended Activities and Materials: • Modify the 5E Community Mapping Lesson from K-5 or choose a Traffic Study lesson • Students read the article and observe/survey how students get to school • Use the MS Educator Guide (Let's Get Safe) or Safe Routes to School Engineering Solutions Guide to collect data on how students arrive at school or move about the community.	
The transportation of goods takes place in a complex global economy that is largely driven by mental models of consumer culture.	TBD	TBD	Overview and Purpose: This concept is included here as an extension concept for instructors that are able to include economics into their lesson sequence. <i>This exemplar does not include sample lessons at this time - lessons TBD.</i>	
Additional considerations: Teaching Strategies Trauma-Informed Practices, Assessment, and Solutionary Activities.	As instructors develop and plan this unit, it is critical to integrate different teaching strategies and tools such as: • Solutionary PBL Teaching Strategies: Each learning segment should blend a mix of strategies • Trauma-Informed Practices: Especially for content and activities that have emotional engagement and ethical reflection • Assessment and Reflection: Learning segments should include and/or end with formative assessment and reflection • Solutionary Activities and Resources: <i>Often when examining problems, students will naturally want to find ways to solve these problems at the individual or collective scale. Depending on the grade and social and emotional development, it may be appropriate for teachers to spend time examining some aspects of solutions after each problem segment. However, to support solutionary thinking that gets at root causes, it is also recommended that students be exposed to all problem segments that a teacher plans to include in a unit of study (or mini-unit) before completing a solutionary design challenge.</i>			

PROBLEM Segment: Inequities and Danger

→ Quick Guidance for Teachers on this problem segment: This problem cycle has a number of complex issues embedded within it, and teachers need to determine which concepts are best to explore with students based on grade level, local context, and time constraints. It is critical that trauma-informed practices be at the center of any lessons related to inequity.

→ [Example slide deck for Inequities and Dangers.](#)

Overview: The purpose of this learning segment is for students to understand that transportation methods can be inequitable and dangerous. Inequitable transportation is a social justice issue involving socioeconomics, race, ability, and urban planning.				
Concept	Standards	Strategies	K-12 Sample Activities	Teacher Adaptations and Notes
In many places, transportation infrastructure and methods are insufficient to provide efficient and equitable mobility across the region. Access to safe and reliable transportation is inequitable, which exacerbates socio-economic divides and contributes to public health inequities.	• CA-NGSS DCIs: ETS1.A • CA History-Social Studies Themes: Haves and Have-Nots; Science, Technology, and the Environment • CA Health: Personal and Community Health • CA Common Core Literacy • CC Math: Number and Operations: Fractions • CA CTE Standard	Engage, Explore, Explain, Elaborate, and Evaluate Discussion, Student-Directed Research, Case Study	This concept is included here as an extension concept for instructors that are able to extend their unit to focus on social justice issues. See a full lesson plan with embedded activities here: Inequitable Transportation and Social Justice 5E Lesson Plan	
There are many dangers associated with the transportation system.	• CA-NGSS DCIs: PS2.A, ESS2.D, ESS3.C • CA CC Literacy	Explain and Engage Modeling, Simulation,	The purpose of this lesson is to explore possible dangers associated with the transportation system. These dangers can be based on accident data, or related to public health issues such as noise and air pollution. Ideally, this concept will be explored with a hyper-local lens and serves as an entry point for <i>Safe Routes to Schools (or parks) initiatives</i>. SRTS Safety Resources	

	• CA Health: Nutrition and Physical Activity, Injury Prevention and Safety, Mental, Emotional, and Social Health	Discussion	K-12 Recommended Activities and Materials: • Students add to their maps showing where walking or biking may be difficult or unsafe • Students add areas with higher noise or air pollution to their maps • Any other hazards? • Students read articles about Transportation Safety (Get Healthy pedestrian safety, stranger safety, and the free-range child debate) • Students should connect these to the California Environmental Principles and Concepts and/or Principles of Environmental Justice. • Students can relate this to street closures during the COVID 19 pandemic Article 1, Article 2	
Additional considerations: Teaching Strategies Trauma-Informed Practices, Assessment, and Solutionary Activities.	<i>As instructors develop and plan this unit, it is critical to integrate different teaching strategies and tools such as:</i> • Solutionary PBL Teaching Strategies: Each learning segment should blend a mix of strategies • Trauma-Informed Practices: Especially for content and activities that have emotional engagement and ethical reflection • Assessment and Reflection: Learning segments should include and/or end with formative assessment and reflection • Solutionary Activities and Resources: <i>Often when examining problems, students will naturally want to find ways to solve these problems at the individual or collective scale. Depending on the grade and social and emotional development, it may be appropriate for teachers to spend time examining some aspects of solutions after each problem segment. However, to support solutionary thinking that gets at root causes, it is also recommended that students be exposed to all problem segments that a teacher plans to include in a unit of study (or mini-unit) before completing a solutionary design challenge.</i>			

PROBLEM Segment: Information

→ Quick Guidance for Teachers on this problem segment: It is highly likely that teachers in K-5 will explore this problem very differently than 6-12 teachers; however, we encourage teachers to introduce these information technology issues to students of all ages as time allows as they connect to modern human impacts on the environment.

→ [Example slide deck for Information.](#)

Overview: The transportation of information has changed significantly in the past 50 years. This has had many advantages for human society, but also has negative consequences for both humans and the planet.				
Concept	Standards	Strategies	K-12 Sample Activities	Teacher Adaptations and Notes
Historically the transportation of information was reliant on vehicles that had a significant time delay.	TBD	TBD	This concept is included here as an extension concept for instructors that are interested and able to extend their lesson unit to include a look at transportation of information during the historical time periods that students are studying in History-Social Studies. <i>This exemplar does not include sample lessons at this time - lessons TBD.</i>	
The use of the internet for the	TBD	TBD	The purpose of this extension topic is to identify the significant role that the internet now plays in transportation information, and how that has created an extensive new infrastructure that contributes to GHG emissions. These lessons have not been built out extensively; however, here is	

transportation of information contributes to global greenhouse gas emissions.			one sample resource: Internet GHG Emissions WebQuest .	
The transportation of information through the internet is vulnerable to hacking/cyber attacks	TBD	TBD	This concept is included here as an extension concept for instructors that are able to extend their unit to include complex computer science and social studies issues.. <i>This exemplar does not include sample lessons at this time - lessons TBD.</i>	
Additional considerations: Teaching Strategies Trauma-Informed Practices, Assessment, and Solutionary Activities.	As instructors develop and plan this unit, it is critical to integrate different teaching strategies and tools such as: • Solutionary PBL Teaching Strategies: Each learning segment should blend a mix of strategies • Trauma-Informed Practices: Especially for content and activities that have emotional engagement and ethical reflection • Assessment and Reflection: Learning segments should include and/or end with formative assessment and reflection • Solutionary Activities and Resources: Often when examining problems, students will naturally want to find ways to solve these problems at the individual or collective scale. Depending on the grade and social and emotional development, it may be appropriate for teachers to spend time examining some aspects of solutions after each problem segment. However, to support solutionary thinking that gets at root causes, it is also recommended that students be exposed to all problem segments that a teacher plans to include in a unit of study (or mini-unit) before completing a solutionary design challenge.			

SOLUTIONS LEARNING SEGMENT: ACTIVITIES, CONTENT, AND RESOURCES



Overview: No matter if it is a full-length unit of study, or a mini-unit, solutionary teaching and learning must include time for students to design (and ideally implement) solutions that are relevant to their local problems and challenges. This applied problem solving is called for in multiple subject area standards and frameworks:

- [CA NGSS Engineering](#) ETS1.A-C
- [CA HSS Civic Engagement](#)
- [CA Health](#)
- [CA CC Math Practices](#)
- [CA CC Literacy](#)
- [CA VAPA Framework](#) (Arts Integration)

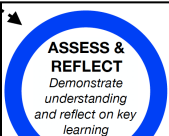
Please note that instructors may choose to integrate solutionary activities at the end of each problem learning segment, and/or teachers may save the majority of solutionary activities (in particular the design challenges) for the end of the unit (or mini-unit).

→ [Example Slide Deck for Solutions](#)

The table below includes general suggestions for introducing solutionary thinking and general solutionary design challenges, as well as specific content for solutionary teaching and learning regarding the transportation system.

Concept	Sample Activities and Resources	Teacher Adaptations and Notes
A Solutionary is someone who is able to identify inhumane and unsustainable systems, then develop solutions that are healthy for people, animals, and the environment.	Introduce students to the concept of a solutionary. Utilize and adapt the following resources for your grade level: • Introduction to Solutionary Mindset Slide Deck • Solutionary Books and Videos	
Solutions for the transportation system are happening at all different scales, and are generally focused on access, conservation and efficiency, renewables, and offsets/allowances.	A) Utilize and adapt the following general transportation solution resources for your grade level and local context: Transportation Solutionary Slide Deck Overview 1) Sustainable Transportation Systems Solutions Overview • UN SDGs: https://sustainabledevelopment.un.org/topics/sustainabletransport • Drawdown: https://drawdown.org/sectors/transportation 2) Examples of Engineering and Community Impact Projects B) Specific Topical Solution Resources • Repurposing of transit infrastructure • Complete Streets example • Urban Planning in Portland, OR • High Line in New York • Wildlife Crossings C) San Mateo County Community-Based Partners	
Humanity cannot wait for students to graduate and get started on doing things that contribute to a better world. We need to give students in every school, at every age, real agency and authentic opportunities to make a difference in this volatile, unpredictable, complex, and ambiguous world. - David B. Hawley: CIO for IBO Curriculum	Students should complete at least one design challenge at the end of the Solutionary PBL unit. Choose a solutionary design challenge from the Solutionary Design Challenges Overview and Examples - handout and slide deck embedded. → Note that design challenges need to be adapted for your topic, grade level, and local context.	

ASSESS (EVALUATE) & REFLECT:



Overview: Assessment (evaluation) provides students an opportunity to apply their understanding of the standards - both content and practices (see below):

- [CA NGSS Science and Engineering Practices](#)
- [CA HSS Civic Engagement](#)
- [CA Health](#)
- [CA CC Math Practices](#)
- [CA CC Literacy](#)
- [CA VAPA Framework](#) (Arts Integration)

Assessments also provide opportunities for students to grapple with the [California Environmental Principles & Concepts](#) (EP&Cs) that are most relevant. A solutionary unit (or mini-unit) provides many opportunities for assessment (evaluation) and reflection, and it is recommended that instructors integrate formative assessment during and after each learning segment. Many instructors may want to use a rubric for assessing students throughout the solutionary unit, and at the end of the unit during the culminating presentation. A few sample rubrics can be found [here](#):

- Solutionary Unit of Study Student Outcomes [Rubric Example](#)
- Zoe Weil @ Institute for Humane Education - [Solutionary Rubric](#)

Assess (Evaluate): Suggestions for how to complete a formative or summative assessment are below.	
Formative: By the end of each learning segment, students should have done multiple formative assessments that demonstrate their understanding of each issue that is relevant to this problem.	Examples of formative assessment/evaluation tasks include: • Students can make the problem visible to others through a diagram, chart, picture, etc. This picture or diagram would include the relevant variables that contribute to the problem, and connections between these variables. • If the problem lends itself to argumentative/persuasive reasoning, students could collect credible evidence that is relevant to the problem, and make a claim (C) that they back up with evidence (E) and reasoning (R) - this CER statement can be done in writing or verbally in a video. • In a whole-class discussion or Socratic seminar, students share their intellectual, emotional, and ethical understanding of the problems and issues. • Students can complete a Triple Bottom Line (TBL) analysis, by identifying environmental, economic, and social impacts. This can be done in a graphic organizer, writing, or in a video. • If a case study was included in this problem exploration, students can complete a case study analysis and contribute to each aspect of a case study analysis, and can collaborate with peers on developing feasible solutions. • Students can choose which of the California Environmental Principles & Concepts (EP&Cs) they think are most relevant to this problem, and analyze how/why in writing or verbally in a discussion or video.
Summative: A culminating summative assessment captures student learning from the entire unit (or mini-unit).	After studying the fundamentals, problem(s), and completing a solutionary design challenge, students will need to capture their learning by demonstrating their understanding of the content (and skills) during each segment of the unit (or mini-unit). It is recommended that instructors have students complete a culminating presentation that will ideally also include a final reflection (see reflection prompts in the reflection section below). Below are some recommended presentation styles: • Whole-Class Presentations (this should include some sort of visual - poster, slide deck, etc.) • Showcase and Solutionary Fair Displays - see details HERE for how to host a solutionary fair • TEDx Style Talk/Video • Presentation to Industry Experts

Reflection: Suggestions for integrating reflection are below.

Reflection is an integral part of the learning process during and at the completion of a unit.	Instructor supports students to reflect on their learning throughout the unit (mini-unit), and to provide an understanding of their enduring understanding at the end of the unit. Possible outcomes from reflection are the following: • At the end of a problem segment, students can complete a reflection journal prompt that expresses their sense of urgency regarding the problems and issues they studied so far. • Students reflect on their overall emotional feelings during and at the end of the unit: fear, hope, outrage, optimism, etc. • Students articulate an enduring understanding from the unit. • Students reflect on their personal growth based on their experiences during the project. • Students reflect on the extent that their implemented solution helped remedy the problem.
--	---