

# Green Transportation

## Certificate



Learn skills for green transportation careers through experiential activities like developing a solar car, making bio-diesel, and designing a transportation friendly city

## **Welcome to the Sustainability Certification Course: Green Transportation**

This package:

- Includes sixteen interactive lessons designed for secondary grade level
- Provides hands-on training in sustainable development, green transportation concepts, urban planning & design, policy, global sustainable transportation initiatives, and workforce opportunities in the sector
- Addresses State, Next Generation Science Standards and Common Core Content Standards
- Includes subject areas in Science, Social Studies, Math, Language Arts and Technology
- Prepares students for “green” jobs

The Sustainability Certification Course is a program of Strategic Energy Innovations (SEI), a non-profit organization that provides energy efficiency and renewable energy consulting and related services to the cornerstones of all communities – schools, local governments, the workforce and the housing sector. For more information, please visit us at <http://www.seiinc.org>.

### **Acknowledgements**

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- Skyline College
- Canada College

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# Certificate Introduction

Welcome to the SEI Green Transportation Certificate. The Green Transportation Certificate explores the general concepts behind green transportation systems and the implementation of green transportation measures and behaviors to reduce social, environmental, and economic impacts. Through this course, students learn to identify and evaluate green transportation vehicles, programs and behaviors, and gain skills directly applicable to the expanding green trades.

This interdisciplinary course uses hands-on demonstrations, interactive activities, discussions and take-home assignments to engage students in understanding and applying important sustainable transportation concepts. It is designed with adaptability in mind to allow the curriculum to span multiple objectives, class schedules, student skill levels and background knowledge. Upon completion of the course, students are awarded a certificate confirming their knowledge and skills in green transportation.

## **This curriculum package includes:**

- Comprehensive lessons change, transportation fuels, electric vehicles, public transportation technology, transportation policy, and green transportation careers
- Hands-on activities allowing students to explore the carbon cycle, the greenhouse effect, solar car design, and sustainable transportation options
- Practical applications in sustainable transportation assessments, conservation campaigns, renewable energy cost/benefit analysis, action planning, reporting, and project implementation
- A unit pre and post-test to assess comprehension and retention of material presented. Administer the test before beginning the unit and upon completion to assess student learning outcomes
- Coverage of Next Generation Science Standards, Common Core ELA Standards, and Career Technical Education Standards

This Green Transportation Certificate was developed by Strategic Energy Innovations (SEI). SEI is a non-profit organization that provides sustainability consulting to cornerstone community institutions - schools, local governments, the workforce, and housing. For more information, please visit us at <http://www.seiinc.org>.

# Curriculum Key

## Lesson Symbols



Look for this camera icon within lessons for image recommendations. Images can be found in the instructional PowerPoint provided with the curriculum.



Look for this icon within lessons for video recommendations.



Look for this pencil icon within lessons for student journal prompts.

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## SETTING THE STAGE

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Each lesson starts with a section entitled “Setting the Stage”, which guides the teacher in the delivery of critical information relevant to the lesson topic or activity for the day. There may be additional resources listed at the end of the “Setting the Stage section”. These provide the instructor with links to extra resources to help solidify their understanding of topics.

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## ACTIVITES

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Each lesson is accompanied by one or more in-class exercises. Instructors can assess and track student performance based on their satisfactory completion of the activities and subsequent discussions.

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## ASSIGNMENTS

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Each lesson includes take-home assignments, which range from worksheets to research or group project prompts. These can be used to assess and track student performance.

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## HANDOUTS

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Each lesson is accompanied by handout(s) that will help the students complete the in-class exercises or the take-home assignments.

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## ASSESSMENTS

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Each main concept is followed by a prompt designed to assess student’s comprehension of the material.

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## EXTENSIONS

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Many (but not all) of the lessons include extensions - project recommendations or assignments that build upon the topic of that particular lesson. Instructors can use these optional extensions as a guide for expanding upon material covered in the lesson.

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## MODULE CONTENT

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The Green Transportation Certificate builds knowledge and skills in a sequential manner to allow students to gain a fundamental understanding of and experience in sustainability and green transportation. Instructors are encouraged to follow the module sequence, but the curriculum is designed to enable teachers to draw out individual lessons according to the needs of their class. See the *Curriculum Matrix Chart* and *Sample Lesson Page* on the following pages for a lesson summary and overview of lesson content.

## CURRICULUM MATRIX: GREEN TRANSPORTATION CERTIFICATE

### 25 - 31 hours of coursework

Module		Lesson		Estimated Time*	Description
1.0	Climate Change and Sustainability	1.1	Sustainability: Problems and Opportunities	80 minutes	Students develop and analyze sustainability definitions, envision a sustainable community, and measure their personal carbon footprints.
		1.2	Climate Change	180 minutes	Students learn about the stages of the Carbon Cycle and how they are being affected by human activity, and investigate the causes and consequences of climate change and opportunities to address it.
2.0	Transportation Fuels	2.1	Energy Sources: Current vs. Ancient Sunlight	135-180 minutes	Our energy choices have a significant impact on climate change. Students look at the history of transportation, identify renewable vs. non-renewable sources of energy and analyze their effects on climate and sustainability.
		2.2	Comparing Transportation Fuels	45 minutes	Students will learn about different energy sources to power transportation and compare non-renewable and renewable sources of transportation fuel.
		2.3	Renewable Transportation Fuels	90 minutes	Students learn about the sources, production and uses of renewable transportation fuels.
3.0	Personal Transportation	3.1	How Do Cars Work?	45-90 minutes	Students will learn the basic parts of a car and how the major systems of a car work. Student groups will begin construction of model solar cars.
		3.2	Electric Vehicles	90 minutes	Students will learn about basic electricity and types of electric and hybrid vehicles.
		3.3	Comparing Car Options	90-180 minutes	Students will build and race solar model cars and investigate the pros & cons of available automotive options.
4.0	Public Transport, Travel & Distribution	4.1	Public Transportation Technology: Make Your Way Around	45-90 minutes	Students will research community transportation options and plan an itinerary while learning about the environmental ramifications of transportation decisions.
		4.2	Travel: Plan Your Dream Vacation	70 minutes	Students will plan a dream vacation and calculate the energy used & greenhouse gases emitted.
		4.3	Distribution Technology: How Does Stuff Get to Our Stores?	45-90 minutes	Truck, train, tanker? Students will evaluate factors, including emissions, in order to make decisions about how to transport products for their dream business.



5.0	Transportation Policy, Planning and Design	5.1	Existing Policies & Goals	180-270 minutes	Students will learn about the policy process and develop a school campaign to reduce campus greenhouse gas emissions.
		5.2	Potential Policies & Global Best Practices	135 minutes	Students will research successful programs and policies from around the world and debate the best program/policy to increase green transportation in their community.
		5.3	Urban Planning, Design & Innovation	90 minutes	Students will learn about land use, infrastructure design, and planning for walking and biking. Students will evaluate policy options for GHG reductions as City Council Members of the City of Tomorrow.
6.0	Green Transportation Careers	6.1	Green Transportation Careers	45-225 minutes	Students will learn about careers and educational opportunities in the Green Transportation sector.
		6.2	Green Career Internship	Up to 6 months	Students will complete an internship at a company or organization in the Green Transportation sector.

\* This curriculum is designed to be taught over the course of one semester, but can be adapted to be taught in a shorter time, if necessary. Lessons can also be taught in a stand-alone format. The total instructional time as laid out above is between **25 and 31 hours**, excluding the green career internship.



## Lesson 2.1 Overview

### Estimated Time

135-180 minutes

### Standards Covered

NGSS: HS-PS3-3

CA History & Social Science:

United States History and Geography (& CA Technical Foundation Standards 1.3): 11.5.7

CCSS Math:

Number and Quantity- Quantities: 1

CCSS ELA Literacy:

Reading Standards for Literacy in Science and Technical Subjects: 7, 9

**Objectives:** Students will be able to:

- Understand how the use of renewable and non-renewable fuels effects the carbon cycle
- Compare the efficiency of the human body to a vehicle for transportation

### Prep Time

- Half hour for printing handouts and collecting materials

### Handout

- 2.1.1 Energy Sources for Transport
- 2.1.2 Major Developments in Transportation History
- 2.1.3 People Powered Transportation

### Materials (for each student/group):

- Pedometer or treadmill
- Stationary bike with calorie counter
- Calculators
- Projector

## Lesson 2.1: Energy Sources: Current vs. Ancient Sunlight

Transportation, the movement of people and things from one place to another, uses current and ancient sunlight as a source of fuel. This lesson discusses how different transportation modes have used current and ancient sunlight throughout history and the impacts this has had on the balance of the carbon cycle, and therefore climate change.

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### KEY WORDS

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**Food Calories:** a measure of energy in food. One food calorie is equal to 1,000 calories, or one kilocalorie, or Calorie (with a capital “C”). If not designating food calorie, Calorie with a capital “C” should be used

**Renewable Fuel:** a fuel that can regenerate at or above the pace of consumption. Energy that comes from renewable sources such as crops, animal waste, municipal solid waste, or electricity derived from renewable energy sources (sun, wind, water)

**Non-Renewable Fuel:** any fuel that exists in limited supply and cannot be replenished at the same rate that it is consumed

**Transportation:** movement from one place to another of people and/or objects

**Feedstock:** the raw source material needed to make fuel

**Current Sunlight:** sunlight energy that has reached the Earth’s surface within recent history

**Ancient Sunlight:** sunlight stored as chemical energy that has been fossilized over millions of years when organic matter that captured sunlight energy through photosynthesis was then subjected to heat and pressure beneath the Earth’s surface

**British Thermal Unit (BTU):** the amount of heat energy needed to raise the temperature of one pound of water by one degree Fahrenheit

## PREPARATION

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- Print a class set of the following handouts:
    - 2.1.1 Energy Sources for Transport
    - 2.1.2 Major Developments in Transportation History
    - 2.1.3 People Powered Transportation
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## SETTING THE STAGE: THE HISTORY OF TRANSPORTATION

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### Teacher Overview

In this lesson, students will understand that for most of history we have used current sunlight as a source of energy. The class will start with an overview of society's transition from current sunlight to ancient sunlight as a transportation fuel source.

- Historically, transportation relied on current sunlight for fuel. Food provided fuel for people to walk or run or for domesticated animals such as horses, camels, and donkeys to carry people. The heat from the sun on the Earth also causes the wind to blow, which provides energy for sailing. Current sunlight provides **renewable energy**.
  - The discovery of fossil fuels allowed for a drastic change in our transportation options. Humans can now travel further and faster than ever before. But there is a limited supply of fossil fuels produced from ancient sunlight, which makes them a **non-renewable fuel**.
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## DISCUSSION: THE HISTORY OF TRANSPORTATION

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**Transportation** is how we move people and objects from one place to another. There are many ways of moving people and goods to their desired destinations and these methods have changed over human history.

### Pair-Share Discussion Questions:

- What is transportation? What are the ways in which we transport people and things?
- What modes of transport do you use? How did you get to school today? What kind of transportation modes do you see in your community? Which modes do you not often see?
  - Ask students to discuss these foundational questions in pairs and then share with the group. Guide students to think about transportation for people *and* things.
  - Reference the Story of Stuff from Module 1 to think about where our stuff is made and how it is transported to end up in our homes, schools, and workplaces.
- Share Major Developments in Transportation History – Handout 2.1.1 and then in their pairs, ask students to review the timeline and discuss last night's homework from Module 1 - the article from Safe Routes to Schools on "The History and Politics of Transportation in the United

States” and the discussion questions. After students discuss in pairs, ask them to share out to the group:

- What are some different methods of transportation mentioned in the *Safe Routes to School History of Transportation* article and the Major Developments in Transportation History – Handout 2.1.1 Timeline?
  - What are the methods of transportation we use today?
  - What transportation development or event stands out as particularly interesting or compelling to you? Why?
  - How does the history of transportation relate to other historical, national, and global developments or events?
- Conclude the history of transportation discussion with this visual that shows the distance that could be traveled in a day or a week at different times in US history:  
<http://www.treehugger.com/slideshows/public-transportation/how-fast-could-you-travel-across-usa-1800s/>

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## ACTIVITY 1: PEOPLE POWERED TRANSPORTATION

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The human body is like a power plant, generating the power needed for us to ride a bicycle, to play soccer, or any other type of useful work.

The human body needs fuel to generate enough power to do useful work, but instead of fossil fuels the human power plant gets its fuel from food.

- **Discussion question:** Is the human body a renewable or non-renewable power plant? Why?

We use the term **food calorie** to measure the amount of energy available in food. For example, an ice cream cone has around 300 food calories. What is the calorie equivalent of a gallon of gasoline?

1. With the class, calculate the amount of calories in a gallon of gasoline.

- One gallon of gasoline has 125,000 BTU of energy. A **BTU**, or British Thermal Unit, is a measure of energy. A British Thermal Unit (BTU) is the amount of heat energy needed to raise the temperature of one pound of water by one degree Fahrenheit.
- One BTU has 0.252 kilocalories. A kilogram calorie (or kilocalorie) is the energy required to raise a kilogram of water 1 degree Celsius. A kilocalorie is the unit used for food calories.
- Using a white/chalk board calculate the number of food calories in a gallon of gasoline:

$$\frac{1 \text{ Gallon of Gasoline}}{1 \text{ Gal. Gasoline}} \times \frac{(125,000 \text{ BTU})}{1 \text{ BTU}} \times (0.252 \text{ kilocalories}) = 31,500 \text{ kilocalories}$$