



# CALIFORNIA STATE RAILROAD MUSEUM INTERPRETIVE HANDCAR PROGRAM. TEACHER'S MANUAL



### Welcome to the Interpretive Handcar Program.

The Interpretive Handcar program is designed to provide students with a safe experience while operating the most basic railroad equipment. Using the principles of STEM and a combination of simple machines, students will learn the history of Maintenance of Way (MOW) crews and the equipment used in maintaining railroad tracks, and the evolution of MOW equipment from the early days of rail until today. Following a safety presentation, students and their adults will experience pumping a handcar 100 yards on the Museum's tracks followed by a 1/8-mile ride down the rails and back again behind a vintage Fairmont motorcar. In the interest of everyone's safety, students exhibiting unsafe behavior can be restricted and/or pulled from the program at the discretion of the program lead.

**Cost: \$150.00. This program must be paid for in advance. Payable by cash, Credit card or check payable to CSRMF. Contact Groupdesk Karen Walker 1-916-323-9274**

**Dress:** Prepare for weather. This is an outdoor activity, rain or shine. **NO open-toed or slick-soled shoes;** tennis shoes are recommended.

**Meet:** Please have your group meet at the "1849" scene, located directly west towards the river from the museum. . **Please be on time.** If you are running late, please call the Museum at 916-323-9280.

**Reminders:** No gum, food, candy or drinks other than water allowed. Please silence cell phones for the duration of the program. Photographs are permissible when not involved with an activity. The program takes place within an active railroad yard. **NO WALKING ON THE RAILS.**

**Age Group:** School groups Grades 4, 5, and 6

**Class Size:** A maximum per reservation of 45 students plus 1 adult chaperone for every 10 students.

**Inclement Weather:** For safety reasons, all Interpretive Handcar Program reservations will be canceled in case of inclement weather. Interpretive Handcar Program staff will determine the necessity for cancellation.

**CANCELLATIONS: No Show -No Call.** Groups later than 15 minutes after their scheduled time is cancelled.If, you are unable to keep your reservation, please call us at (916) 323-9274 or 916-323-9280. **No-shows and cancellations made less than 24 hours prior to program will forfeit all fees paid.**



## CALIFORNIA STATE RAILROAD MUSEUM INTERPRETIVE HANDCAR PROGRAM

### Meeting History - Social Science Content Standards for CA Public Schools

#### **4.4 Students explain how California became an agricultural and industrial power, tracing the transformation of the California economy and its political and cultural development since the 1850s.**

1. Understand the story and lasting influence of the Pony Express, Overland Mail Service, Western Union, and the building of the transcontinental railroad, including the contributions of Chinese workers to its construction.

#### **8.6 Students analyze the divergent paths of the American people from 1800 to the mid-1800s and the challenges they faced, with emphasis on the Northeast.**

1. Discuss the influence of industrialization and technological developments on the region including human modification of the landscape and how physical geography shaped human actions. (growth of cities, deforestation, farming, and mineral extraction).
2. Outline the physical obstacles to and the economic and political factors involved in building a network of roads, canals, and railroads (e.g., Henry Clay's American System).

#### **STEM – Science Technology Engineering and Math**

##### **Meeting Next Generation Science Standards: Energy**

**4-PS3-1** Use evidence to construct an explanation relating the speed of an object to the energy of that object.

**4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

**4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

#### **MATH**

**4.0.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

**4. G.1 Draw and identify lines and angles, and classify shapes by properties of their lines and angles.** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

**4. MD.1&2 Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.**

1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb., oz.; l, ml; hr., min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.
2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.



The Interpretive Handcar Program is presented in five stations:

1. Rules and regulations for operation of railroad equipment---Safety First!
2. History of the railroad handcar, motorcar and other Maintenance of Way Equipment.
3. Hands-on experience of pumping the California State Railroad Museum's Interpretive Handcar.
4. Roundhouse track and turntable interpretation.
5. The motorized track vehicle. Experience the 1/8-mile ride down the rails, being pulled by a Vintage Motorcar and back again.

## SAFETY RULES

1. Play it safe. Don't horse around!
2. Keep the tracks clear. No walking on the rails.
3. Use the steps to get on and off the Handcar. No jumping.
4. Keep hands on the pump handle at all times during the ride.
5. Keep both feet on Handcar deck at all times during the ride.
6. Do not climb on railroad equipment unless instructed to do so by Museum staff.
7. Pump the Handcar handle slowly.
8. Do not play with rocks or put them on the track.
9. Keep hands on the pump handle at all times during the ride.
10. Bend your knees while pumping the Handcar.
11. Place all purses and packages on the Handcar deck or designated place with staff member.
12. Do not get off the handcar until you are instructed to do so.

**TEACHERS: Please go over the SAFETY RULES with your students before your visit.**

## Safety First- is our motto...



Operation Lifesaver's top priority is to educate people on how to be safe around highway-rail grade crossings and railroad tracks.

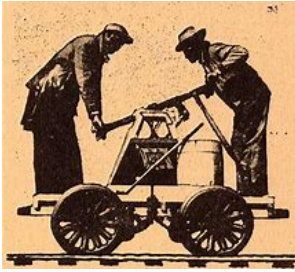
Trains today are often bigger, faster and quieter than ever. Though diligent safety practices and engineering advancements have reduced the numbers of injuries and fatalities at highway-rail crossings, incidents resulting from rail trespass--often involving young people--remain a constant challenge. Predictions for a substantial boost in rail travel mean that in the near future there will be more trains on busier tracks, giving our mission to reach kids, teens and young adults' added urgency.

### KNOW YOUR SIGNS



These signs alert drivers to the presence of railroad tracks and to the possibility of an approaching train. These signs and devices also provide a safety message and remind the driver of the laws regarding highway-rail grade crossings. More information can be found at [www.operationlifesaver.com](http://www.operationlifesaver.com)





## A History of the Railroad Hand Car

By J. H. White, Jr.

Since the beginning of the railway, the humble handcar has been omnipresent and essential to the everyday workings of the industry. It is said, to be the oldest railroad vehicle of any type. With the coming of the steam railroad, it was relegated to the maintenance-of-way crews and came to symbolize the drudgery associated with the heavy labor of the track repairer. It was the maid-of-all-work for track gangs, signal, fence, water tank and bridge repair crews and has proved a handy conveyance for innumerable inspection parties. It surely lacks the glamour of the steam locomotive or the Pullman and this is why, we suppose, its history has been ignored, if not despised even into the present age when nearly every other facet of the railroad story has been romanticized and recorded in lavish detail.

The most elementary handcar was the push car. It was nothing more than a tiny, four wheel flatcar, devoid of all non-essential encumbrances and it is still with us today. Surely, it was not long before some Stone Age track gang figured that a free ride was available by coasting down grade. However, what of propulsion on the level? Pushing was a drag. Some bright trackman must have thought of sitting on the rear edge of the car and kicking the ties. This time-honored method was still employed when W. R. Camp wrote his classic work *On Track* (1903). With several well-booted trackmen kicking, it was said to be an effective means of propulsion. Some other ancient, wise in the ways of boating, must have tried poling. Any alert yeoman who had seen a flat boat or ferry would have observed this method. An early example, but not likely the first, was a "train" on the Sacramento Valley Railroad, which ran on August 11, 1855. It consisted of a handcar "poled" down R. Street in Sacramento by Theodore Judah and three other men.

The knack of running a handcar fast is to get force to the handles, and this cannot be done as easily by trying to bear down and pull up hard against them while they are moving rapidly as it can by using moderate strength and trying to make the hands race with the handle. In this way more force can be put to the lever while it is moving rapidly than by trying to exert so much strength.

The three-wheel pump car has popularly been credited to George S. Sheffield of Three Rivers, Michigan. According to the story, Sheffield, a poor mechanic, found that no suitable train service was offered between Three Rivers and his farm home seven miles down the track. The walk was too much for him after a ten-hour day and besides it meant that much less time with his family.

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It occurred to Sheffield in the winter of 1877, to build a simple rail scooter as the solution to his commuting problem. In his spare time, he produced a little homemade three-wheel car that served his needs nicely. One evening while pumping homeward, he noticed a break in the track. He borrowed a lantern from a nearby farmer and stopped the night freight. His action not only saved the train but also brought his tripod car to the attention of the local Michigan Central officials. Some were inclined to prosecute Sheffield for unauthorized use of the Michigan Central track but one officer suggested instead that the mechanic had something useful in that little velocipede and why not adopt it for switch tenders and other one man crews. Therefore,, the story ends with Sheffield being set up in a profitable business. An engaging example of folklore but as such the tale ignores the real history of the rail velocipede.



\* *Pioneers in Industry, the Story of Fairbanks Morse & Co. 1830-1 945, no author listed, pp. 45-48.*

*Lives and Works of Civil and Military Engineers of America, C. B- Stuart, 1871, pp. 137-138.*

*Welch, important to rail design and railroad civil engineering matters was a long time executive of Camden and Aniboy R.R. His hand car patent is dated Dec. 13, 1859 (No. 26453).*

*R. R. Gaz., Feb. 28, 1879, p. 107. The correspondent may have been referring to William rather than Samuel Romans. The former was known to be a Master Mechanic of Pennsylvania Railroad at Columbus, Ohio in 1870's. Reference is made to lever car inventor "now" living at that place.*



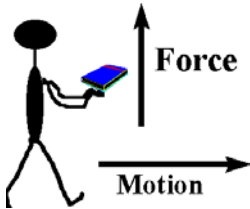
*Postage Stamp issued March 25 1983*

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## STEM – Science Technology Engineering and Math

### Science



#### Motion, Forces, & Energy

ALL objects require either a push or pull to put them into motion, to stop them, or change their direction.



**Motion** means moving from one place to another. The length of a line between the start and end of the motion is the distance traveled. The time you take to travel this distance depends on your speed. Fast movements cover more distance in a shorter amount of time.

A **force** can make something go from standing still or moving slowly to moving very quickly. This is called **acceleration** or increasing speed. Nothing can get moving without a force pushing or pulling it along. Forces allow humans to walk and talk. Without forces, the world would be still and silent. Nothing would move and nothing would happen. The laws of motion explain what happens when forces make things move.

**Energy** is present whenever there are moving objects. The faster a given object is moving the more energy it possesses.

### Handcar application:

- Handcar uses force to move
- A push pull action is needed to move the handcar down track
- When pushing and pulling the handcar moves either faster or slower (acceleration)
- The speed is the rate of motion
- Friction is added to slow the motion. Brakes, sandy tracks or pumping slower are all examples of friction.
- Gravity is used to ease the heavy trains down the tracks from the passenger station. You cannot see the slope but you can feel the slope.
- Human Energy to Machine- Energy can be transferred in various ways between objects. The handcar converts Human power to machine movement.



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## Technology

One of the products of engineering is new technology. Many people have a misconception that technology refers only to electronic devices such as computers and cellphones. While these are indeed technologies, the term *technology* describes all of the ways that people have modified the natural world to meet their needs. A metal plow or even a pencil is as much a technology as the newest electronic gadget. All technology, new and old, has the capacity to transform human capabilities and experiences. Mr. Sheffield had a need to improve his mode of transportation from walking to riding. As technology improves so does the product. Look at these types of Handcars used for transportation of people and equipment.



**Three Wheel Pump car**  
What is the power?



**Push Car**  
What is the power?



**Sail Car-**  
What is the power?



**High Rail**  
Today trucks with special rail wheels are used to transport people and equipment.



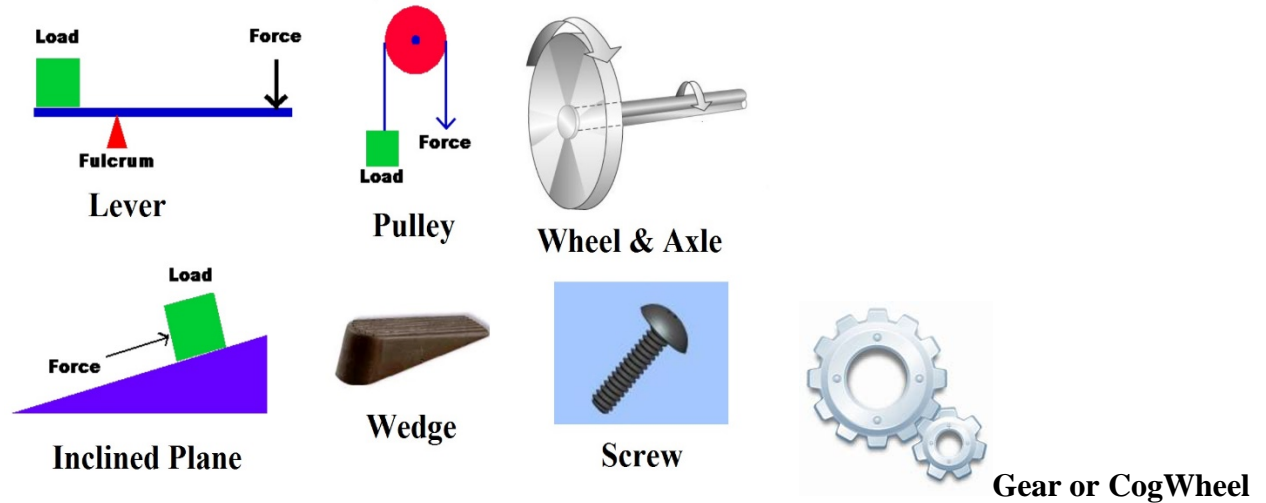
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## Engineering

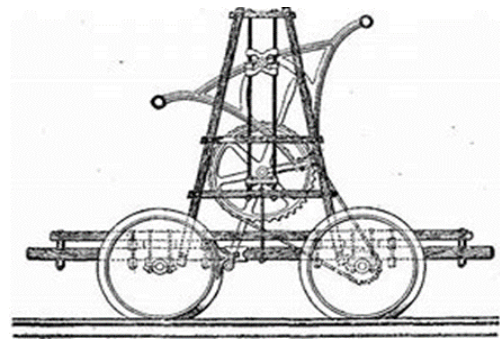
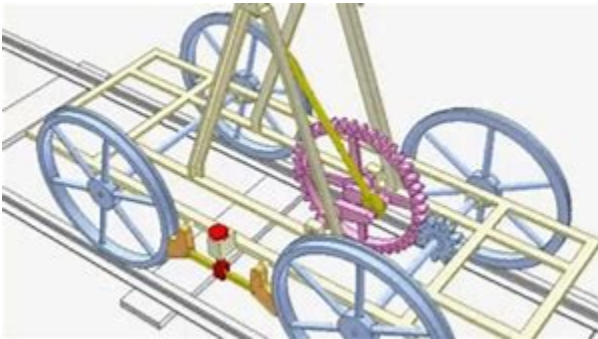
Engineering's main focus is not explanation, but rather proposing solutions to human problems. Examples include how to build a self-driving car, how to provide clean water, or how to generate electricity more efficiently. Unlike in science, there is never one *best* solution; instead there are multiple solutions that engineers evaluate using criteria different from those used by scientists. Engineers make use of these simple machines to solve human situations.

### Simple Machines



So lets design a car that can operate on the railroad tracks to carry workers and equipment needed to maintain the tracks for trains.

Can you identify the simple machines used in building the handcar?



## Turntable

The turntable was a common, but very important, device that could be found in most railyards during the steam era. During this time steam locomotives were operated most efficiently in the forward direction and thus had to be turned around to make a return trip. In any event, with the advent of the diesel locomotive the turntable became obsolete as new technology enabled locomotives to go forward and in reverse without the use of a turntable. Today, turntables are rarely used by freight railroads. However, they have not completely disappeared as several have found a second life turning the many restored steam locomotives still in service on railroad museums and tourist railroads. Our Turntable built in 1912 is over 100 years old, not original to the museum but has historic value as the I street bridge was also built by the same American Bridge Company.

## The Roundhouse

The roundhouse's unique circular design was built around the turntable to easily and quickly turn locomotives. Built during the steam locomotive era steam, the roundhouse met its demise during the arrival of the diesel locomotive. The building was mostly rendered obsolete since diesels could operate in multiple directions and also allowed maintenance facilities to be placed much further apart. The engine house, as it was also known, continued to remain in use to some extent during the diesel era but by the 1980s most had been abandoned or torn down. Our roundhouse built in 1981 is a quarter roundhouse and plays an important role in our Sacramento Southern Railroad. Railroad cars and locomotives are brought into the roundhouse via the turntable for display in the California State Railroad Museum.



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## Math

### Problems:

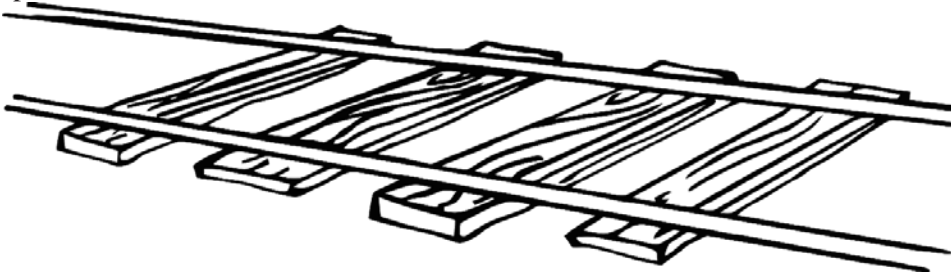
1. A person needs to walk to the jobsite 5 miles away. A person can only walk 3 miles per hour. When will he/she arrive to work?
  - a. Less than an hour
  - b. More than an hour

How many minutes will it take to reach the job site? \_\_\_\_\_

2. A person uses a handcar to travel to a jobsite 5 miles away. The handcar travels 8 miles per hour. When will he/she arrive to work?
  - a. Less than an hour
  - b. More than an hour

How many minutes will it take to reach the job site? \_\_\_\_\_

3. Our turntable weighs 60 tons. There are 2,000 pounds in a ton. How many pounds does the turn table weigh? \_\_\_\_\_
4. The motorcar travels  $\frac{1}{8}$  mile down the track. A mile is 5,280 feet. How many feet does the motorcar travel?
5. True or False  
The Slope of the track is +4%. Is it easier to go up hill or downhill?
6. The handcar travels 1400 yards down the track. It takes 6 minutes to get to the job site. What is the speed of the handcar?





## Standard Gauge

Railroad track around the world have many different sizes or gauges. The gauge of a railroad track is measured from the inside of one rail, to the inside of the parallel rail. The most common gauge for the United States is called **Standard Gauge**. Standard Gauge is four feet, eight and a half inches (4' 8 ½"). In the United States prior to 1862, many railroads had their own different gauges, which made difficulty for passengers and freight, as they had to be moved to another train on a different railroad for long journeys. In 1862, the United States passed the Pacific Railroad Act, which created the Union Pacific Railroad, allowed for the UP, and the Central Pacific to start building the Transcontinental Railroad Congress established the gauge of the transcontinental railroad to be four feet, eight and a half inches. There is a also popular rumor that Standard Gauge originated from the width of wheels from Roman war chariots. However, there is no evidence to support this claim and this rumor should be disregarded as just an old myth and untrue.



## Maintenance of Way- also known as MOW

Maintenance of way is an aspect of railway maintenance which is designed to ensure that the railway remains clear, safe, and navigable. The term “maintenance of way” may also be used to describe similar procedures performed by highway crews and other transportation professionals who maintain right of way. Crews which engage in maintenance of way tasks work in all weather and all conditions, ranging from sunny days when routine checks of the tracks may be performed to howling storms in which debris needs to be cleared from the tracks.

There are a number of components of this maintenance. A big part involves maintaining the tracks themselves. Tracks must be regularly checked for signs of problems, which can include missing or damaged ties, damage to the rails, and obstructions such as fallen trees or disabled trains. Maintenance of way includes routinely checking, clearing, and repairing the tracks, with the use of a variety of specialized equipment.

Maintenance of way also involves the area immediately adjacent to the tracks. Workers must keep this area clear for safety. Their work can include removing debris, clearing drainage trenches, installing drainage systems, trimming back trees and shrubs, reapplying gravel, and other activities. Keeping this area clear promotes visibility so that train drivers can clearly see what is ahead of them, reduces track obstructions by keeping the area around the track clear of potential obstructions, and reduces fire hazards.

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## INTERPRETIVE HANDCAR PROGRAM Post-Evaluation Form

School: \_\_\_\_\_ Date of visit: \_\_\_\_\_

Grade: \_\_\_\_\_

Teacher: \_\_\_\_\_

Dear Teacher:

After your class has participated in the Interpretive Handcar Program, please take a few minutes to fill out this form. It is important that we have your feedback, as it will enable us to improve our Museum's educational programming. Forward the completed form to the address shown at the bottom of this page.

1. List two important facts your class learned from this field trip.

a. \_\_\_\_\_

b. \_\_\_\_\_

2. What did your class enjoy the most about their interpretive handcar Experience?

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3. Did you feel the trip was worthwhile? (Check one) Yes\_\_\_\_ No\_\_\_\_

Comments:

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4. Was the data presented to the class informative? Yes\_\_\_\_ No\_\_\_\_

Comments:

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5. Do you have any suggestions for improving the Interpretive Handcar Program?

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Thank you for your assistance in this matter. Please forward your completed form to:

Interpretive Handcar Program Attention: Karen Walker  
California State Railroad Museum  
111 "I" Street (916) 323-9274  
Sacramento, CA 95814

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