Sonoma County Museum

Customized: The Art and History of the Bicycle

September 23, 2011- February 5, 2012

Educator Guide

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www.sonomacountymuseum.org

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Exhibition Overview

The exhibition *Customized: the Art and History of the Bicycle* will explore not only the history of the bicycle but the role that the bicycle has played in history. Through the exhibit students will see the evolution of the bicycle from the Velocipede (meaning "fast foot") to the modern mountain bike and the role of the bicycle as a functional art form. Through this evolution students will learn how the bike has impacted the infrastructure and the social structure of both the United States and the world. Students will also learn the role of the bicycle in California's history and local Santa Rosa history. The bicycle is not just a means of transportation, it is democratizing vehicle that has cultural and social overtones. The Sonoma County Museum's exhibit brings to light the many aspects of bicycle engineering and its impact on modern society.

Exhibition Sections

The First Bicycles:

Students will be introduced to the "Running Machine", the first step in the development of the bicycle. Powered by kick-propulsion and sometimes called a running machine, the Draisienne was accepted for some practical uses, but mostly was viewed as a novelty and a recreational machine – a "hobby horse" – in Europe, England, and the United States. From there they will be able to examine the Velocipede.

<u>The Velocipede</u>

In the summer of 1863, Frenchman Pierre Lallement completed the first prototype of the vehicle that we now recognize as the bicycle. The two-wheeler was referred to as a velocipede, or "fast foot." Initially, it did not attract much attention. But in 1865 Lallement headed to America, and in 1866 he filed the first and only patent covering the basic bicycle. What immediately separates the Velocipede from the Draisienne is the addition of pedals. "The Velocipede Craze" traveled quickly across the United States, and by 1869 was firmly established

on the West Coast. But riders, while initially enamored of the two-wheeler, grew dissatisfied. The machines were novel, but remained difficult to work and uncomfortable. The velocipede earned the unflattering nickname “boneshaker,” and its popularity faded.

The High Wheel

After the Velocipede the next step towards the modern bicycle was the High Wheel. Its name comes from the very large wheel that was the front tire. A bigger wheel meant faster speeds, and wheel diameters continued to increase into the 1870s. While many of these adaptations were targeted at competitive racers, a wider circle of riders became interested in the high wheel bicycle, and manufacturers met the demand. From 1870 to 1885, the evolving high wheelers started a new bicycle boom in England, Europe, the United States, and many other countries. Unfortunately this also forced the rider to sit very high off of the ground.

The High Wheel however had its own drawback, the “header”. Due to the large tire being in front even the smallest change in terrain could cause the bike to crash. The height of the High Wheel already made crashes particularly dangerous, but in the case of the High Wheel the rider often flew over the handlebars onto their heads. These catastrophic accidents gave rise the next step in the evolution of the bicycle.

That step manifested in England in 1885 and became known as the “safety bicycle.” Manufacturers themselves were caught off-guard by the enormous demand for the bicycle. Where the high wheeler had appealed largely to young, affluent men, the safety bicycle opened up a much wider market that included women. Major innovations of the early safety bike included the chain, which had become cheaper to manufacture, the pneumatic tire – invented in 1888 – and the diamond-shaped frame, also from 1888. In basic construction the bicycle has not changed much since.

Women and the Bicycle:

The safety bicycle not only enticed women buyers it changed the entire social structure at the turn of the century. Transportation has always been equated with freedom, and as such bicycles played a key role in the social liberation of women in the nineteenth century. Small numbers of women began riding bicycles early on, beginning in the 1860s as the velocipede was

customized with a lowered bar so that women could ride in long dresses. In France in 1868, the first women's bicycle race occurred, during which the women involved were permitted to wear shorter skirts for serious cycling. By the 1890s, women were riding bicycles in huge numbers, and bikes continued to be customized to accommodate female riders.

The Bicycle in California and Sonoma County:

The bicycle from the very beginnings of its history has been a part of culture in California and in particular Sonoma County. In April of 1869, the *Sonoma Democrat* newspaper declared that the velocipede had at last reached Santa Rosa. As people took to the novel machine, velocipede schools sprang up in various spots throughout California, including in Santa Rosa. Santa Rosa even had at least one citizen hand-building velocipedes. However, like elsewhere in the country, the velocipede proved to be a short-lived fad, with riders eventually giving up on the "boneshaker" as uncomfortable and awkward.

As the bicycle made its return with the High Wheel and the Safety Bicycle, and more people began to ride, riders created movements to improve the roads and infrastructure of the cities they lived in. In the 1880s, The League of American Wheelmen formed and initiated the Good Roads Movement that both improved roadways for cyclists, and literally helped pave the way for the automobile in the United States. Both Santa Rosa and Healdsburg formed Wheelmen clubs in the 1880s, during the era of the high wheel, and Petaluma added a club in the 1890s.

Sonoma County's history of frame building is as long as its love affair with the bicycle. In the early years of custom bicycles many builders were also the local carriage makers, first car mechanics, and even airplane makers. Two important local mechanics during the bicycle boom of the 1890s were George Schelling and Fred Wiseman. Wiseman and Schelling both operated bicycle shops in Santa Rosa, and both men would make historic contributions aside from their work with bicycles. Schelling built Santa Rosa's first automobile in his bicycle shop in 1899, and Wiseman would go on to design and construct the first airplane ever built California in 1911. While there is no record of the specific work that Schelling and Wiseman did with bicycles, there is little doubt that such accomplished mechanics would have made their own modifications to bicycles, or even built them from scratch.

Luther Burbank and Sonoma County History:

Luther Burbank, the world famous horticulturalist and nurseryman from Santa Rosa, was among the notable early cyclists in Sonoma County. Burbank traveled by bicycle between his home and gardens in Santa Rosa and his Goldridge experimental farm in Sebastopol. His commute by bicycle even warranted a mention in Popular Science Magazine:

At the turn of the century there was a divergence between Europe and the United States in regard to the bicycle and cycling in general. In Europe the bicycle remained a very

popular form and transportation, and advanced technically. The technical advances of European bicycles at the time include the derailleur and internal hub gears. This allowed the bicycle to have multiple gears making it a more efficient for of transportation. In the United States however the automobile began to reign supreme. This shift toward the automobile left cycling technology lagging. In the United States bicycles remained single gear vehicles, and were relegated to the realm of children's toys. It would be a half a century before Americans began focusing their attention back on the bicycle.

It is here that we see some of the first artistic leaps in bicycle construction. Many children's bikes came with features to engage a child's imagination. Many of these features however reflected American's fascination with the motor car, such as headlights, speedometers and faux gas tanks. With generations of children growing up with the freedom of the bicycle it is not surprising that after time these same people would bring the bicycle back into vogue in the United States and be the ones to change it again.

Off-Road Experiments:

The sense of freedom that came with the rise of the bicycle has always encouraged people to go off road, even before the first mountain bikes were built in the 1970's**.** Individuals took their road bikes onto rugged terrain as a matter of recreation, and necessity. In the 1890s, the U.S. military formed a bicycle corps that once rode from Montana to Missouri, a distance of nearly 2,000 miles over difficult terrain, on specially modified bicycles. The two-wheeler even played a role in the Klondike gold rush, as a handful of prospectors crossed the Alaskan tundra atop bicycles. In competitive riding, cyclo-cross, first developed in France, has been around for well over a century. Cyclo-cross racers ride modified road bikes, traversing rough, even mountainous terrain and picking up their bikes and running when necessary.

As recreational biking surged in the united state in the 1970's a new class of juvenile two-wheelers customized for rugged riding. This was the Bicycle Moto Cross or BMX bicycle. Small and single-geared, BMX bikes became especially popular among California teenagers in the mid-1970s. With small wheels around 20 inches in diameter, the BMX bike is highly maneuverable and well-suited for rugged outdoor rides, steep drops, sharp turns and aerial acrobatics. The first BMX bikes were simply modified Schwinn Stingrays. This is a pattern of modification that also influenced the rise of the mountain bike.

Mountain Bikes:

While cyclists have been taking their wheels off-road for well over a century, the purpose-built, fully-adapted mountain bike did not emerge until the 1970s. Customization was at the heart of the mountain bike story. Custom builders of the 1970's would take heavy - framed, 1940s balloon tire bikes, and add elements such as cantilever brakes, stronger handlebars, and knobby tires to create something suitable for intense off road cycling. From the

lessons learned modifying and riding old bikes, some of the riders began to design and build a series of bicycles from scratch, ushering in the era of the mountain bike.

By the early 1980s, mountain bikes were being factory-produced in large volumes by emerging companies such as Fisher, Specialized and Univega. Production of mountain bikes boomed, increasing from about 200 in 1979 to an estimated 50,000 in 1983. In 1984, mountain bikes accounted for 20 percent of bike sales in the United States, and by 1996 the sport of mountain biking had been added to the Olympics.

The Rockhopper: The Sonoma County Mountain Bike Race:

In 1982, in the midst of the explosion of off-road biking that followed the arrival of the mountain bike, Sonoma County introduced a race called the Rock Hopper. Held in Annadel State Park, the first race featured many of the original mountain bike riders from Marin County.

In its second year, the Rockhopper included 373 riders, making it the world's largest event of its kind at the time. The course through the park was a single lap featuring 19 miles of dirt roads and rough trails. Five miles of descending course made parts of the race a fast and treacherous ride.

Road Cycling:

From the earliest days of the bicycle, there have been bicycle races. Competitive cyclists pushed the first, bone-rattling bicycles to their limits in races near Paris in the 1860s, and the high wheel bicycle developed largely because of the desire for greater speed among competitive racers. As riders looked for a competitive edge, the bicycle would continue to be refined.

In the early-twentieth century, track racing dominated competitive cycling in the U.S., and road racing remained primarily a European sport. During the 1930s, the racing bicycle achieved an extraordinary degree of refinement due to the work of European craftsmen. Bike frames became much lighter, with thin-walled tubing that thickened toward the ends at stress points.

In recent decades, the technology of the racing bike has continued to be advanced and honed. Frames built of steel have given way to materials such as carbon fiber and titanium, and the engineering of aerodynamics has also greatly increased the speed and efficiency of the modern road cycle.

Sonoma County Bike Racing:

In the 1890s, bicycle races were organized in Northern California by local cycling clubs, such as the Wheelmen. After a period mid-century in which racing was a small and specialized sport in the United States, a recreational cycling boom in the 1960s and 1970s rekindled American interest and participation in road racing. In Sonoma County, several committed cyclists and local business owners helped spur interest among young cyclists.

In recent decades, Sonoma County has cemented its reputation as one of the world's greatest places for road cycling. With 1,400 miles of roads, many of them remarkably free of traffic, terrific scenery and ideal weather conditions, the region has become a popular location for professional racers to train year round. In 1988, the Coors International Bicycle Classic started on a portion of the Sonoma Coast, and in 2006 the first Tour of California, featuring 127 of the world's top cyclists, started in Santa Rosa. The Tour of California continues to be one of the most important cycling races in the United States, and Santa Rosa resident Levi Leipheimer, one of America's top pro-racers, has become a strong local proponent of regional cycling. Finally, BMC racing team, founded in 2007 and based in Santa Rosa, has also given world-class cycling an established presence in Sonoma County. The team's manager is Sonoma County native Gavin Chilcott, a former professional cyclist himself. In 2011, BMC team racer Cadel Evans won the world's most famous bicycle race – the Tour de France.

Sonoma County Road Ride Events:

The GranFondo

Levi Leipheimer's King Ridge GranFondo is one of North America's most popular cycling events. It is a challenging, long distance, mass-participation cycling event that welcomes professional, amateur, and recreational cyclists of all abilities. While not strictly competitive, the GranFondo riders are timed to ensure cyclists complete the entire course, and have some way to gauge their performance along the route. The GranFondo is a fundraising event, not a race; no awards are given for finishing first.

The Terrible Two

The Terrible Two is a double-century, a bicycle ride of 200 miles in one day. In 1976, three local cyclists, Rod Mowbray, Gordon Burns, and Clifford Scott, had done other doubles and felt that Sonoma County would make an ideal venue for one that was as scenic and as challenging as anything around. During the summer of 1976, the first Terrible Two took place, and the ride is still an annual event.

The 1920s were the golden age of track racing, much of which took place on steeply banked velodromes. One of the most dramatic events was the six-day race, in which a team of two cyclists would take turns on the track, sometimes covering more than 2,500 miles combined over the course of the event. One of the most famous venues for these track races

was Madison Square Garden in New York. In their heyday in the mid-1920s, bike races at the Square attracted up to 20,000 spectators.

In Sonoma County, Cotati boasted a velodrome that was built in 1921. While used almost exclusively for automobile races, the velodrome track in Cotati clearly attracted the attention of local cyclists.

Sonoma County's Custom Builders:

As one of the great cycling regions of the world, it is no surprise that Sonoma County boasts an extremely talented group of custom bicycle builders. A number of factors, including the confluence of engineering and technical know-how in northern California, the free-thinking creativity of the 1960s and 70s, the creation of the mountain bike, the environmental movement, and of course the enormous rise in popularity of cycling in California, have all contributed to the emergence of regional bicycle builders.

There is more than one generation of bike builders in Sonoma County. Several of the frame builders featured here have strong ties to the development of the mountain bike and the circle of local cycling enthusiasts that was especially active in the 1970s. A younger generation of builders carries forward the tradition. The bicycles created by these builders are not only precisely engineered for individual riders, but also show an exquisite attention to detail and an artist's aesthetic sensibility.

Art Bikes:

Art bikes in many ways represent the ultimate in bicycle customization. Part functional bike and part kinetic sculpture, an art bike can be defined as any bicycle that has been modified for creative purposes. The ways in which art bikes are built vary greatly. Some builders start with collected frames and scrap parts, putting together a bike that creatively merges vintage bicycle pieces with newly built parts. Other artists design their bicycles from scratch, producing their own design plans, then welding the frame and machining other parts.

Although an art bike is always ride-able, its commitment to function can vary greatly. Some art bikes straddle the divide between art and work, with builders designing purpose-built bikes that creatively re-envision what a bike can be used for. Other art bike creators enjoy pushing design to its physical limits, focusing more on answering the question "Why not?" than focusing on concerns of utility, efficiency, or maneuverability.

Educational Objectives

Customized: the Art and History of the Bicycle as an exhibit focuses on the history of customization of the bicycle and its impact on society. The following curriculum standards are geared to assist teachers in fitting the educational objectives in the classroom, with the educational resources available in the museum. While the exhibit has substantial local history tie-ins to CA curriculum standards, this educator guide provides lessons that highlight the scientific principles of bike design and engineering necessary for customization.

The following curriculum tie-ins for *Customized: the Art and History of the Bicycle* relate to **California State Content Standards**:

Social Science:

Historical Context:

Kindergarten .6	Learning and Working
First Grade 1.2, 1.4	Place in Time and Space
Second Grade 2.1	People Who Make a Difference
Third Grade 3.1	Continuity and Change
Fourth Grade 4.1	California: A Changing State

Science:

Physical Science:

Kindergarten .1	Properties of Materials
First Grade 1.0	Material in Different Forms
Second Grade 2.1	Motion of Objects
Third Grade 3.1	Energy and Matter
Fifth Grade 5.1	Elements and Their Combinations
Seventh Grade 7.5	Structure and Function
Eighth Grade 8.1, 8.2	Focus on Physical Science

The Art of the Bike

Classroom Activities

Before the Museum Visit

Before students come to the Sonoma County Museum to view *Customized: the Art and History of the Bicycle*, have them engage with the following activities in preparation of their visit.

Lesson Title: Identifying Bike Basics
Grade Level: Grades 3-6
CA Curriculum content: Language Arts, Visual Arts
Time Required: 40 minutes
Objective: To familiarize students with the components of bikes and label them.
Materials: Paper, Pencil, Bike Labeling Worksheet (provided)

Activity Instructions:

1) Have students get into groups of four and brainstorm the answers to the following questions. Have one student be responsible for writing down the answers and another student responsible for sharing the group's answers with the entire class.

Within each group's answers to the following questions on a piece of paper:
Part 1: What are the main components of a bicycle? Write down as many the parts of a bicycle as you can think of.
Part 2: What are the benefits of riding a bicycle? How does it help you, the environment and the community?

2) Have each group share their answers and write down the bike terms that come up most often on the board. Of the words/terms that come up, select the top 5 to 7 terms as a group and then individually have students label the parts of the bike template provided in the worksheet below.

3) On the back of the worksheet ask students to write a personal reflection on why they think bikes are important. Have students write a few sentences about their own experiences riding bikes or where they like to ride their bikes.

Possible Extension: Ask students to focus on one particular part of the bike. Have the students draw a one inch by one inch square around the section of the bike they are focusing on. Have students draw that same section but larger on a 8 ½ inch by 11 inch piece of paper. This activity teaches students to look closely at the structure of the bike and through drawing what they see, trains their eyes to look at details and replicate as accurately as possible the details that they observe.

Bike Worksheet:

What are the basic parts of the bike? Label them:

Here is one example of a labeled bike:

The Science of the Bike

Classroom Activities

Before or After the Museum Visit

Background:

In the last fifteen years, there has been a revolution of sorts in the development and use of new materials for building frames. It wasn't that long ago that frames were made out of cast iron or even wood. Today bicycles are made out of exotic materials such as titanium, aluminum, and carbon fiber. Bicycle frames in the 1990s are lighter and stronger than ever before.

Swiftwalkers

German Inventor Karl von Drais is credited with developing the first bicycle. His machine, known as the "swiftwalker," hit the road in 1817. This early bicycle had no pedals, and its frame was a wooden beam. The device had two wooden wheels with iron rims and leather-covered tires. As the name suggests, a rider walked on top of the bike with his feet leaving the ground during descents.

Velocipedes

While it might seem simple and obvious now, getting the rider's feet completely off the ground was a major innovation in bike development. The rider used pedal-cranks attached to the hub of a wheel to propel himself. The “velocipedes," or “swift foots” of the mid 1800s consisted of two wooden tires, a front fork, handlebars for steering, a saddle on wooden frame, and pedals on the axle of the front wheel. The velocipede also received a nickname, the "boneshaker." With the rider now completely mounted on the bicycle, he felt all of the bumps--the early velocipedes were not equipped for absorbing vibrations. It wasn't until the development of the pneumatic tire that this problem was effectively addressed. At around the same time the pneumatic tire was developed (1888), lighter materials began to be used for frames, improving the ride dramatically.

Modern Materials

By the time the modern "safety" bicycle was developed in the late 1800s most frames were made with steel tubing instead of wood or cast iron. While the steel bicycles were quite strong they were also very heavy. It was not uncommon for a bicycle of that era to weigh in at over 80 pounds (36.28 kg.) Steel frames are still used today, but the tubing has thinner walls and weighs considerably less. Modern frame makers use a variety of materials for highly specialized bikes such as steel, aluminum, titanium, and even carbon-fiber. Which material he uses depends on the type of bike, the rider's preference, and the cost, with each material possessing its own unique qualities.

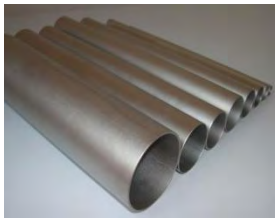
Steel

Steel has been the longest utilized metal for bike frames. Builders use it because it is the most versatile material and can vary in thickness, without losing its strength. It is cheaper and more durable, compared to other materials, but the frames tend to be heavier.

Aluminum

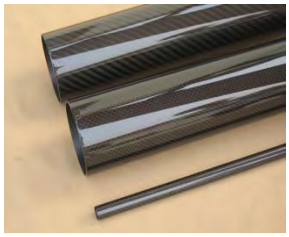
Aluminum is a light-weight material that does not have a lot of yield strength, which means that it cannot flex very much without it breaking. Aluminum frames have tubing with a larger diameter to limit the amount of flexing, but are still lighter than steel frames with the same diameter of tubing.

Titanium



Titanium is the material of choice for many builders. It has a great strength-to-weight ratio and is very durable. It has a high level of elasticity, which means it returns to its shape easily. However, titanium tubing can cost up to 15 times more than steel, it is the most exotic and expensive metal commonly used for bicycle production.

Carbon-Fiber



Carbon-Fiber is the most versatile material because you do not have to mold it into a tube. Carbon-fiber can form into any shape. It is light-weight, strong, and durable. It is perfect for creating custom frames and while it is expensive, it is the most popular material among bicycle builders and cyclists because of its versatility.

Lesson Title: Frame Materials: Elasticity, Yield Strength, and Ultimate Strength
Grade Level: Grades 9-12
CA Curriculum content:
Time Required: 30 minutes
Objective: To identify the matter properties and qualities of bike frame materials.
Materials: Plastic comb, rubber band, ballpoint pen, pencil, paperclip

Activity Instructions:

1) Tell students that older bikes were made out of cast iron and wood while today bikes are made out of exotic materials such as titanium, aluminum and carbon fiber that allow bikes to be light weight, strong, durable and flexible. Bikes are subject to strong forces and need to be strong, yet flexible to absorb the shock from the road and be light and convenient for riders to move and carry. When a bicycle maker chooses a material to make a bike frame, he or she usually considers the following properties of the material: **Elasticity, Yield Strength, and Ultimate Strength.**

> **Elasticity**: When an object responds to bending or stretching by returning to its original shape, it is said to have a high level of elasticity. A material which bends and then holds the bent shape has very little elasticity.
> **Yield Strength**: The amount of force needed to bend a material to the point where it cannot return to its original shape.
> **Ultimate Strength**: The amount of force needed to break a material. This is the amount of force needed to break a material. This is the point at which a bicycle frame breaks apart.

2) For the activity you will need some or all of the following:

> **A plastic comb**
> **A rubber band**
> **A ballpoint pen**
> **A pencil**
> **A paperclip**

Step 1: Try and bending (not breaking) and stretching the following materials and test the flexibility of the material by holding the object at each end and pushing forward with your thumbs. Hold the material in your hand and think about the weight of the material too.

Step 2: Have students answer the following questions: Which material do you think has the greatest elasticity? Which has the least? Which has the greatest yield strength? Which has the least? How about ultimate strength? Which material would be good for a bike frame, based on the strength, elasticity and weight?

Step 3: What is going on? Have a discussion with the class about what they observed in how the different materials reacted to bending and stretching.

The various materials used for bicycle frames are in many ways similar to the materials you've tested. Steel, like the paper clip, has good ultimate strength, with a much lower yield strength. This is good, since it means that a steel frame will bend well before it breaks, lessening the chance of a disastrous crash. Unlike the paper clip, steel used for bikes has pretty good elasticity. This combination of properties has made steel a longtime favorite of frame builders. Steel's only drawback is its relatively high weight.

Aluminum has recently become a choice material for frames, because of its very light weight. However, aluminum has a yield strength very close to its ultimate strength. In other words, it is quite brittle, and prone to breaking. This has many dangerous consequences for the rider of an aluminum bike, so frame makers have responded by over-building aluminum bikes with very large tubes and thick welds, to lessen the chance of frame breakage. The wooden pencil has properties similar to aluminum: light weight, high strength, and brittleness. Wood, like aluminum, will only bend slightly before breaking.

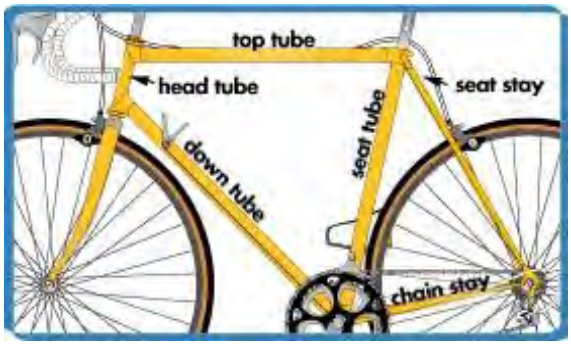
Other materials, like carbon fiber and titanium, are similar in qualities to the plastic comb and pen: light weight, high elasticity, high ultimate strength, relatively low yield strength. This means that frames made of these materials need to be designed well, in order to be stiff enough to resist pedaling forces. It also means that such frames are extremely light and resilient. However, these materials are extremely expensive, putting carbon-fiber or titanium frames out of reach for all but the wealthy or the fanatic racer.

Lesson Title: Frame Design: Design your own Bike
Grade Level: Grades 9-12
CA Curriculum content: Science, Language Arts
Time Required: 30 minutes
Objective: To have students think critically about the material and design requirements of bike building. Also, to have students design a bike for a particular purpose.
Materials: Design your own bike worksheet

Activity Instructions:

1) Introduction: The bicycle is a human-powered vehicle that depends on the rider's pedaling energy to move forward. As the rider pedals against a strong wind he/she may find that it gets harder to pedal. To make this movement easier, designers try to streamline the shape of the bike to cut through the air more smoothly. This makes the rider travel faster and use less energy to pedal the bike. While the types of materials used are an important part of frame building, the design and positioning of essential features are also important.

Have students identify the main features of the bike frame:



Tell students that the most popular frame design is known as the diamond or double- triangle. This design has changed very little since the advent of the safety bicycle in the 1880s. The modern bike frame is ideal for bracing angles and strength. It lends itself to being beat up pretty hard and still being ride-able. The strength of the design comes from the triangle shapes that make up the diamond design.

While the diamond design is the core of most bicycles built today, some frame builders are experimenting with new variations on this classic design. For example, some carbon-fiber frames are being made with oval tubing, making the bicycle more aerodynamic. New full-suspension bikes have altered the diamond design to allow for a large shock to be mounted on the seat stem. However, most changes to the design are more subtle and have to do with maximizing performance for different types of terrain or uses.

Modern customizations to make the bike more aerodynamic:

> **Frames**: Traditionally shaped into round cylinders and welded together, bike designers have recently been designing oval or tear-shaped tubes to reduce weight and wind drag on the bike.
> **Wheels**: Designers have also reduced or gotten rid of the spokes that connect the tire to the frame so wind does not draft through the spaces and create drag. Disc wheels produce less wind drag and turbulence as they spin.
> **The human body**: Positioning the handle bars further out and creating "drop bars" allows the rider to lean forward and reduce the frontal area they must overcome to pedal the bike forward. Tight-fitting synthetic clothing and reduce skin friction, reduce drag and increase speed.

2) The following can be a group activity or an individual activity. Have students consider the materials they tested in the previous lesson. Take into account the flexibility and strength of certain materials when considering the design of bike frames.

3) Have students consider the design of the frame, the diameter, spokes and grip of the wheels, and the placement of the handle bars.

4) Have students design their own bikes on the worksheet provided or on a piece of paper. Students should identify what type of material the bike is made out of, why they chose the material and design elements, and how or where the bike is indented to perform.

For example: A bike made of lightweight titanium would be ideal for a thin frame that is used in the construction of a racing bike.

Design your own bike worksheet

Choose your material:

Choose your frame:

Choose your components:

Choose your placement:

Write a paragraph explaining the following: What material did you use for your frame and why? Why did you choose your components and how do these components help in what you want your bike to be able to do? What is your bike able to do? Where will you use your bike?

At the Museum

The Sonoma County Museum, in an attempt to enrich the educational experience of school groups visiting the museum offers docent-led tours with an interactive in-gallery component. Students are able to complete a Bikes scavenger hunt that is available at the information desk at the museums, and a simplified design your own bike activity that is located in the office gallery adjacent to the main gallery. The simpler design your own bike is ideal for K through 3rd graders and the scavenger hunt is ideal for 3rd grade through 9th grade.

After the Museum Visit

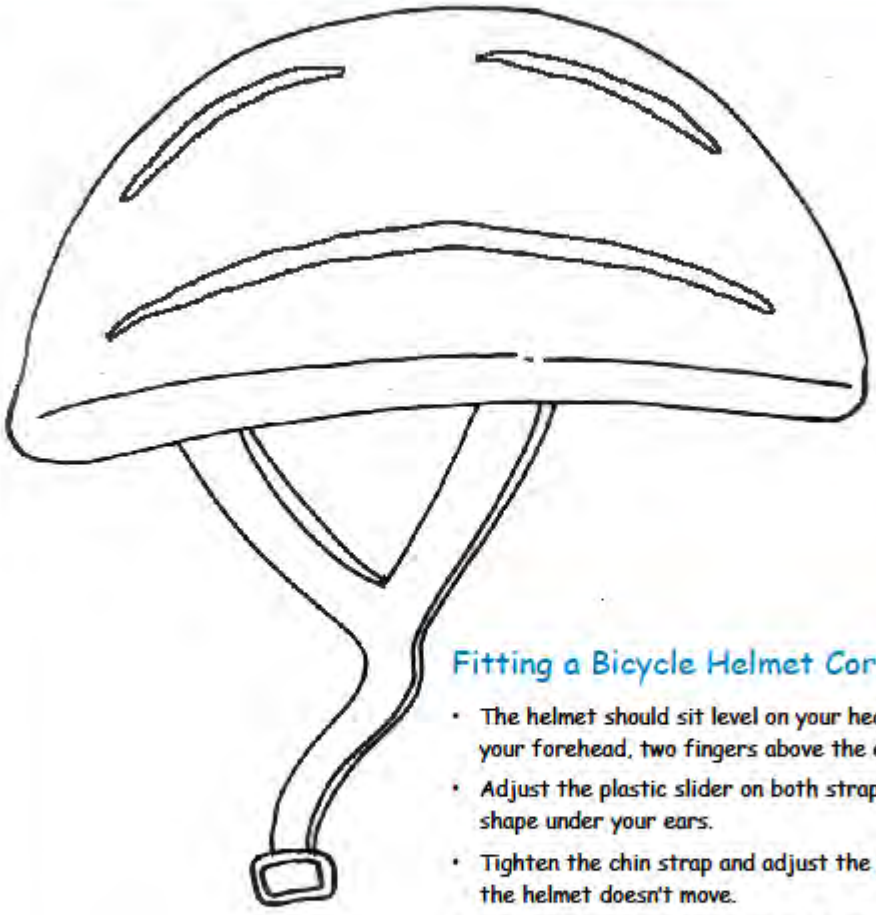
Safety Activities for Pre-K to 2rd grade

The following activities are available as PDFs are part of the Bicycle Safety Activity Kit made available by the National Highway Traffic Safety Administration (NHTSA) and available for download at http://stnw.nhtsa.gov/people/injury/pedbimot/bike/bskitboth/
Activities are geared toward ages 4 to 7 and ages 8 to 11.

BIKE SAFETY ACTIVITY SHEET (AGES 4 TO 7)

ACTIVITY #2: DECORATE THE HELMET

Add stickers, glitter, etc., or simply color the helmet the way you like.



Fitting a Bicycle Helmet Correctly-

- The helmet should sit level on your head; wear it low on your forehead, two fingers above the eyebrows.
- Adjust the plastic slider on both straps to form a "V" shape under your ears.
- Tighten the chin strap and adjust the pads inside so the helmet doesn't move.
- The helmet should fit snugly and must always be buckled—EACH time you ride.

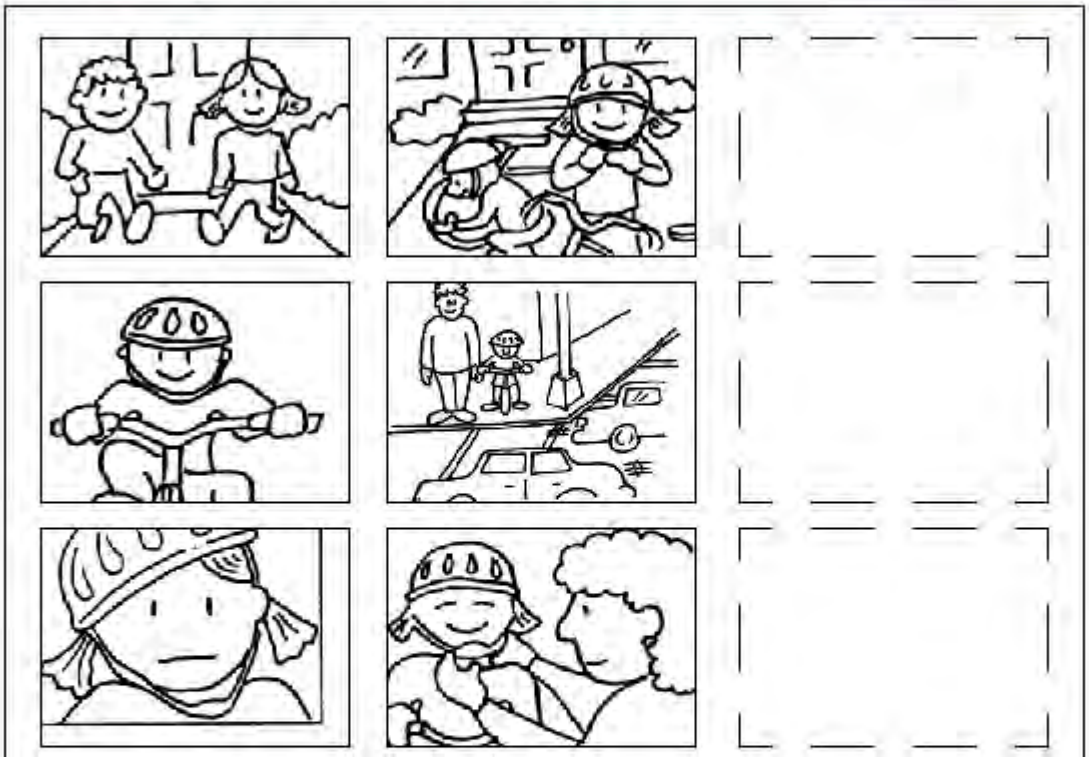
NAME: _____ AGE: _____

DOT HS 810 709w
January 2007

BIKE SAFETY ACTIVITY SHEET (AGES 4 TO 7)

ACTIVITY #3: COMPLETE THE SAFETY LESSON

Cut out the missing picture and complete the safety lesson.



Cut out and paste above

NAME: _____ AGE: _____

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BIKE SAFETY ACTIVITY SHEET (AGES 4 TO 7)

ACTIVITY #9: WORD FIND

Find the words listed on the left in the group of letters on the right.
Circle the word when you find it.



HELMET	G	B	R	H	K	Q	R	R
RED	Y	R	W	G	B	I	K	E
STOP	E	O	E	R	U	A	L	D
GREEN	L	Y	H	E	L	M	E	T
BIKE	L	W	V	O	N	G	R	S
YELLOW	O	U	B	I	S	T	O	P
	W	X	K	R	E	N	J	K



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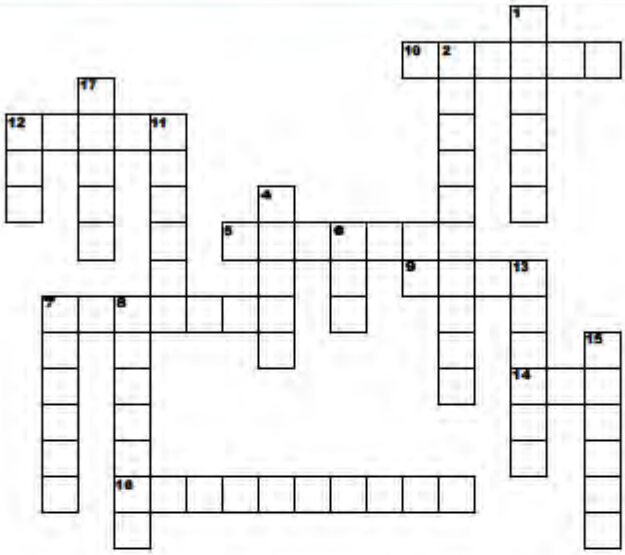
BICYCLE SAFETY ACTIVITY SHEET (AGES 8 TO 11)

ACTIVITY #6: CROSSWORD PUZZLE

Answer the questions and write the word in the correct space for each number.



ACROSS

5. You must watch out for this when you enter a street
7. This book is about_____safety
9. Red sign with 6 sides (called a hexagon) means that you must _____ when you see it
10. When you're riding together, tell your _____ what you learned today
12. You must follow these on the road and at school
14. Check this in your tires before you ride
16. You must always ride _____ _____ _____

DOWN

1. This is what you must wear to protect your head
2. If you must ride at night, place these on your bike
4. When the traffic light is _____ you can go
6. Riding your bike should be safe and _____
7. Wear_____ clothing when you ride your bike
8. You must approach corners with _____
11. Your main concern when riding
12. When the traffic light is _____ you must stop
13. You place your feet on these to make your bike move
15. Before you ride, check these on your bike too
17. On the road, and especially on cross streets, be _____to traffic

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ACTIVITY #9: DRAW A MAP

Draw a map of your favorite bicycle route (to school, to a friend's, etc).

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Additional Resources

Sonoma County Bicycle Coalition Safe Routs to School Program

http://www.sonomasaferoutes.org/

Bike Safety and the Community

http://learningtogive.org/lessons/unit88/lesson1.html

Safe Routes to School Lessons

http://www.saferoutestoschools.org/lessonplans.shtml

Bikeability Lessons

http://www.dft.gov.uk/bikeability/schools/lesson-plans/

Bibliography

Exhibition Information

Sonoma County Museum Docent Guide. 2011

Lesson Plans

Information retrieved from http://www.exploratorium.edu/cycling/index.html October 2011

Information retrieved from http://www.nhtsa.gov October 2011