The Wright Way: Innovation Through Engineering

North Carolina—First in Flight

Wilbur Wright (1867-1912)
Orville Wright (1871-1948)

Wingspan, 12.3 m – Chord, 2 m
Overall Length, 6.4 m – Height, 2.8 m
Weight, 250 Kg (or 550 lbs)

Revolutions per min: Engine, 1025; propellers, 325 (reduction, about 3 to 1)

Revolution per min: Engine, 1025; propellers, 325 (reduction, about 3 to 1)

Wings

Nose

Radical

Wing Droop, 25.4 cm

Weight, 229 Kg (without pilot)

Airspeed, 50 km per hour

Truck: A wooden beam, with "skate-like" rollers supported the airplane as it ran down the monorail during take-off. It was left behind as the airplane rose.

Sprinkler on propeller shaft drawn by chains from engine

The rear edges of the wingtips were flexible and could be warped to maintain lateral balance.

Pulley moved by wires from control lever shaft operated by pilot's left hand.

Bicycle hub rolled on monorail.

Instruments to record distance traveled, engine revolutions, and time while in the air.

Elevator Control Lever

Rudder

Skids for landing.

Wire Bracing

Elevator

Radiator

Gasoline Tank

Spruce Struts

Sprocket on propeller shaft driven by chains from engine

The rear edges of the wingtips were flexible and could be warped to maintain lateral balance.

Pilots lay prone with head forward, his left hand operating the elevator lever, his legs in a saddle. (Shifting the legs from side to side pulled the wires attached to the rudder, warping the wings and turning the rudder, both with one action, thus balancing and steering the airplane.)

100th Anniversary of Powered Flight

1903-2003

Kitty Hawk, NC

www.centennialofflight.gov
Sled Kite Flying Journal

Date: ____________________
Student Name: ____________________

Sled Kite

What happened when I walked with my sled kite?

What happened when I ran with my sled kite?

What did I find about the different types of sled kites?

What did I find about making my own sled kite?

Final Kites

What is the best way to make a kite?

What did I learn about making kites?

What did I learn about flying kites?

What did I learn about using kites in different ways?

What did I learn about the history of kites?

What did I learn about the science of kites?
Sled Kite Flying Journal

Goal: To determine if a sled kite will fly when it is moved to a gentle incline.


de we put one foot forward and the other back and start running.

Bird kite: We lost it.

What happened when I added my sled kite?

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The Metric CUBE

The Metric CUBE is designed to help students understand and apply the metric system. It is a physical model that can be used to teach the concept of volume and to demonstrate how the system works. The CUBE is divided into smaller sections, each representing a different unit of measurement. By manipulating the CUBE, students can learn how to convert between different units and how to use the metric system in real-world applications.

The CUBE can be used in a variety of educational settings, including classrooms, laboratories, and hands-on workshops. Teachers can use the CUBE to create interactive lessons and activities that engage students and help them develop a strong foundation in the metric system.

The Metric CUBE is available for purchase through the NASA and Education Store. It is an affordable and effective tool for teaching the metric system and promoting scientific understanding among students of all ages.

For more information about the Metric CUBE and how to use it in your classroom, please visit the NASA website.

Sled Kite Flying Journal

Date: 12/12

What happened when I asked my dad to help?

Step 1: What if I fly it by myself? I think I will make my own kite by the time. When I had a few triangles to my dad, he flew the kite.

Step 2: I asked a friend to help me. Then I went home.

Step 3: What if I ask my dad to help? He will make my dream come true.

Step 4: When I asked the tail of my kite, I had a lot of fun.

Step 5: What if I ask my friend to help me? He will make my dream come true.

Step 6: When I asked the tail of our kite, it flew fine.

Area

0         5         10

Area Equivalents

1 cm = 1 cm
2 cm = 2 cm
3 cm = 3 cm
4 cm = 4 cm
5 cm = 5 cm
6 cm = 6 cm
7 cm = 7 cm
8 cm = 8 cm
9 cm = 9 cm
10 cm = 10 cm

Please provide feedback on how this poster has been used. Complete the survey at www.nist.gov.

The Metric System

The metric system is a decimal system of measurement that is used in most countries around the world. It is based on the meter, gram, and liter as the fundamental units of length, mass, and capacity, respectively. The metric system is preferred because it provides a consistent and logical system of units that can be used in a wide range of applications, from scientific research to everyday activities.

The metric system is based on powers of ten, which makes it easy to convert between units. For example, to convert from meters to centimeters, you simply multiply by 100, and to convert from centimeters to millimeters, you multiply by 10. This system of units is widely used in science, engineering, and technology, and it is recognized by the International System of Units (SI).

The metric system is supported by the meter, which is defined as the distance traveled by light in a vacuum in 1/299,792,458 seconds. Thegram is defined as the mass of one liter of water at 4°C, and the liter is defined as the volume of one kilogram of water at 4°C. The metric system is used in most countries, and it is used extensively in the United States for scientific research and in some industries.

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### Measurement Standard, Pre-K–2

**Understanding measurable attributes of objects, systems, and processes of measurement**

- Recognize that objects have measurable attributes, such as length, weight, volume, area, and time.
- Compare measurable attributes of objects and select appropriate tools for measuring.
- Describe the relationship between tools and units of measure; for example, as a tool makes a measurement work easier, the unit chosen for measuring size affects the accuracy of the results.

**Apply appropriate tools, techniques, and formulas to determine measurements**

- Use standard tools and techniques to measure objects and systems.
- Apply formulas and procedures to determine measurements.

**Emphasis in the Classroom**

- Help students understand the importance of measurement in everyday life.
- Encourage students to apply measurement concepts to real-world situations.

**Simple Measurement Problems**

- Measure objects using standard units, such as cups, inches, and ounces.
- Use measurement tools, such as rulers and balances, to determine measurements.

**Applying Measurement**

- Apply measurement concepts to solve real-world problems.
- Use measurement tools to solve real-world problems.

**Measurement Standard, Grades 3–5**

**Understanding measurable attributes of objects, systems, and processes of measurement**

- Understand such attributes as area, weight, volume, and angles.
- Use standard units, such as metric and customary units, to measure objects and systems.

**Apply appropriate tools, techniques, and formulas to determine measurements**

- Use standard tools and techniques to measure objects and systems.
- Apply formulas and procedures to determine measurements.

**Emphasis in the Classroom**

- Help students understand the importance of measurement in everyday life.
- Encourage students to apply measurement concepts to real-world situations.

**Simple Measurement Problems**

- Measure objects using standard units, such as cups, inches, and ounces.
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**Applying Measurement**

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- Use measurement tools to solve real-world problems.

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### Sled Kite Flying Journal

**Objective:** Students will analyze and interpret data from the four flight trials of the Wright brothers on December 17, 1903, and use communication skills to write explanations of the events.

**Expectations:**

- Students can compare and contrast data across multiple飞翔 trials.
- Students can use data to make predictions about future飞翔 trials.

**Skills in estimating and the use of benchmarks should be strengthened.**

**Rich vocabulary development should include:**

- similarity, velocity, vertex, scaling, proportionality

**Measurement:**

- Speed = Distance/Time

**Materials:**

- Four-flight trials data
- Writing paper
- Pencils

**Procedure:**

1. Use the data table and calculate the average speed of each flight trial.

2. Analyze the graph "Speed vs. Time". Identify the events that correlate to the X, Y, and Z-axis.

3. Calculate the average speed of each flight trial.

4. Analyze the graph "Speed vs. Time". Identify the events that correlate to the X, Y, and Z-axis.

5. Write a summary comparing the average speed of the four flight trials. What factors might have influenced the flight of the Wright brothers on December 17, 1903?
Measurement Standard, Pre-K–2

Understanding measurable attributes of objects and the units, systems, and processes of measurement

• Recognize that objects have physical attributes such as length, weight, and capacity, and can be measured using different units; and that objects have other attributes, such as color, which are not usually measured.

• Choose and use objects to measure length, weight, and capacity; and the chosen objects must be the same size or shape to be compared.

• Choose and use tools to measure length, weight, and capacity; and the tools must be consistent in size or shape to be compared.

Applying appropriate techniques, tools, and formulas to determine measurements

• Use a ruler to measure length and express the length of an object using the metric system.

• Use a balance to measure weight and express the weight of an object using the metric system.

• Use a cup to measure capacity and express the capacity of a container using the metric system.

Incorporating the Classroom

• Discuss the importance of accurate measurement in everyday life.

• Provide students with opportunities to measure various objects using different units and systems of measurement.

• Have students compare their measurements to those of their peers using the same units and systems of measurement.

• Have students analyze the accuracy of their measurements and the accuracy of their peers’ measurements.

Applying appropriate techniques, tools, and formulas to determine measurements

• Use a ruler to measure length and express the length of an object using the customary system.

• Use a balance to measure weight and express the weight of an object using the customary system.

• Use a cup to measure capacity and express the capacity of a container using the customary system.

Incorporating the Classroom

• Discuss the importance of accurate measurement in everyday life.

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Sled Kite Flying Journal

Grade 3–5

Sled Kite flights can take place on December 17, 1903, and at any other time of the year.

Incorporating the Classroom

• Discuss the importance of accurate measurement in everyday life.

• Provide students with opportunities to measure various objects using different units and systems of measurement.

• Have students compare their measurements to those of their peers using the same units and systems of measurement.

• Have students analyze the accuracy of their measurements and the accuracy of their peers’ measurements.

First Flights

Grade 6–8

Sled Kite flights can take place on December 17, 1903, and at any other time of the year.

Incorporating the Classroom

• Discuss the importance of accurate measurement in everyday life.

• Provide students with opportunities to measure various objects using different units and systems of measurement.

• Have students compare their measurements to those of their peers using the same units and systems of measurement.

• Have students analyze the accuracy of their measurements and the accuracy of their peers’ measurements.

For the Educator

The purpose of this lesson is to help you integrate science and mathematics into your curriculum. The lesson provides opportunities for students to explore the principles of flight and the application of geometry and measurement in real-world situations.

The lesson is designed for students in grades 6–8, but can be adapted for use with older or younger students. The activities are intended to be used as part of a larger unit on the Wright brothers or an introduction to the history of aviation.

To support the activities, you will need the following materials:

• Wright brothers poster

• Activity guide

• Measurement tools

• Sled kites

• Other materials

The lesson is divided into three parts:

Part 1: Introduction

• Discuss the importance of accurate measurement in everyday life.

• Provide students with opportunities to measure various objects using different units and systems of measurement.

• Have students compare their measurements to those of their peers using the same units and systems of measurement.

• Have students analyze the accuracy of their measurements and the accuracy of their peers’ measurements.

Part 2: Hands-On Activities

• Conduct individual or group activities that involve the measurement of length, weight, and capacity.

• Have students use the measurement tools to measure the length, weight, and capacity of various objects.

• Have students record their measurements in a chart or table.

• Have students analyze their measurements and compare them to their peers’ measurements.

Part 3: Applying Concepts

• Have students apply the concepts of measurement to real-world situations.

• Have students analyze their measurements and compare them to their peers’ measurements.

• Have students explain how the concepts of measurement are used in everyday life.

The lesson is designed to be completed in one 50-minute class period. However, it can be divided into multiple sessions if necessary.
The Metric System

The metric system is a decimal-based system of measurement that is used in most countries around the world. It is based on the meter, which is defined as the distance traveled by light in a vacuum in 1/299,792,458 of a second. The metric system is easier to use than the imperial system because it uses only base units and prefixes, such as milli, centi, and kilo.

To convert from one metric unit to another, you simply multiply or divide by a power of ten. For example, to convert from centimeters to meters, you divide by 100, because there are 100 centimeters in a meter.

This is different from the imperial system, which uses a variety of different units for different types of measurements. For example, there are 3 feet in a yard, 12 inches in a foot, and 5280 feet in a mile. Converting between these units can be difficult because they are not directly related to each other.

The metric system is also more consistent and accurate than the imperial system. Because it is based on the meter, all metric measurements are based on the same standard. This makes it easier to compare measurements from different countries and to conduct scientific research.

The metric system is used in science, engineering, and technology because it is a convenient way to describe and compare measurements. It is also used in everyday life, such as when measuring ingredients for cooking or monitoring weight loss.

The metric system is becoming more widespread as the world moves towards a more technologically advanced future. It is already used in most countries, and it is likely that it will continue to be used in the future as more countries adopt it.

In conclusion, the metric system is a decimal-based system of measurement that is used in most countries around the world. It is easier to use than the imperial system and is more consistent and accurate. It is used in science, engineering, and technology, and it is likely to continue to be used in the future as more countries adopt it.
The Wright brothers' first flight is considered the beginning of the modern age of aviation. In 1903, Wilbur and Orville Wright successfully flew their Flyer, a free-winged biplane, at Kitty Hawk, North Carolina. The first flight lasted 12 seconds and traveled 120 feet. The Wright brothers were able to achieve this feat by applying their understanding of aerodynamics, engineering principles, and mechanical design.

This educational resource, "The Wright Way: Innovation Through Engineering," highlights the engineering and aviation careers of the Wright brothers and focuses on the following areas:

- Understanding the engineering of the Wright Flyer
- Applying engineering principles to the design of a kite
- Understanding and applying the scientific method to explore the Wright Flyer's flight
- Understanding the role of technology in aviation

The resource includes activities and materials for educators to use in their classrooms. It is available in both print and electronic formats. Teachers can order the print version or access the electronic version through the NASA Educator Resource Center (NERC) at http://education.nasa.gov.

For more information, contact NASA's Aeronautics Program Office at (321) 867-4090 or via e-mail at nasaco@leeca.org.

[Additional educational resources and activities related to the Wright brothers can be found on the NASA website, including the metric system and its applications in various fields, such as science, technology, engineering, and mathematics.]

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**Metric System Activities**

**Calculations within the metric system involve:**

- Understanding the relationship between units (e.g., centimeters, meters, kilometers)
- Converting between units (e.g., centimeters to meters)
- Estimating metric units in everyday situations

**Materials (per kite):**

- Crepe paper
- Tissue paper
- Newspaper
- One paper clip

**To Assemble:**

1. Cut a piece of standard length and run with the kite to the
   wind speed in meters per second as opposed to miles per hour. As your students investigate how the Wright brothers used measurements in their flights, they can explore the relationship between wind speed and flight performance.

2. Cut the length of the two drinking straws to:**

   - 5 cm
   - 4 cm
   - 3 cm

3. Place the drinking straws in the middle of the kite to:**

   - Measure the length of the drinking straws to:**

   - 10 cm
   - 8 cm
   - 6 cm

4. Then do place side by side, the

   - 5 cm
   - 4 cm
   - 3 cm

5. After the height of the kite.

   - 2 cm
   - 1 cm

6. Measure the length of the kite.

   - 5 cm
   - 4 cm
   - 3 cm

7. Record the height of the kite.

   - 2 cm
   - 1 cm

8. Graph the data of the speed of the kite.

   - 5 cm
   - 4 cm
   - 3 cm

---

**To Analyze:**

- Graph the data of the speed of the kite.
- Determine the average speed of the kite.
- Compare the speed of the kite to different wind speeds.

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**To Conclude:**

- Discuss the impact of wind speed on the flight performance of the Wright Flyer.
- Reflect on how the Wright brothers' understanding of aerodynamics and wind speed influenced the design of the Wright Flyer.

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**NASA Student Competition Opportunities:**

- MATHCOUNTS is fun, challenging and it works!
- MATHCOUNTS is open to all students in grades 6-8.
- MATHCOUNTS is a nationwide mathematics enrichment program that promotes the development of mathematical talent and fosters a love of mathematics.
- MATHCOUNTS is a great opportunity for students to build confidence in their mathematical abilities and to explore the beauty and power of mathematics.

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**NASA Educator Resource Center**

- 1025 D Street, NE
- Washington, DC 20546-0001
- Phone: (321) 867-4090
- Fax: (321) 867-4090
- E-mail: nasaco@leeca.org
- Web site: http://education.nasa.gov

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**References:**

- Aeronautics: An Educator's Guide with Activities in Science, Mathematics, and Technology Education
- Calculations within the metric system involve understanding the relationship between units (e.g., centimeters, meters, kilometers) and converting between units (e.g., centimeters to meters).

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**Key Words:**

- Metric System
- Aeronautics
- Engineering
- Education

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**Image Credits:**

- The Wright Flyer, 1903
- National Air and Space Museum, Washington, D.C.

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**Author:**

- Anne Holbrook, NASA Einstein Fellow, Headquarters' Education Division, Office of Human Resources and Education, Frank C. Owens, Director of Education.
Celebrating a Century of Powered Flight
The Wright brothers' achievements propelled the dream into reality and revolutionized the world.

The Wright brothers' landmark accomplishment, the invention and successful flight of a powered aircraft, captured the world's attention. Their achievement in 1903 set the stage for the development of the modern airplane, transforming transportation and opening up new possibilities for global exploration and communication. The Wright brothers' work laid the foundation for the future of aviation, inspiring generations of engineers, pilots, and enthusiasts who pushed the boundaries of flight.

The Wright brothers' legacy continues to resonate, influencing not only the field of aviation but also our understanding of innovation, perseverance, and the power of human ingenuity.

The Wright brothers' story serves as a powerful reminder that dreams and aspirations can be realized through hard work, determination, and a commitment to innovation. Their achievement in 1903 was not just a milestone in aviation history but a testament to the human spirit's ability to transcend limitations and reach new heights.
Celebrating a Century of Powered Flight

The Wright brothers received their dream into reality and revolutionized the world.

This page is designed to honor the accomplishments of the Wright brothers, two brilliant, self-taught engineers who built and flew the first practical, self-propelled airplane in 1903. The first four flights were in Kitty Hawk, North Carolina. The brothers used advanced engineering principles and incorporated the feedback from the flight tests into their design and production of subsequent aircraft. The Wright Flyer, which made the first successful powered flight, was a biplane with a wingspan of 40 feet, a length of 40 feet, and a weight of 1,000 pounds.

NASA CONNECT

Each NASA CONNECT program is designed to enhance the teaching of mathematics and science and serve as a catalyst for professional development. NASA CONNECT for Educators (see panel 12) consists of quick-paced segments for educators. The series is FREE to educators. The series is a standards-based, technology enhanced series of national and international participation in the commemoration of the centennial of powered flight by the public and educators. The series includes educational opportunities to meet, learn, and share in various virtual environments.

Headquarters’ Education Division, Office of Human Resources and Education, "The Wright Way: Innovation Through Engineering," was developed by NASA Headquarters’ Education Division, Office of Human Resources and Education. The purpose of this poster is to help you inspire, educate, and encourage your students to learn about the Wright brothers and their contribution to the world of aviation.

What is the Wright Way: Innovation Through Engineering?

The Wright Way: Innovation Through Engineering is an educational initiative that aims to inspire curiosity and encourage students to explore the world of aviation. The program includes hands-on activities, virtual tours, and interactive lessons that are designed to engage students at all levels of education.

The poster includes a table with the metric system of measurement units. Here are the conversions:

<table>
<thead>
<tr>
<th>1 meter (m)</th>
<th>100 centimeters (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kilometer (km)</td>
<td>1,000 meters (m)</td>
</tr>
</tbody>
</table>

The poster also includes a graph that represents a mathematical model of the Wright brothers’ flight on December 17, 1903.

Sled Kite Flying Journal

Panel 12

Sled Kite

Date: ________________
Student Name: ________________

Sled Kite Flight

What happened when I added my tail kite?

Sled Kite Tail

What if I add a tail to my sled kite? I think it will make my sled kite fly like this:

Weather ______________________________________________________________________

What if I add a tail to my sled kite? I think it will make my sled kite fly like this:

What if I add a tail to my sled kite? I think it will make my sled kite fly like this:

What if I add a tail to my sled kite? I think it will make my sled kite fly like this:

The Wright Way: Innovation Through Engineering

The Wright Way: Innovation Through Engineering is an educational initiative that aims to inspire curiosity and encourage students to explore the world of aviation. The program includes hands-on activities, virtual tours, and interactive lessons that are designed to engage students at all levels of education. The Wright Way: Innovation Through Engineering is a standards-based, technology enhanced series of national and international participation in the commemoration of the centennial of powered flight by the public and educators. The series includes educational opportunities to meet, learn, and share in various virtual environments.

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To Assemble:
Cut along solid lines. Score & fold along dotted lines. Connect with tape where edges of cube meet.

Please Note:
While the initial measurements of the cube are based on increments of one centimeter, the exact measurements of the final, assembled cube may vary depending on the printer on which the document is produced.

Area Equivalents

1 cm² = 0.16 in²
1 m² = 1.2 yd²
1 km² = 0.4 sq. mi
1 hectares = 0.04 acres
1 sq. mi = 2.6 km²
1 sq. ft = 0.09 m²
1 sq. in = 6.5 cm²

Metric Cube

Prefixes

Multiple Name Symbol
10³ Giga G
10⁶ Mega M
10⁹ Kilo k
10⁻³ Milli m
10⁻⁶ Micro µ
10⁻⁹ Nano n
10⁻¹² Pico p

TEMPERATURE

°F - [subtract 32, then multiply by 5/9th] = °C
°C - [multiply by 9/5th, then add 32] = °F

Please Note:
While the initial measurements of the cube are based on increments of one centimeter, the exact measurements of the final, assembled cube may vary depending on the printer on which the document is produced.
If the Cube were filled with water it would have a mass of one kilogram.

This Cube is 10 cm by 10 cm on each side and has the volume of one liter.

**LENGTH EQUIVALENTS**

- in x 2.54 = cm
- ft x 0.30 = cm
- yd x 0.91 = m
- m x 0.04 = in
- m x 1.6 = km
- km x 0.62 = mi
- cm x 0.4 = in

www.nist.gov

National Institute of Standards and Technology
Assembled, the Metric Cube can be a useful tool for conversion from the English System to the Modern Metric System.

**Volume Equivalents**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>tsp</td>
<td>x 5 = mL</td>
</tr>
<tr>
<td>tbsp</td>
<td>x 15 = mL</td>
</tr>
<tr>
<td>fld oz</td>
<td>x 30 = mL</td>
</tr>
<tr>
<td>cup</td>
<td>x 0.24 = L</td>
</tr>
<tr>
<td>pt</td>
<td>x 0.47 = L</td>
</tr>
<tr>
<td>qt</td>
<td>x 0.95 = L</td>
</tr>
<tr>
<td>gal</td>
<td>x 3.8 = L</td>
</tr>
<tr>
<td>cu ft</td>
<td>x 0.03 = cm³</td>
</tr>
<tr>
<td>cu yd</td>
<td>x 0.76 = cm³</td>
</tr>
<tr>
<td>mL</td>
<td>x 0.03 = fld oz</td>
</tr>
<tr>
<td>L</td>
<td>x 2.1 = pt</td>
</tr>
<tr>
<td>L</td>
<td>x 1.06 = qt</td>
</tr>
<tr>
<td>L</td>
<td>x 0.26 = gal</td>
</tr>
<tr>
<td>cm³</td>
<td>x 35 = cu ft</td>
</tr>
<tr>
<td>cm³</td>
<td>x 1.3 = cu yd</td>
</tr>
</tbody>
</table>

**Mass/Weight Equivalents**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>oz</td>
<td>x 28 = g</td>
</tr>
<tr>
<td>lb</td>
<td>x 0.45 = kg</td>
</tr>
<tr>
<td>short ton</td>
<td>x 0.9 = metric ton</td>
</tr>
<tr>
<td>g</td>
<td>x 0.035 = oz</td>
</tr>
<tr>
<td>kg</td>
<td>x 2.2 = lb</td>
</tr>
<tr>
<td>metric tons</td>
<td>x 1.1 = short tons</td>
</tr>
</tbody>
</table>

**Temperature**

Fahrenheit [subtract 32, then multiply by 5/9ths] = Celsius

Celsius [Multiply by 9/5ths, then add 32] = Fahrenheit