NIST Metric Program
US Metric Association Virtual Open House
18 May 2022
Mission:
Promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

Vision:
Be the world's leader in creating critical measurement solutions and promoting equitable standards. Our efforts stimulate innovation, foster industrial competitiveness, and improve the quality of life.
About Us

NIST
Timeline:

- 1901 - National Bureau of Standards
- 1988 - National Institute of Standards and Technology

NIST's original campus stood at the intersection of Connecticut Ave. and Van Ness in Washington, D.C.

March 3, 1901
NIST Founded

Heeding the call from the nation's scientists and industrialists to establish an authoritative domestic measurement and standards laboratory, the U.S. Congress founded NIST on March 3, 1901. The fledgling agency quickly assembled standards for electricity, length and mass, temperature, light, and time, and created a system to transfer those values to the public.

First Director: Samuel W. Stratton
March 3, 1901
Main Campuses

Gaithersburg, Maryland (234 hectare)

Boulder, Colorado (84 hectare)

Additional Locations:

- Joint Institute for Laboratory Astrophysics (JILA) - Boulder, Colorado
- Hollings Marine Laboratory - Charleston, South Carolina
- Institute for Biosciences and Biotechnology (IBBR, formerly CARB) - Rockville, Maryland
- Joint Quantum Institute (JQI) - College Park, Maryland

Credits: NIST
Laurie E. Locascio, Ph.D.
Under Secretary of Commerce for Standards and Technology and NIST Director

- ~3400 scientists, engineers, technicians and support and administrative personnel
- Hosts ~3800 associates from academia, industry, other government agencies
James G. Kushmerick, Ph.D.
Director, Physical Measurement Laboratory (PML)

- Maintenance, development, and dissemination of U.S. national measurement standards
- Full suite of calibration services
- + 600 employees and + 700 guest researchers at Gaithersburg, MD and Boulder, CO campuses

- Applied Physics Division
- Microsystems and Nanotechnology Division
- Nanoscale Device Characterization Division
- **Office of Weights and Measures**
  - Quantum Electromagnetics Division
  - Quantum Measurement Division
  - Quantum Physics Division
  - Radiation Physics Division
  - Sensor Science Division
  - Time and Frequency Division
Office of Weights and Measures

Katrice Lippa, Ph.D.
Director, Office of Weights and Measures

Credit: NIST
Office of Weights and Measures

Core Areas

- **U.S. and International Standards.** Develops documentary standards important for legal metrology devices and laboratory metrology in practice.

- **Traceability for the States.** Facilitates State weights and measures standards traceability to the International System of Units (SI) through NIST. Develops procedures for legal metrology inspections & tests. Provides guidance on uniform weights and measures laws and regulations adopted by State and local weights and measures programs.

- **Technical Guidance and Training.** Designs & delivers training for State laboratory metrologists, weights and measures officials, legal metrology device practitioners, and metric (SI) educators.
Responsibilities

NIST Organic Act - 15 U.S.C. 271 § 2(c) - In carrying out the functions specified in subsection (b), the Secretary, may, among other things -

(1) construct physical standards;
(2) test, calibrate, and certify standards and standard measuring apparatus;
(3) study and improve instruments, measurement methods, and industrial process control and quality assurance techniques;
(4) cooperate with the States in securing uniformity in weights and measures laws and methods of inspection;

Fair Packaging and Labeling Act §1458. Cooperation with State Authorities; Transmittal of Regulations to States;

(a) A copy of each regulation promulgated under this chapter shall be transmitted promptly to the Secretary of Commerce, who shall (1) transmit copies thereof to all appropriate State officers and agencies, and (2) furnish to such State officers and agencies information and assistance to promote to the greatest practicable extent uniformity in State and Federal regulation of the labeling of consumer commodities
Metrological Traceability
An Unbroken Chain from the SI to the Marketplace

International System of Units (SI)

National Standards

National Measurement Institute

Laboratory Accreditation System

Accredited Primary Reference Laboratory

Accredited Calibration Service Supplier

Measuring Instrument

Measurand

Credit: NIST
Stay Connected

- Quarterly digital newsletter
- Articles of interest
Metric Program

Elizabeth Benham
Program Coordinator

Dinelka Jagoda
Montgomery College
Intern

Tanna Ngyuen
Montgomery College
Intern

Travis White Jr.
Mercer University
SURF Intern (Summer 2022)
# OWM Staff & Technical Experts Directory

<table>
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<tr>
<th>Type of Information</th>
<th>Contact</th>
<th>Phone</th>
<th>Email</th>
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<tr>
<td><strong>Weights &amp; Measures</strong></td>
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<td><strong>Metric Program</strong></td>
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<td>Federal Agency Metric Progress Reports</td>
<td>Benham</td>
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Metric Program

Increase Use of the SI:

Trade and Commerce

Everyday Life

Legal Directives:

1866 - Metric Law

1975 - U.S. Metric Conversion Law

1991 - Presidential Executive Order 12770
Policy Highlights

Preferred System of Measurement for Trade & Commerce

Convert on a Voluntary Basis

Seek ways to Increase Understanding
- Educational Information
- Guidance
- Government Publications
Responsibilities


As amended by the Omnibus Trade and Competitiveness Act of 1988

• Seek out ways to increase metric system understanding through educational information and guidance and in Government publications

• SP 330 and SP 811 - Official interpretation of SI for the U.S.

Presidential Executive Order 12770 of July 25, 1991 (FR 56 35801-35803)

• Guidance and Coordination

• Agency Progress Reports and Guidelines
Metric Program Assistance

- Coordinate, Collaborate, Provide Technical Guidance

- Industry, Trade Associations, State & Federal Agencies, Consumers
  - Sector by Sector Basis
  - Online Training

- Consumer & User Education Materials

- Technical Resources
Packaging & Labeling Timeline

- 1906: Pure Food & Drug Act
- 1906: Federal Meat Inspection Act
- 1938: Food Drug & Cosmetic Act
- 1966: Fair Packaging & Labeling Act (FPLA) (US Customary Units Only)
- 1990: Nutritional Labeling & Education Act
- 1992: FPLA Metric Amendment
  + Metric Units Added (Dual Units)
- 1994: Dual Units Effective
  FPLA & State UPLR
- 1999: State UPLR (Dual Units)
  + Metric Option Added
- TODAY: NIST Proposal
  Update FPLA (Dual Units)
  + Add Metric Option
Proposal to Amend the Fair Packaging and Labeling Act (FPLA)

- Frequently Asked Questions (FAQ) format
- Explores current challenges and opportunities related to FPLA amendment
- Federal law prohibits the majority of U.S. consumer product manufacturers from using export-friendly Metric labeling option
- Ability to respond to marketplace demands and consumer preferences is limited by law
- Proposed text
Comparing Units: Volume

**Customary + Metric**

**Dry Volume**
- dry pint
- dry quart
- peck
- bushel

* cord for firewood

**Fluid Volume**
- ounce
- pint
- quart
- gallon

**Metric**
- milliliter (mL)
- liter (L)
- cubic meter (m³)
Proposal to Amend the Fair Packaging and Labeling Act (FPLA)

Amendment expands U.S. Manufacturer options and gains alignment with State labeling laws

GOAL: Facilitate U.S. (esp. small) business to EXPAND exports

Proposed Metric option would eliminate the need to maintain segregated product inventories
# Consumer Value Comparison

## Determine the Best Value

<table>
<thead>
<tr>
<th>Brand</th>
<th>Price</th>
<th>Unit Price</th>
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<tbody>
<tr>
<td>Brand A</td>
<td>$3.19</td>
<td>$1.42 per 100 mL</td>
</tr>
<tr>
<td>Brand B</td>
<td>$3.39</td>
<td>$1.13 per 100 mL</td>
</tr>
<tr>
<td>Brand C</td>
<td>$5.79</td>
<td>$1.22 per 100 mL</td>
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</table>

- Customers use unit pricing on store shelves and online e-commerce platforms to make value determinations.
- In this example, Brand B is the best value.

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## Adopt Unit Pricing

### Brick + Mortar, E-commerce

- **Unit Pricing Guide (2015)**

### NIST Special Publication (SP) 1181

**Best Brand Filtered Water 500 mL**

- **Retail Price**: $1.05
- **Unit Price**: $2.10 per liter

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Credit: NIST
Metric Unit Pricing

**eCommerce**

**Dr. Pepper**
- Product: Dr Pepper Soda Pop, 2 L bottle
- Price: $1.98
- Metric Unit: 99.0 c/l

**Minute Maid**
- Product: Minute Maid Zero Sugar Lemonade Bottle, 52 fl oz
- Price: $2.38
- Metric Unit: $1.56/l
Welcome to NEST-R!

A catalog of STEM educational resources from the National Institute of Standards and Technology

NEST-R has something for everyone! From K-12 to Postgraduate Students, Parents, Teachers, or Working Professionals, we invite you to explore the catalog of resources to deepen your knowledge in a new subject.

Click here to explore the NEST-R catalog!
Example Record

- Descriptions
- Related school subjects
- Target audiences
- Teaching tips
- Estimated teaching time
Online Resources
SI Redefinition

Meet the Constants

Introduction: Redefining the World’s Measurement System
Road to the Revised SI

Meter
Kilogram
Second
Ampere
Kelvin
Mole
Candela
Definitions of SI Base Units
Meet the Constants
Resources for Reporters
Credits
AVOID common written unit symbol errors

Manuscript Review Checklist

Guide for the Use of the International System of Units (SI)

Check List for Reviewing Manuscripts

The following check list is intended to help NIST authors review the conformity of their manuscripts with proper SI usage and the basic principles concerning quantities and units. (The chapter or section numbers in parentheses indicate where additional information may be found.)

(1) ☐ Only SI units and those units recognized for use with the SI are used to express the values of quantities. Equivalent values in other units are given in parentheses following values in acceptable units only when deemed necessary for the intended audience. (See Chapter 2.)

(2) ☐ Abbreviations such as sec (for either s or second), cc (for either cm$^3$ or cubic centimeter), or mps (for either m/s or meter per second), are avoided and only standard unit symbols, SI prefix symbols, unit names, and SI prefix names are used. (See Sec. 6.1.8.)
Publications

NIST SP 1247

Credit: NIST
The Measurement League: Guardians of the SI (Videos)
Superheroes: Mole, Professor Second, Monsieur Kilogram, Mizz Ampere, Dr. Kelvin, Meter Man, & Candela

www.nist.gov/education
SI Teacher Kits Available for Educators

Attention Teachers! Did you know that you can obtain a free set of metric education resources for use in your classroom? Contact the NIST Metric Program at TheSI@nist.gov™ and include your name, school, subject, grade level, phone number, and mailing address. The NIST SI Teacher Kit contains a SI Education USB and other measurement resources.

NIST LC 1140 - Metric Pyramid is a helpful study aid that can be easily constructed with yellow cardstock to keep common approximate unit conversion factors for mass, length, area, volume, temperature, and energy close at hand. It’s a great homework helper!

TheSI@nist.gov

Credit: NIST
SI Education BEST Practices

1) Teach the SI as a system
2) Application - Use metric tools
3) Practice - Build proficiency & confidence making measurements
4) Develop reference points
5) Build estimation skills

6) Employ an Interdisciplinary approach
7) Teach SI all year
8) WIIFM - Real life connections & connect to STEAM careers
9) Make it fun!
10) Don’t teach non-SI unit conversions unless necessary
Training and Professional Development

OWM Calendar of Events

**Webinars:**
- Metric System Estimation
- Metric Education Resources
- Virtual Volume Activity (Coming Soon)
- Measurement System Basics for Regulatory Officials
Professional Development

NIST Summer Institute for Middle School Science Teachers
(July)

Use Our Model to Translate Research into the Classroom

The paper below describes how we at NIST created this program to encourage interest in science in our local middle school community. If you’re a teacher, we encourage you to reach out to local laboratories for resources. If you’re a scientist, we encourage you to build something similar at your laboratory, and reach out to the schools around you.

The NIST Summer Institute for Middle School Science Teachers: Translating NIST Research into Activities for the Middle School Classroom by Mary Satterfield, NIST and Susan Heiner-Zeier, NIST

NIST selected middle schools as an area of interest because we noticed that many middle school teachers are asked to teach science topics in ever changing and expanding fields. Our program introduces teachable ideas in line with school curricula, with lessons that can be immediately implemented.

Benefits from this program include:
- engaging scientists who have a genuine interest in sharing their knowledge with middle school teachers;
- increasing teachers’ enthusiasm and confidence in the latest science findings;
- building pre-nongraduate interest and excitement about math and science, laying the groundwork for the development of the skilled workforce of the future.

Credit: NIST
Collaboration
NCWM
Weights & Measures Week
1 to 7 March
Commemorates President John Adams signing 1st U.S. weights & measures law
2 March 1799

World Metrology Day
Celebrates the Meter Convention
20 May 1875

9 to 15 October 2022
Collaboration

2008 - USMA HQ, Northridge, CA.  Valarie Antoine (USMA), Elizabeth Benham (USMA) & Lorelle Young (USMA)

2008 - NIST, Gaithersburg, MD.  David Sefcik (NIST), Lorelle Young (USMA), James Frysinger (USMA), Lisa Warfield (NIST), Kenneth Butcher (NIST), & Elizabeth Benham (NIST)

2019 - NIST, Gaithersburg, MD.  Don Jordan (USMA), Don Hillger (USMA), Elizabeth Benham (NIST), Mark Henschel (USMA), Doug Olson (NIST), & Paul Trusten (USMA)

Credit: NIST
Metric Program

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Metric Program Training
Chat:

**Share (1) thing you learned about NIST, Office of W&M, or Metric Program**