



NIST Summer Undergraduate Research Fellowship (SURF) Program

Dr. Brandi Toliver
Managing SURF Program Director



NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

NIST Overview



NIST: Did You Know...

- NIST's weight and measures services provide the basis for *fairness* and *efficiency* of sales?
- About 2.6 billion times a day (30,000 per second), NIST's internet time service sets computer clocks and other networked devices?
- In the Army alone, 58,000 different types of equipment require NIST-traceable calibration?
- NIST led the development of performance standards for smoke detectors?
- Closed-captioning for people with impaired hearing, now featured on all TV sets, was co-invented at NIST, earning it an Emmy Award in 1980?
- More than 3,000 law-enforcement officers have been spared from death or disabling injury as a result of NIST-developed standards for ballistic-resistant body armor ("bullet-proof" vests)?
- Many of the tools and materials used in modern dentistry—from the panoramic X-ray to composite fillings to an array of adhesives—originated at NIST through a partnership with the American Dental Association that began in 1928?

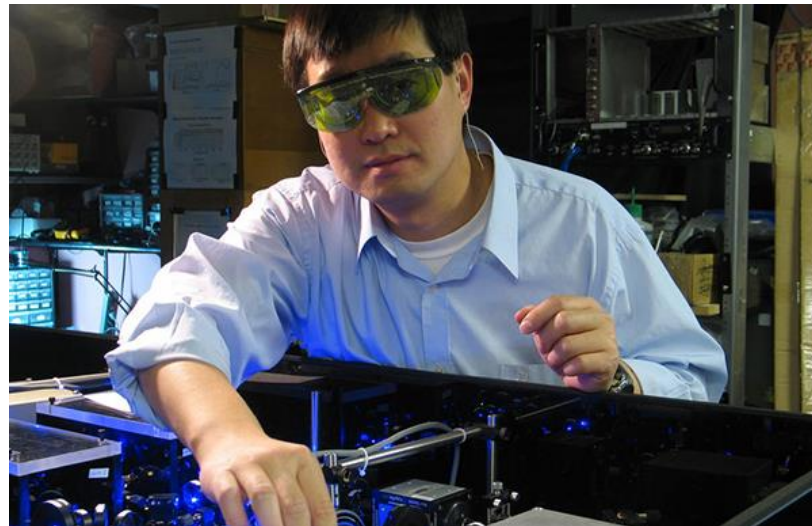


www.nist.gov/public_affairs/factsheet

NIST Mission



To 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



Measurements essential to commerce, trade, and innovation

Federal role
established in the
U.S. Constitution

insure domestic Tranquility, provide for
and our Posterity, do ordain and establish

Article I

Section 1. All legislative Powers herein granted shall be vested in a Congress of the United States, which shall consist of a Senate and House of Representatives.

Section 2. The House of Representatives shall be composed of Members chosen every second Year in each State - and the Electors in each State shall have the Qualifications requisite for Electors of the most numerous Branch of the State Legislature.
No Person shall be a Representative who shall not have attained to the Age of twenty five Years and seven Years, and who shall not, when elected, be an Inhabitant of that State in which he shall be chosen.

Representatives and direct Taxes shall be apportioned among the several States which may be included within this Union, according to their respective Numbers, which shall be determined by adding to the whole Number of free Persons, including those bound to Service for a Year, and the free male Persons of the Age of sixteen Years and upwards, three fifths of all other Persons. The actual Enumeration shall be made within three Years after the first Meeting of the Congress, and within every subsequent Term of ten Years, in such Manner as they shall by Law direct. The Number of Representatives shall not exceed one for every thirty Thousand, but each State shall have at least one Representative, and until such Enumeration, the Number of Representatives shall be apportioned among the several States as they were in 1790. The House of Representatives shall choose their Speaker and other Officers, and shall have the sole Power of Impeachment.

Section 3. The Senate of the United States shall be composed of two Senators from each State, chosen by the Legislature thereof, for a Term of six Years; and each Senator shall have one Vote.

Immediately after they shall be assembled in Consequence of the first Election, they shall be divided into three Classes. In the first Class, one third shall be chosen; in the second Class, one third shall be chosen; in the third Class, one third shall be chosen. At the Expiration of the second Year, of the second Class, one third shall be chosen; at the Expiration of the fourth Year, of the third Class, one third shall be chosen; and at the Expiration of the sixth Year, of the first Class, one third shall be chosen. If Vacancies happen by Death, Resignation, or otherwise, during the Term for which a Senator was chosen, the Governor thereof may fill the Vacancies until the next Election.

When vacancies happen in the Representation from any State, the Executive Authority thereof shall issue Writings of Necessity, to the Legislature thereof, to fill such Vacancies until the next Election.

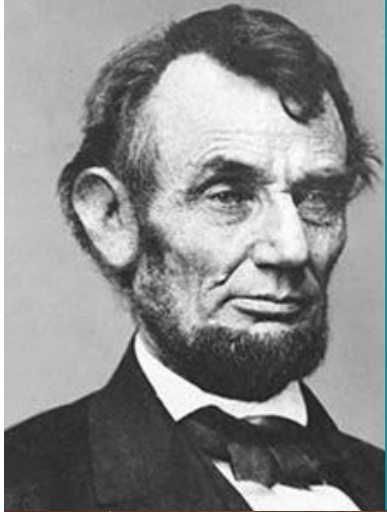


Important to:

- **Commerce**
- **International trade**
- **Innovation**

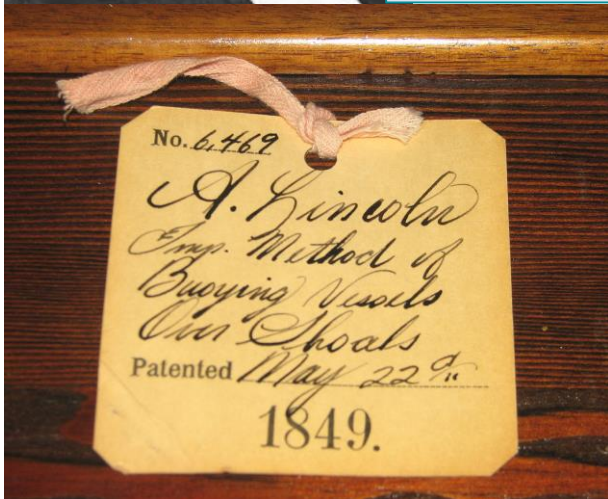
Up to 92% of U.S. exports
affected by standards /
technical regulations

Innovation



The patent system ... added the fuel of interest to the fire of genius in the discovery and production of new and useful things.

Abraham Lincoln – April 6, 1858

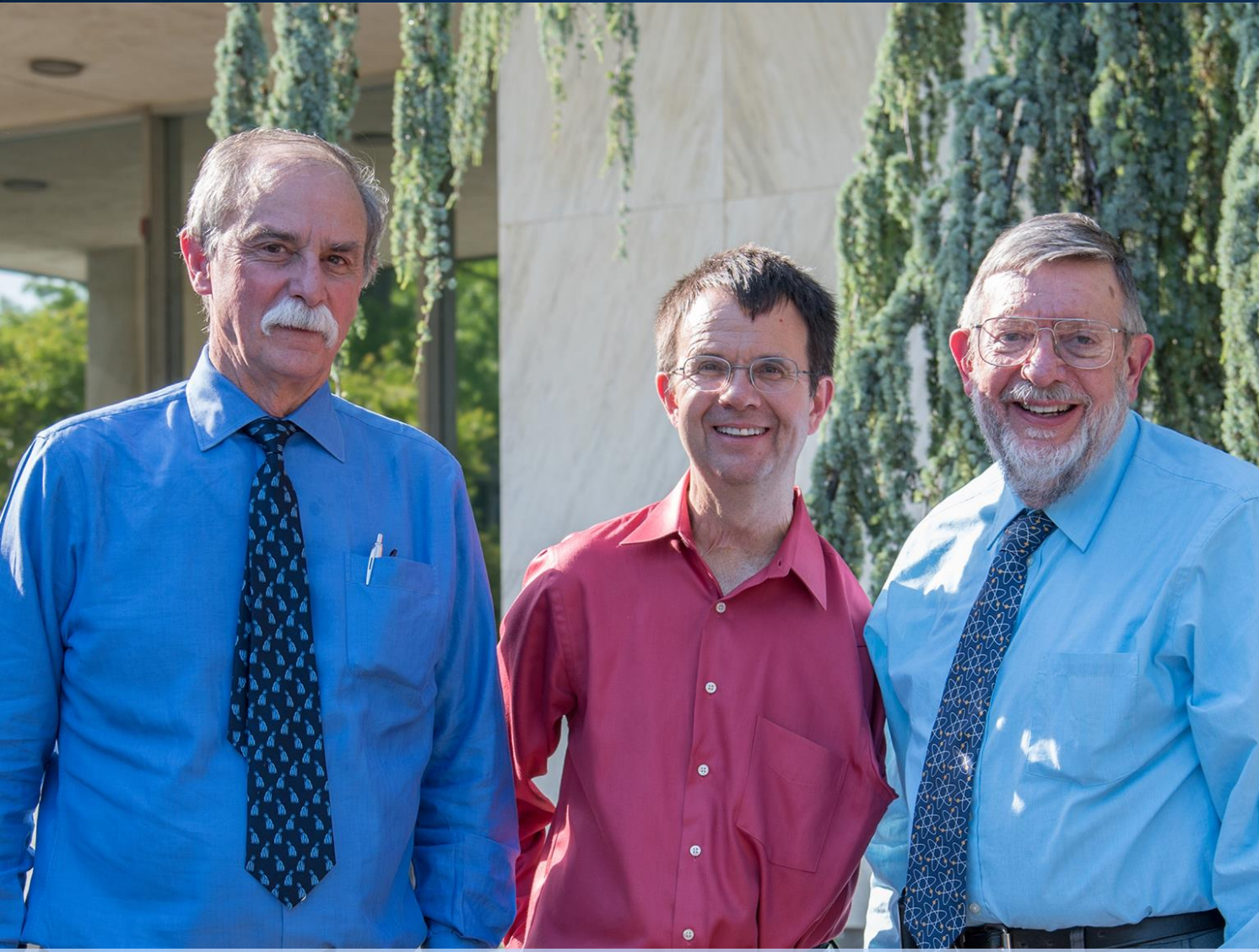


U.S. Patent No. 6469

...Giving effectual encouragement as well to the introduction of **new and useful inventions** from abroad as to the exertions of skill and genius in producing them at home, and of facilitating the intercourse between the distant parts of our country...

George Washington, State of the Union Address, January 8, 1790

NIST's Biggest Strength: Our Reputation



- Technical excellence
- Integrity
- Uncompromising
- Rigorous
- Unbiased
- Industry focused
- Non-regulatory



NIST Nobel Laureates David Wineland, Eric Cornell, and Bill Phillips

NIST Partners Include Industry, Academia, and Government



Industry



Agilent Technologies



Universities



UNIVERSITY OF
MARYLAND

University of Colorado
at Boulder



Penn
UNIVERSITY of PENNSYLVANIA



THE UNIVERSITY
of
WISCONSIN
MADISON

Nonprofits



International Technology Roadmap
for Semiconductors



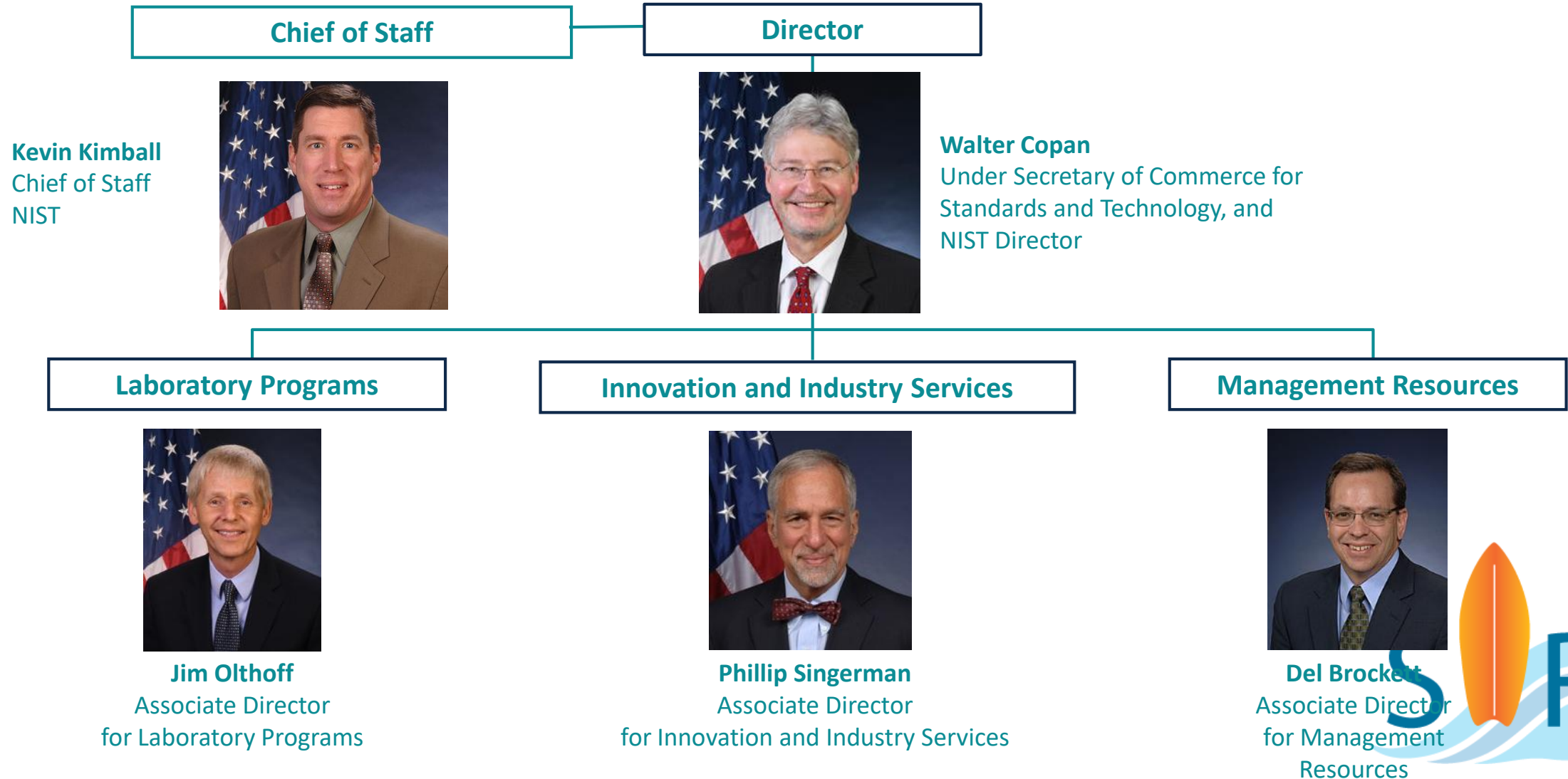
Government



Homeland
Security

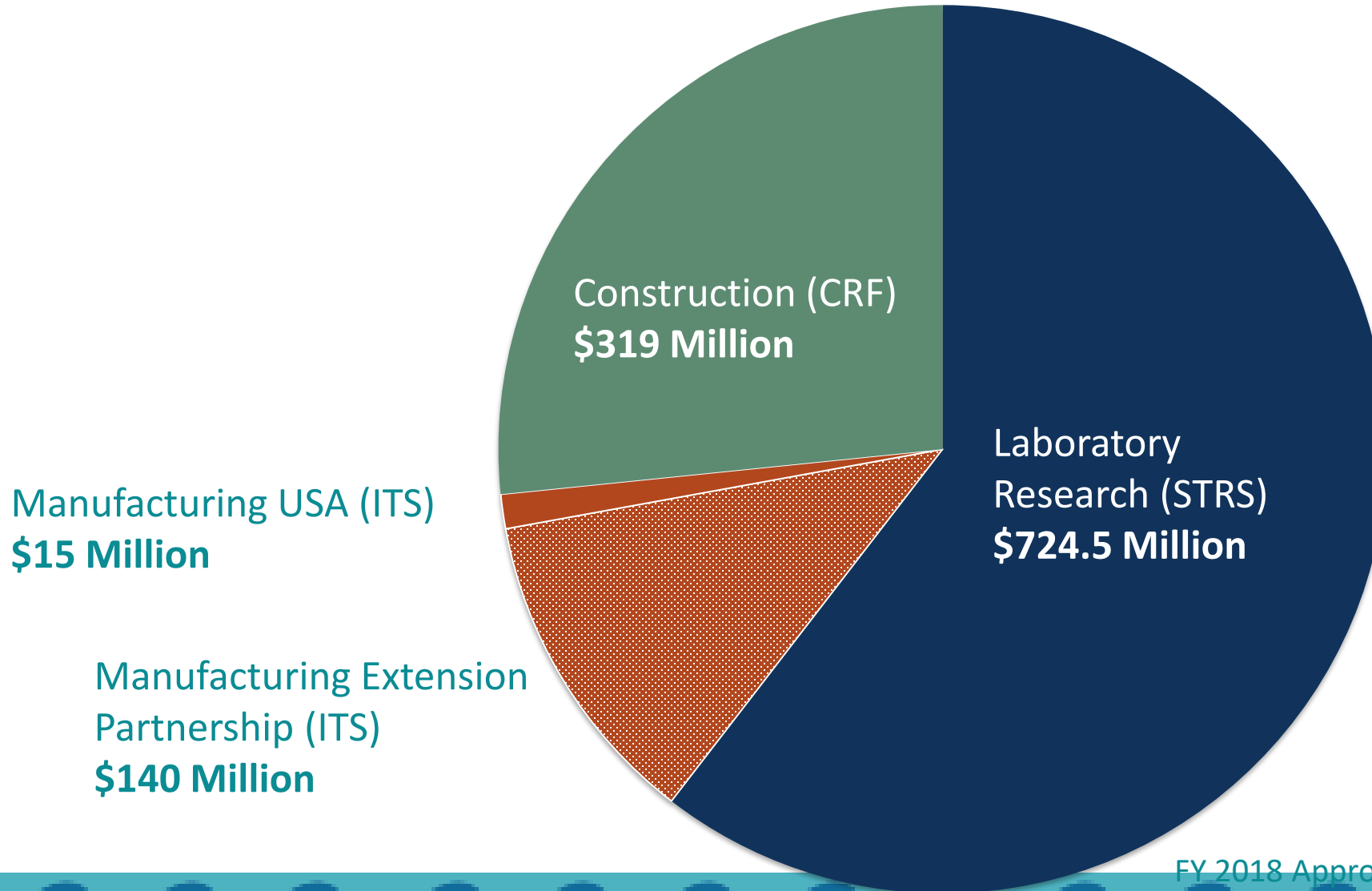


NIST's Leadership Team



NIST Budget: \$1.2 B

NIST



FY 2018 Appropriated Budget

NIST

NIST AT A GLANCE

Industry's National Laboratory



3,400+
FEDERAL
EMPLOYEES



5
NOBEL PRIZES



2 Main Campuses
GAITHERSBURG, MD [HQ]
BOULDER, CO



3,500+
ASSOCIATES

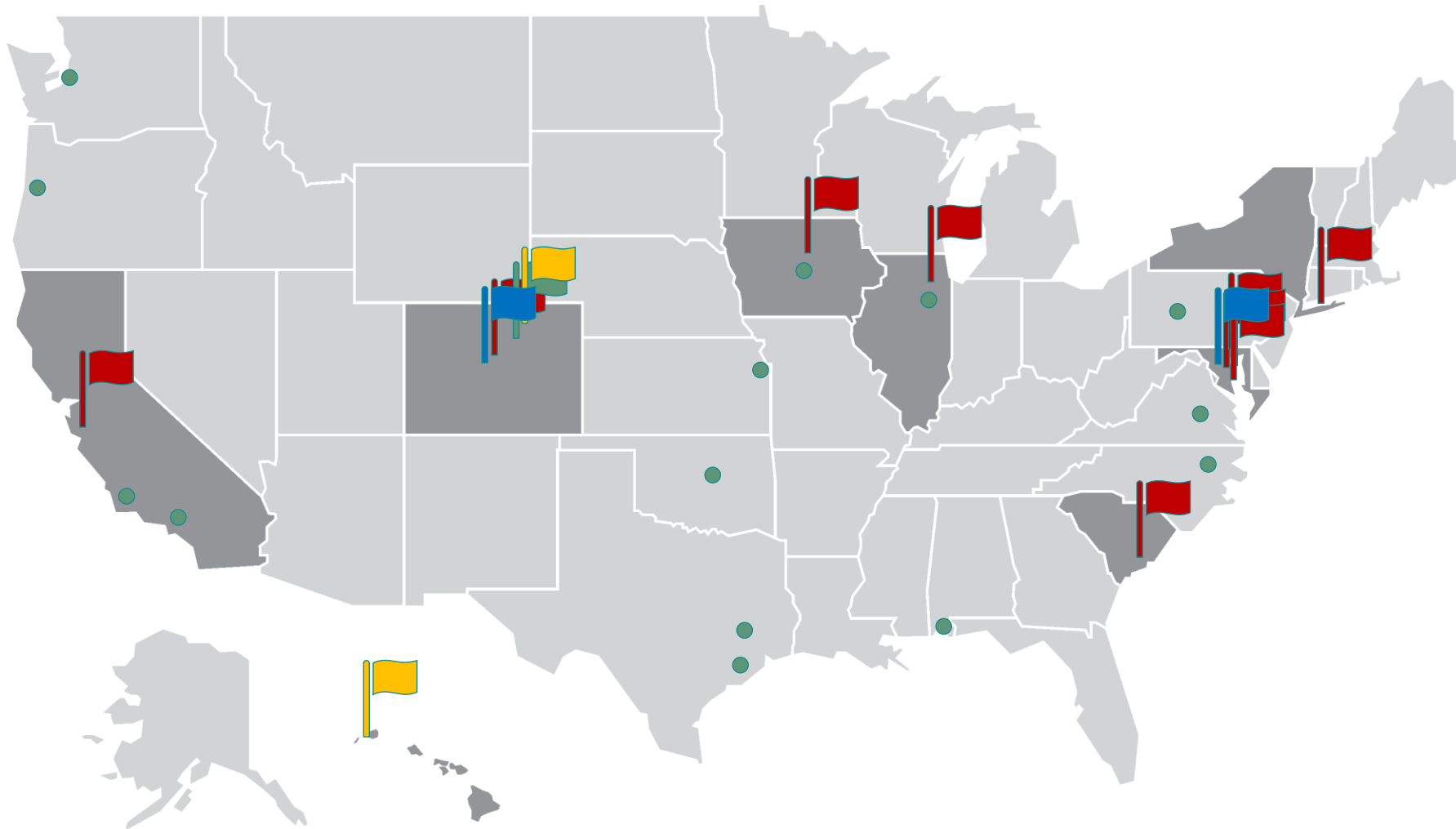


10
COLLABORATIVE
INSTITUTES



Thousands
of U.S. BUSINESSES
Collaborate with NIST

NIST and Joint Institute Locations



NIST Main Campuses

- Gaithersburg, MD
- Boulder, CO



Joint Institutes and Centers

- National Cybersecurity Center of Excellence
- Institute for Bioscience & Biotechnology Research
- Joint Quantum Institute
- Joint Center for Quantum information & Computer Science
- JILA
- Hollings Marine Lab
- Brookhaven National Lab
- Joint Initiative for Metrology in Biology



Atomic Clock Signal Stations

- NIST Ft. Collins CO WWV
- NIST Kaula HI WWVH



NIST Centers of Excellence

- Forensic Science
- Disaster Resilience
- Advanced Materials



NIST Collaborative Research Centers

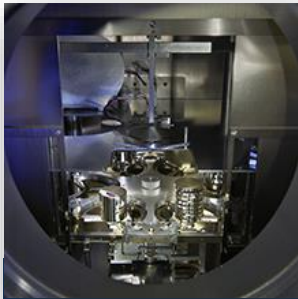


NIST Laboratory Programs

NIST



**Material
Measurement
Laboratory**



**Physical
Measurement
Laboratory**



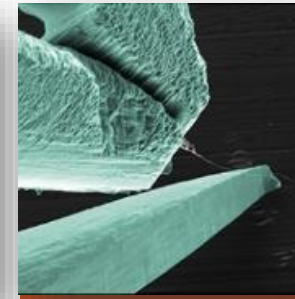
**Engineering
Laboratory**



**Information
Technology
Laboratory**



**Communication
Technology
Laboratory**



**Center for
Nanoscale
Science and
Technology**



**NIST Center
for Neutron
Research**



NIST Extramural Programs



Public-private
partnerships
improving U.S.
economic
competitiveness



**Hollings
Manufacturing
Extension
Partnership**



**Manufacturing
USA**



**Baldridge
Performance
Excellence
Program**

Manufacturing USA Network

NIST



NIST

Unique NIST Products and Services



1,200 Standard Reference Material (SRM) products

100 Standard Reference Data (SRD) products

600 measurement services

Every year:

32,000 SRM units sold

13,000 calibrations and tests

800 accreditations of testing and calibrations laboratories

Accurate Time is Essential

GPS, Internet, and
Telecommunications rely
on NIST's time standard



55AD0	2AB618	837	C3E0A23	5C42D
55C258	FEAF180F	F876	2D0D46D	284F07
08D9AC	C2DE	93442	6816C2	2F8E08C95
EFC2	3B8FE	989F6A4	D61CFA	FC5A
9B56C468	AEC89F8F	0ADA	4A1C4234	160A95
A883458D	08B11A2			E01758
				0F1288



Calibrated Equipment is Essential

Boeing force
measurements are
traceable to the SI

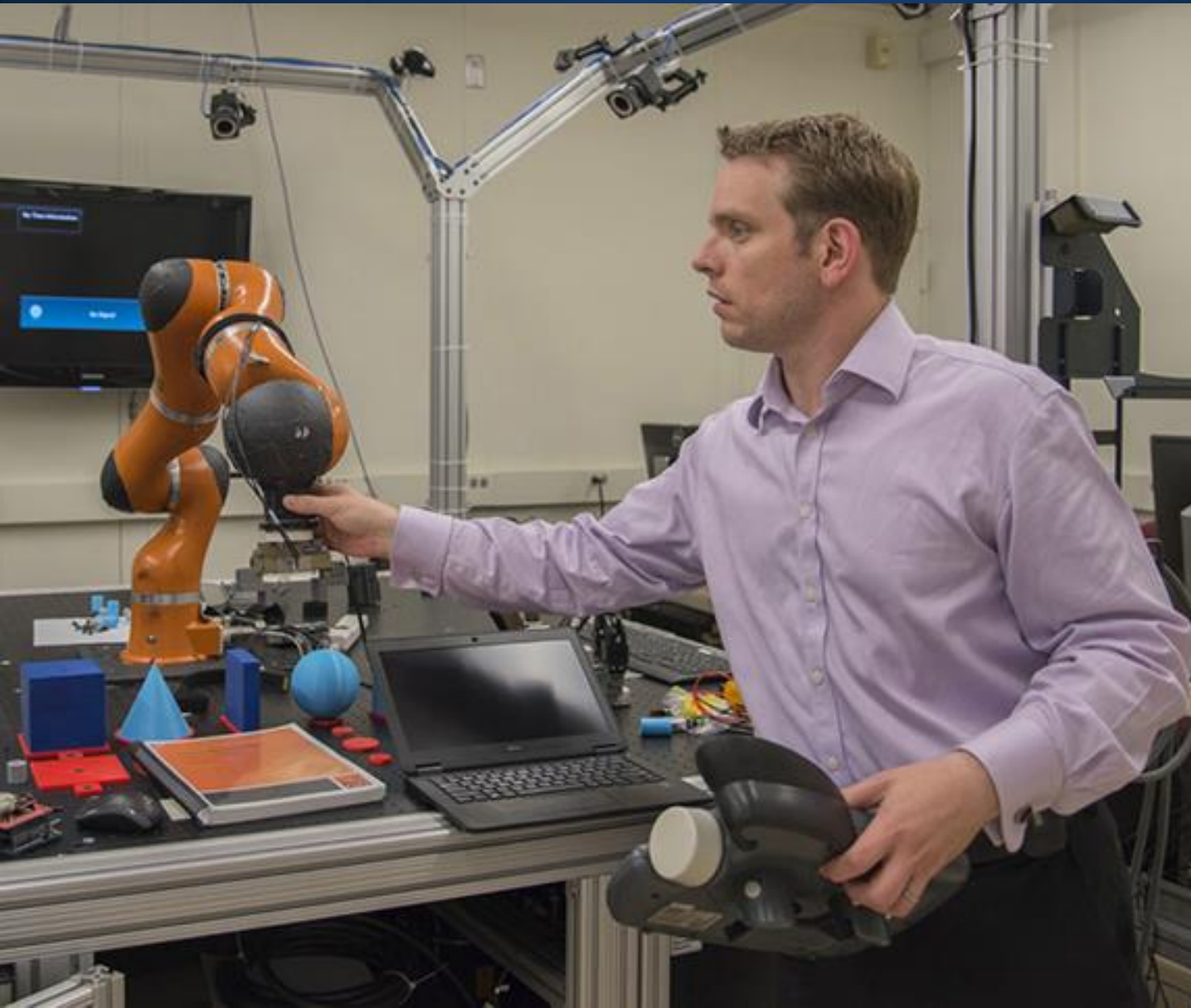


Certified Reference Materials are Essential

NIST's Genome in a
Bottle reference
material ensures the
accuracy of new, high-
throughput DNA tests



Documentary Standards



Important Role

- 400+ NIST technical staff in 100+ standard committees
- Leadership in international standards bodies

NIST's technical expertise results in improved standards and U.S. competitiveness

Strategic Priorities, National Impacts

NIST



Cybersecurity



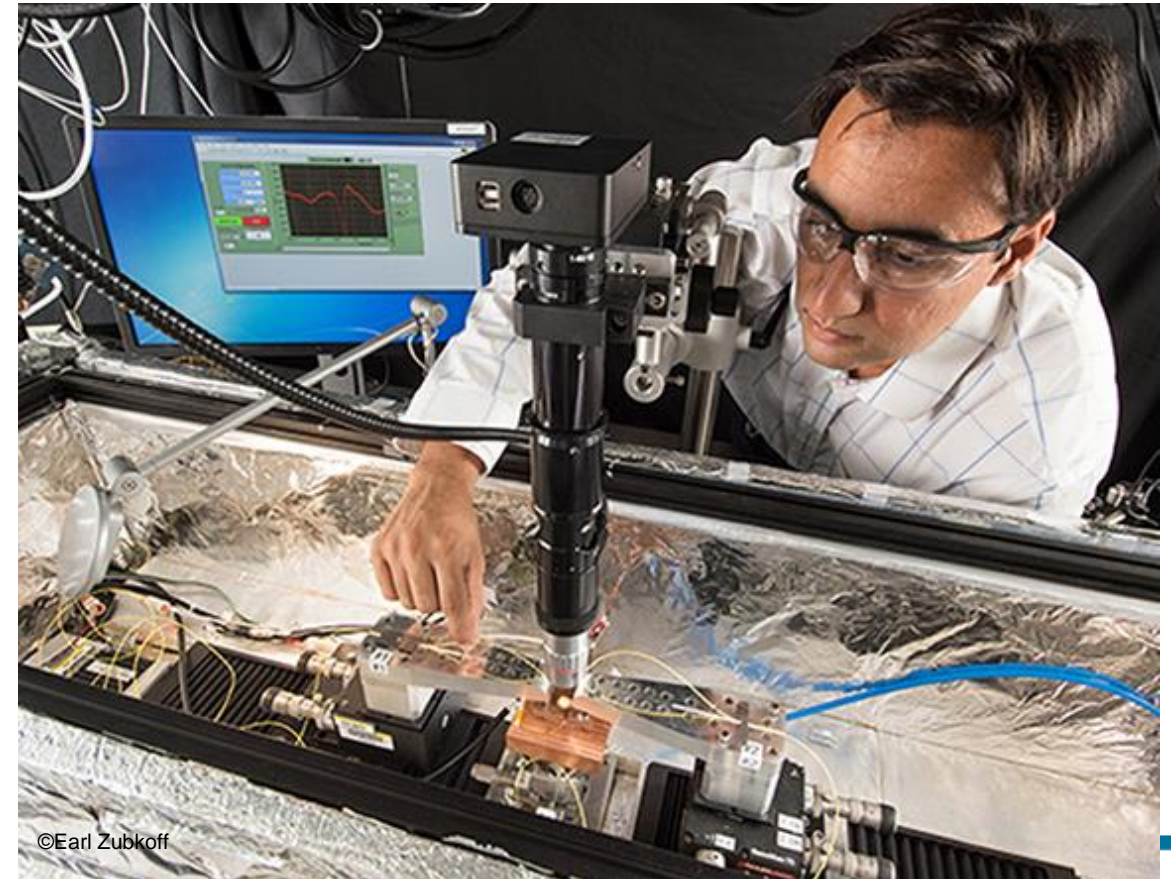
Advanced Manufacturing

Strategic Priorities, National Impacts

NIST



Bioeconomy



Quantum Science



Strategic Priorities, National Impacts

NIST



Artificial Intelligence



Internet of Things

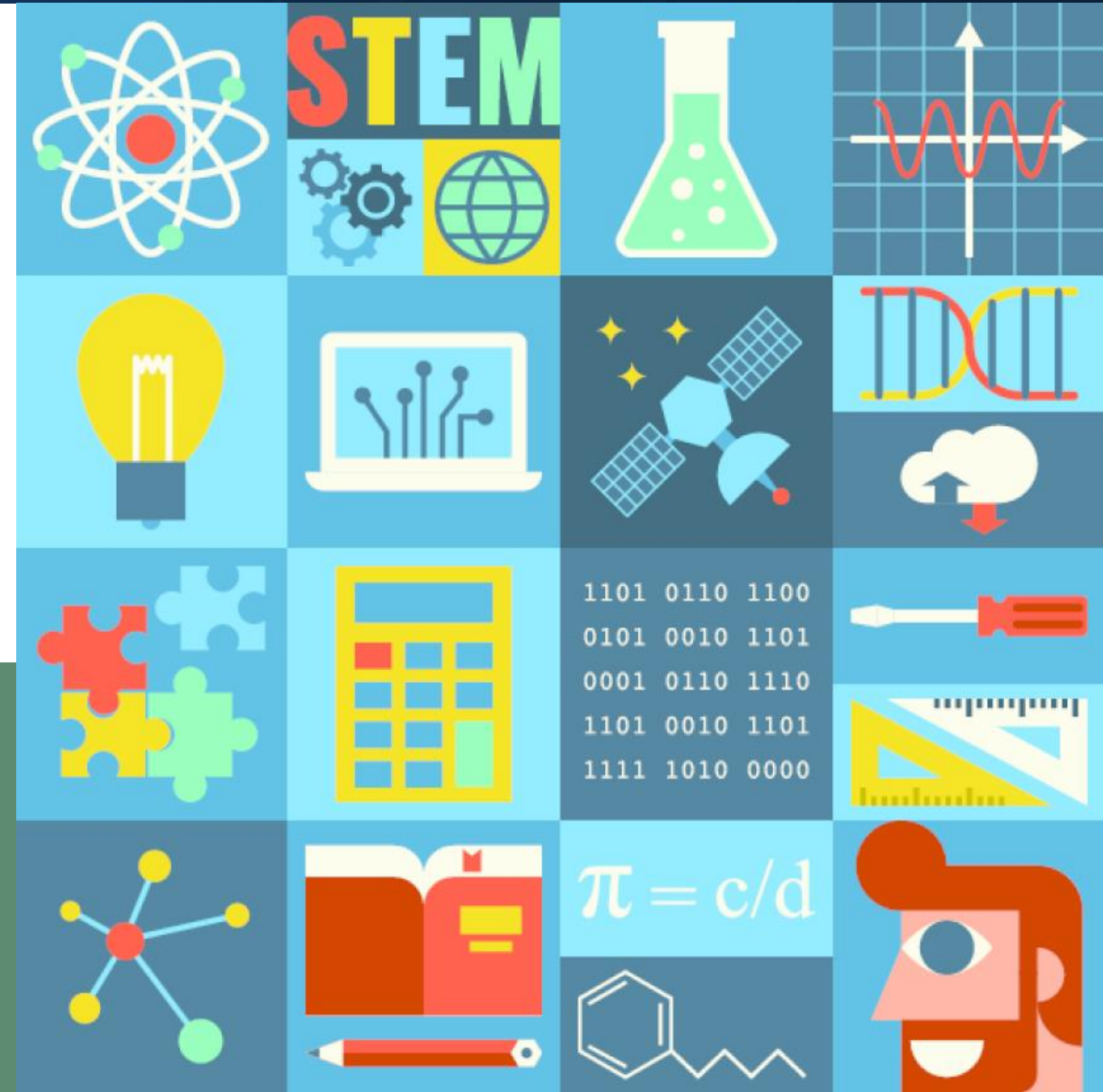


Mission in STEM Education

NIST

To develop a diverse, world-class pool of scientists and engineers to support NIST's mission in measurement science and standards research, and to support the development of a general population that understands and appreciates measurement science and standards.

The development and support of highly-skilled, talented people is an integral component of U.S. economic strength



SURF Program



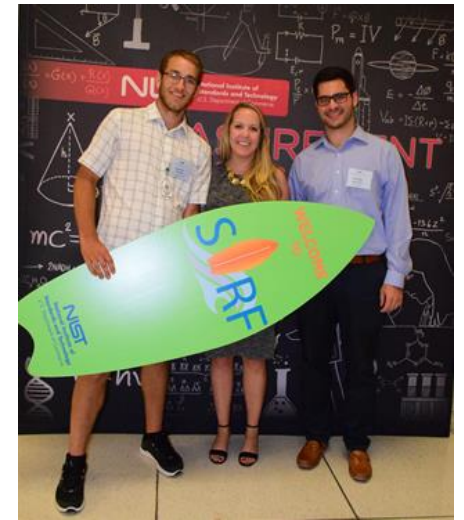
Background info on the SURF Program

- Founded in 1993 in the Physics Laboratory
- Provides opportunities for undergraduates to engage in hands-on research pertaining to the NIST mission under the guidance of a NIST scientist or engineer
- A partnership supported by NIST and participating colleges/universities for students majoring in science, mathematics, and engineering
- Eleven week fellowships available in all the NIST laboratories @ Gaithersburg and Boulder campuses
- To date 2,812 undergraduates have participated in the program
- The 2018 SURF Program consisted:
 - Boulder:** 23 participants
 - Gaithersburg:** 194 participants
- SURF website: <https://www.nist.gov/summer-undergraduate-research-fellowship-surf>



Eligibility Requirements

- Must be a United States citizen or US Permanent resident
- Must be an undergraduate (freshman, sophomore, junior, or senior) majoring in biology, biochemistry, chemistry, computer science, engineering, mathematics, materials science, physics, or STEM field
- Must be in good academic standing
- Considering the pursuit of a graduate degree or career in STEM



Important Dates

- **APPLICATION DEADLINE: February 3, 2019** (*tentatively*)
- **Program Dates**
 - SURF Boulder: May 20, 2019-August 2, 2019**
 - SURF Gaithersburg: May 28, 2019-August 9, 2019**



Application Process

- Students must apply and submit their entire application package on USAJOBS.gov. *The announcement is scheduled to post on USAJobs.GOV soon .*
- A completed application package consists of the following:
 - Resume
 - Transcript (Unofficial recommended)
 - Two letters of recommendation
 - Proof of health insurance coverage
 - Proof of US citizenship or lawful residency
 - Questionnaire
 - *Includes a question requesting the applicant to furnish a personal statement-The personal statement should contain information that helps the review committee make an informed decision about the student such as why the student wants to participate in the SURF program, what areas of NIST research interest the student, and career interest.*



NOTE: All SURF Program applicants must create a profile on USAJobs.Gov to apply to the program.



Tips For Making Your Application Competitive



Questionnaire

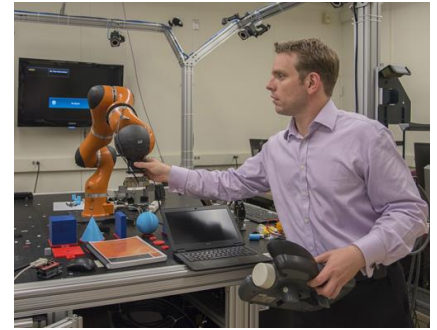
- Answer all questions
 - Eligibility Questions: Unless you've been a federal employee, most of your responses are "No" or "NA."
 - Vacancy questions: Read and answer carefully.
 - Selection of research preference
 - Personal statement (limited to 6000 characters)



Selecting Research Preferences for the SURF Program @ Gaithersburg

➤ Gaithersburg Process

- Students select top two (2) laboratory preferences
- Laboratories should be chosen carefully, because the completed application is considered primarily by the first choice host laboratory.
- Occasionally, a laboratory outside of the selected preferences may align with the desired skillset



SURF Gaithersburg Lab Preferences

- **Communications Technology Laboratory**
- **Engineering Laboratory**
- **Information Technology Laboratory**
- **Material Measurement Laboratory** – consists of three concentrations
 - Chemical and Biochemical Sciences
 - Materials Science (includes projects from the NIST Center for Neutron Research.
 - Computational Materials Science
- **Physical Measurement Laboratory** – includes the Center for Nanoscale Science and Technology

Note: Descriptions of each lab can be found at <https://www.nist.gov/surf/surf-gaithersburg/research-programs>.



NIST Gaithersburg: SURFING Special Projects – Special Projects

- Periodically, there are opportunities for SURF students to participate in technical special projects (in Gaithersburg) which are not located in the NIST laboratories. NIST is soliciting applications for SURF students in the following special projects:
 - Standards Coordination Office (SCO) – 2 opportunities
 - Information Services Office (ISO)- 1 opportunity
 - Technology Partnerships Office (TPO)- 1 opportunity



Selecting Research Preferences for the SURF Program @ Boulder

➤ Boulder Process

- Students select top six (6) research project preferences
 - Visit <https://www.nist.gov/surf/surf-boulder/research-opportunities> for a description of the 2019 research opportunities



Example of Research Opportunity Posting @ Boulder Site

Secure | <https://www.nist.gov/summer-undergraduate-research-fellowship-surf/research-opportunities>

SURF Gaithersburg +
SURF Boulder -

Application
Eligibility
Housing
Research Opportunities

CONNECT WITH US
✉

Research Opportunities

f G+ t

Application deadline is February 12, 2018.

***Note: All research opportunities for 2018 are listed below.*

Applied Chemicals and Materials Division

647-1 Development of Novel Alternative Fuels
Thomas J. Bruno, 303-497-5158, [bruno\[at\]boulder.nist.gov](mailto:bruno[at]boulder.nist.gov)

The best method to study the phase properties of biofuels is the composition-explicit distillation curve developed at NIST. The technique provides an energy content channel in addition to the volatility of a fuel. We have applied this method to many fuels, and this summer we will extend this to include pyrolysis-based renewables. A SURF student working on this will become expert at gas chromatography, mass spectrometry, and many other analytical techniques. Contact adviser for more details.

647-2 Vapor Characterization and Analysis in Forensic Sciences
Thomas J. Bruno, 303-497-5158, [bruno\[at\]boulder.nist.gov](mailto:bruno[at]boulder.nist.gov)

- Division Name
- Project Title
- NIST staff project contact
- Project description



Personal statement

- Limited to 6000 characters
- Put time and effort into writing your personal statement as this is what sets applicants apart.



Part 1: Personal Statement

I decided to attend North Carolina State University for the intellectual challenge. As a junior in the Engineering Physics program, I would say that I found that challenge. Every day, I find myself throwing my pencil to the paper and pushing myself back in my chair for the sheer magnitude of wonder that each lecture presents. I find, and have always found, physics beautiful. This is how the world works. And it is awe inspiring. My other classes only add to the wonders opening before me. For example Programming Concepts and Digital Electronics did not so much awe me by the wonders of what the world is, but instead made me breathless by the wonders of what I can do for it.

I am on the unique path of a five year combined program with an Engineering Physics Bachelor's Degree and an Applied Mathematics and Statistics Masters. This gives me the opportunity to see the wonders of the world in a different way than many of my classmates. I am given two lenses to use when approaching electricity and magnetism or quantum mechanics. It is important to me not just to understand what these are, but to understand how they can be used to solve some of the great problems of the world. Last semester I learned how to build and use AND gates and OR gates, and electronically what that looks like. I designed and built a counter and a machine that measures and displays an unknown frequency. But what I loved most about that was taking that knowledge with me as I learned how to program in C++, and seeing the differences between hardwiring a chip and programming a computer. I loved having an idea of what the computer looks at to see if 5 is truly equal to 5. But even that was not the most satisfying part of my semester. I then took what I learned from that class and brought it to my EPICS course, a course designed to give students experience in working with teams, clients and supervisors, writing paperwork, and executing a real-world problem. So I was able to take what I knew from one language and apply it to another as we learned Python in order to write a program that analyzed data for the location of water molecules in varying sizes of carbon cages and returned plots of the location and hydrogen bond density over time. Stepping from Physics and into the world of math and programming to return to physics, understanding the nature of the world around us is one of the greatest joys I will ever encounter. This is a full circle that many of my peers never get the opportunity to see.

Start your personal statement by describing why you have a passion for STEM. Think about what sparks your interest in your discipline. In other words, what energizes you.



Part 2: Personal Statement

Last summer, I attended the field session for physics. This is a summer only class where every major at Mines offers a unique experience geared toward their students. In this time, I assembled a laser from a mirror and a HeNe tube and used that laser to create a 3-D image on a screen. I also investigated vacuum technology, including thin film deposition and analyzing the deposition using several tools to show reflectivity and thickness. Another project was to build a small steam engine from a Solidworks part, which included spending time with lathes and cnc machines. In that time I also learned LaTeX, Mathematica and Kile and spent time exploring labview - programming a working musical tuner with labview. It was a wonderful experience to have that many hands-on projects, and I learned a lot from that time. I hope to get as much out of this summer.

To get the opportunity to work closely with the projects at NIST would be a dream come true for me. Learning and discovering is one of my passions, and I have found in myself the desire to see that discovery benefit the world. The Center for Nanoscale Science and Technology appeals to my desire not only to be on the cutting edge of discovery, but to bring what we know forward. These projects look specifically at how to take what has been done and improve it, nanofabrication, nanophotonics, and thermoelectrics are fascinating. They seem like science fiction, and yet are already in use in some places, holding within them the potential to aid in our energy crisis. Looking at the Engineering Laboratory, I see ways to improve the safety and energy efficiency of construction. At the beginning of this year, I spent some time on a construction site and noticed that each worker had a badge on which they wrote "I am safe for:" some had "rock climbing" and others a photograph of their daughter or family. It made me realize that in such an environment, safety is critical. Improving guidelines and methods will not only improve the buildings we live in, but the quality of work for the people who build them. This holds for every manufacturing industry, and I feel that this is important to recognize. These two topics were discussed in an ethics course I took, and I found them of great

interest from the side of morals, discussing questions such as releasing the relative unknown of nanotechnology to the public, or the perceived strictness of health and safety standards.

In my career, I hope to work in research, preferably in a laboratory working to bring new discoveries to light and to the world's benefit. Whether I spend time at a well-known institution such as NIST or hidden within a small company, my goal is to improve the world with my knowledge. Getting the opportunity to experience that first hand is not just a resume builder for me, it is the opportunity to do my dream job.

- Include descriptions of previous research opportunities or related projects
- Elaborate on why you wish to participate in the SURF Program.
- Which lab are you interested in conducting research.
- What do you hope to gain from the experience
- What are your career interest?
- Do you plan to attend graduate school?



Supporting Documents

- The following must be attached in USAJOBS
 - Resume
 - Letters of recommendation (2)
 - Transcript
 - Proof of U.S. citizenship or lawful residency
 - Verification of health insurance coverage

***Failure to attach any of these documents will result in your application package submission labeled incomplete/ineligible for review.



Resume

Michael Johnson
michael.johnson3@gmail.com
999-545-8888

Local Address: 110 Smith Lane
Raleigh, NC 21910

Permanent Address: 123 Jackson Street
Gary, IN 27519

Objective

Obtain a research opportunity at NIST to develop my technical skills chemistry.

Education

North Carolina State University, Raleigh, NC
B.S. May 2017 (expected)
Major: Mechanical Engineering
GPA 3.43

Job Skills

- Labview, Word, Excel, PowerPoint, Mathematica,
- Laboratory: Safety measures, titrations, reading measurements, analytical instrumentation (FTIR, SEM, DSC)
- Communication: Public speaking, technical writing
- Other: Spanish, Arabic

Projects

Green Plastic Bag Project

- Compared the biodegradability of green plastic bags in a kitchen composter. Documented the weight measurements and physical appearance (light microscopy) for 6 months.

Biodegradable Film Project

- Worked under the direction of a graduate student to synthesize films using commercially available green chemicals on a hot press. Study the structure of the green films.

Freshman Design Project

- Studies the impact of various concentrations of chlorine on the cuticle layer of Caucasoid, Negroid, and Mongoloid hair types. Documented the change in chemical structure (FTIR) and physical structure (scanning electron microscopy)

Work Experience

North Carolina State University, Raleigh, NC June 2015 – August 2015
Chemistry 101 Teaching Assistant

- Grade assignments and tests, set up review sessions, oversee studio workings and answer questions, be available for weekly office hours

North Carolina State University, Raleigh, NC August 2014 – Present
Resident Assistant

- Organize educational events and activities for 30 first year students in the University Scholars Program ensuring their mental health and safety and serving an on call duty rotation while collaborating closely with other staff members

Honors and Activities

- Women in Science and Engineering (WISE) – Secretary
- American Chemical Society (ACS)
- Alpha Alpha Alpha Sorority- Membership Intake Chair
- Chemistry Tutor-University Tutorial Center

Be sure to include the following

- GPA
- Study Abroad Experiences
- Special Skills (research, computer, language)
- Any tutoring or mentoring experience
- Leadership Skills
- Involvement in professional organizations



Letters of Recommendation

- Request recommendations from professors who are knowledgeable about your academic background (preferably in STEM) or prior internship supervisors
- Give adequate time for your recommenders to write a good letter
- Required to be uploaded on USAJobs.Gov



- Undergraduate transcript is required
- Unofficial is preferred
- Make sure personal identifiable information such as social security number is blacked out

D01	D02	DSAvg	DFile	Gr	Ave
180 1 090 2					
Days Abs: 17.0					
Panama High School (214) B.C.					
D01	D02	DSAvg	DFile	Gr	Ave
00	02	91	88	1	1973 1
02	00	87	89.6	1	1988 2
03			72	0.028	13
06.5			83	1.181	11
Days Abs: 11.0					
120.000					
Information					
Profile					
Created August 15, 2009					



Proof of U.S. citizenship or Lawful residency

- Proof of U.S. citizenship

- Birth certificate with seal
- Unexpired passport book
- Unexpired passport card
- Naturalization Certificate
- Certificate of citizenship
- Consular Report of Birth Abroad



- Proof of lawful residency

- United States Permanent Resident Card(USCIS Form 1-551)



Verification of health insurance coverage

- Copy of health insurance card

HealthCare+		HMO
Name JANE DOE	Group # xxx-xxx-xx	
ID # xxx-xxx-xxxx	Effective xx-xx-xxxx	
	Coverage INDIVIDUAL	
	Plan HMO	
Copay \$xxx.xx	Rx YES	
	RXBIN xxxxx	
	RXPCN xxxxxxx	



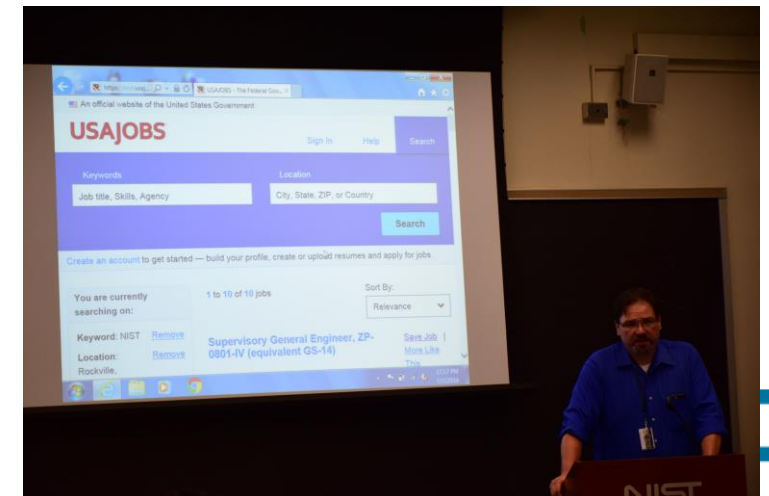
Enrichment Activities of the SURF Program



Weekly Technical Seminars



Laboratory Tours



Professional Development Seminars

Benefits of the SURF Program



Stipend and Housing Allowance

- **SURF** participants receive
 - \$5500 stipend for an 11-week fellowship or \$500/week
 - Travel allowance (up to \$600)
 - Housing in a nearby apartment or suite-style apartment



Benefits of Participating in the Program

- Contribute to exciting, real world, innovative, ongoing projects in the NIST laboratories
- Build professional networks with scientist and engineers
- Opportunity to establish a mentor
- Enrichment opportunities through professional development and technical seminars
- Visit new places
- Decide if a career in research is right for you
- Land a permanent position



Acceptance Rates

- *SURF Boulder*

24 acceptances
178 applications

=

13%

- *SURF Gaithersburg*

194 acceptances
750 applications

=

25%



Don't Forget!!!

- Students apply to the SURF Program on USAJOBS.Gov. The announcement is anticipated to post on December 15th.
- If applying to Boulder and Gaithersburg locations, must submit an application package to each location separately.
- SURF Boulder has 400 applicant limit while SURF Gaithersburg does not have a limit at this time.
- Read a blog posting about “Why You Should Consider a Summer Internship at NIST”
<http://nist-takingmeasure.blogs.govdelivery.com/calling-college-stem-students-why-you-should-consider-a-summer-internship-nist/>
- SURF Website - www.nist.gov/surf
- Application deadline is February 3, 2019





Hope you will consider applying to the SURF Program next year. We may just find you in this picture for the 2019 SURF Program!





Thank You!!!

Visit: www.nist.gov/surf

or

e-mail: Brandi.Toliver@nist.gov

