Smithsonian
National Museum of Natural History

News

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June 13, 2013

Media website: http://newsdesk.si.edu

Smithsonian Genome Exhibition Unlocks 21st-Century Science of Life

The Smithsonian's National Museum of Natural History, in partnership with the National Human Genome Research Institute of the National Institutes of Health, opens "Genome: Unlocking Life's Code" June 14—a multimedia exhibition that explores how the genomic revolution is influencing people's lives and the extraordinary impact it is having on science, medicine and nature.

The exhibition looks at the complexities of the genome—the complete set of genetic or hereditary material of a living organism—and chronicles the remarkable breakthroughs that have taken place since the completion of the Human Genome Project 10 years ago. With cutting-edge interactives, 3-D models, custom animation and engaging videos of real-life stories, the exhibition examines both the benefits and the challenges that genomics presents to modern society.

"Genome: Unlocking Life's Code" will be on view at the National Museum of Natural History through Sept. 1, 2014, when it will begin a tour of venues throughout North America.

"Genomic research is a vital tool for exploring the mysteries of the natural world, and it is an important part of Smithsonian science," said Kirk Johnson, the Sant Director of the National Museum of Natural History. "'Genome: Unlocking Life's Code' will help our visitors understand how genomics is transforming what we know about ourselves and how we make important life decisions."

"Genome: Unlocking Life's Code" celebrates the anniversaries of two landmark scientific discoveries: the 10th anniversary of the Human Genome Project's first completely sequenced human genome and the 60th anniversary of James Watson and Francis Crick's discovery of DNA's double helix structure.

"This exhibition reflects a remarkably productive collaboration between two scientific icons of the U.S. government—the Smithsonian Institution and the National Institutes of Health," said Dr. Eric D. Green, director of the National Human Genome Research Institute, one of the 27 institutes and centers that make up NIH in Bethesda. "Our ability to share the science of genomics with the more

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than 7 million annual visitors to the National Museum of Natural History is profoundly exciting for the broader genomics research community."

When visitors enter the 4,400-square-foot exhibition they will be immersed in an interactive environment that communicates the pervasiveness of genomic science and provides new ways of looking at themselves—as individuals, as members of a family and a species, and as part of the diversity of all life.

"Genome: Unlocking Life's Code" is organized around four themed areas, offering visitors personalized and interactive experiences that examine what a genome is ("The Genome Within Us"), how it is related to medicine and health ("Your Genome, Your Health"), how it connects them to all of life ("Connections: Natural World and Genomic Journey") and how it is a part of their own personal story ("Genome Zone"):

- **The Genome Within Us—**At the center of the exhibition, museumgoers will explore how the genome is a part of their own bodies. They will discover what a genome is, where it is located in the human body (in the cell nucleus), why it matters and how it influences life, all through introductory videos produced by the History channel. Visitors will see three-dimensional models of a human genome and watch historic interviews with Human Genome Project researchers. They can also participate in a media interactive that explores the ethical, legal and social implications of advancing DNA sequencing technologies and submit their responses on an interactive station and find out how their views compare with those of other visitors. An electronic news-ticker display will provide an ongoing stream of recent developments in genomics.
- **Your Genome, Your Health—**Visitors will explore the many ways in which genome sequencing benefits patients through improved health care. They can learn about genes, genomic solutions to mysterious medical diseases, and through a futuristic DNA interactive, search for the right medicine for a given disease. An interactive puzzle presents how genetic, environmental and random factors influence an individual's risk for a particular disease.
- **Connections: Natural World and Genomic Journey—**Visitors will learn about the ways that genomes reflect the connection of all life on the planet, human ancestry and evolution—and even human society. They can explore how the Smithsonian is using new genomic technologies to preserve genetic diversity and study changes in the environment through the

Global Genome Initiative, the Laboratories of Analytical Biology and its growing world-class biorepository of tissues as well as plant and animal DNA.

- **The Genome Zone—**Visitors are presented with a lively room, full of conversations, educational activities and hands-on learning experiences that all personalize a genome. They can discover what unique traits they have at the "Trait Tree," explore how much information their genomes can store despite their molecular scale at the "Genome in Time" and participate in a diversity of activities that all relate visitors to their own genomes in personal and tangible ways.

"Today, the Smithsonian is a leader in utilizing genomic research to understand the diversity of life on earth," said Jonathan Coddington, associate director for science at the National Museum of Natural History. "This exhibition provides a unique opportunity to showcase the cutting-edge biotechnological research going on behind-the-scenes at the museum, and features some of our scientists' work on hot topics like bird strikes, butterflies, wine grapes, bio-coding, Tasmanian devils and the Global Genome Initiative. Thanks to genomics, we now have the tools to sequence every organism on the planet, allowing us to preserve genetic diversity, study changes in our environment and learn more about how these changes affect all life on Earth."

The exhibition includes free educational resources and programs on genetics and genomics and an educational-based website: unlockinglifescode.org. A program of exhibition-related events in Washington, D.C., is being developed by The Smithsonian Associates and the National Human Genome Research Institute and will be announced on the website.

An advisory committee, which included eight genomic scientists, provided input during the development of the exhibition. The exhibition was produced in association with Science North and designed and fabricated by Design & Production Inc. and Evidence Design.

The exhibition was supported by its lead sponsor, Life Technologies Foundation.

Other major sponsors include Johnson & Johnson, Ancestry.com and The Brin Wojcicki Foundation.

Note to editor: For images of "Genome: Unlocking Life's Code" and other related photos and videos, visit http://newsdesk.si.edu/photos.

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June 4, 2013

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Media Advisory

Genome Exhibition Preview and Forum on the Future of Genomics

WHAT: State-of-the-art exhibition about the human genome opens at the Smithsonian

WHEN: Thursday, June 13
8:30 a.m.: Media arrival and set-up
9:30 a.m.: Press preview begins
11:30 a.m. to 3 p.m.: Science Reporters' Workshop and Luncheon

WHERE: Smithsonian's National Museum of Natural History
10th Street and Constitution Avenue N.W.
Public Affairs staff will escort media to the exhibition on the second floor, northeast hall. Please call (202) 633-2950 for assistance.

WHO: Kirk Johnson, The Sant Director of the National Museum of Natural History
Eric Green, director, National Human Genome Research Institute
Jon Coddington, associate director for science, National Museum of Natural History

On **Thursday, June 13**, there will be a briefing and advance tour of a new exhibition at the Smithsonian's National Museum of Natural History: "Genome: Unlocking Life's Code." The morning preview will be followed by an afternoon forum for media to ask questions and hear directly from genomic scientists and leaders on what genomic research has accomplished, where the field is headed and the impact it will have on human health, medicine and technology.

The exhibition is a multiyear collaboration between the museum and the National Human Genome Research Institute of the National Institutes of Health to commemorate the anniversary of two landmark, scientific events—the 10th anniversary of the completion of the Human Genome Project in 2003 and the 60th anniversary of James D. Watson and Francis Crick's discovery of DNA's double helix in 1953. The exhibition opens to the public June 14.

Note: Space is limited for all events. Media are requested to RSVP to Ryan Lavery at laveryr@si.edu in advance.

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Morning Session: Overview of the Exhibition and Tour

8:30 a.m.: Doors open to all media (use Constitution Avenue and 10th Street entrance; Smithsonian staff will escort media to the exhibition space)

9:30 a.m.: Remarks and exhibition overview: Kirk Johnson, Eric Green, Jonathan Coddington

10-11:30 a.m.: Guided tour of the exhibition; interviews with NMNH and NHGRI experts in the exhibition space.

Afternoon Session: Science Reporters' Workshop on the State of the Art for Genomics

11:30 a.m.: Luncheon reception begins in Executive Conference Room

12 p.m.: Welcome remarks: Kirk Johnson, director, National Museum of Natural History

12:10 p.m.: Formal program begins. Each topic addressed will be followed by a media Q&A:

- *The Current State of Genomics*—Eric Green, NHGRI director
- *The Evolution of Genomic Technology and Where It Is Going*—Richard Wilson, director, Genome Center, Washington University School of Medicine, St. Louis
- *State of the Field of Genome Sequencing Industry*—Greg Lucier, CEO, Life Technologies
- *How a Leading Pharmaceutical Company Views Genomics and Its Role in Developing Personalized Medicine*—Susan B. Dillon, Global Therapeutic Head, Immunology, for Contocor Research & Development, Inc, a Division of Johnson & Johnson Pharmaceuticals Research and Development
- *Use of Sequencing Technology in Basic Research: Global Genome Initiative, Biodiversity Research and Evolutionary Studies*—Jonathan Coddington, associate director for science, National Museum of Natural History
- *Future Application of Genome Technologies to Medical Care*— James Evans, Bryson Distinguished Professor of Genetics and Medicine, University of North Carolina at Chapel Hill
- *Genomic Privacy and Protection of Research Data in Public Databases*—Laura Rodriguez, director, NHGRI DCPE, and NIH lead on genomic privacy

3 p.m.: Final Remarks and Wrap Up

Note: Seating for the science reporters' workshop is limited. RSVP to Ryan Lavery at laveryr@si.edu in advance.

Background on the Exhibition

The completion of the Human Genome Project in 2003 represented a remarkable scientific event. The field of genomics continues to advance at a rapid pace with new research breakthroughs occurring nearly every week. This exhibition brings forth a multitude of innovative resources to encourage better understanding of the ways that genomics affects our lives. Through hands-on interactives, 3-D models,

animated and emotional videos of real-life stories, artifacts, replicas and a mobile device-enabled experience, the 2,900-square-foot exhibition will:

- Take visitors deep inside their own bodies to explore and understand the mysteries of the human genome.
- Revolutionize visitors' thinking about the human body, health, disease, the latest advances in genomic medicine and their connections to life on Earth.
- Reveal how the Human Genome Project has given rise to a modern era of genomic technologies and research.
- Dispel common misconceptions about genetics and genomics, and challenge visitors to think more deeply about the complex ethical, legal, social and environmental issues raised by genomic advances.

Organized around four key themes: the "Genome within Us," "Your Genome, Your Health," "Connections: Natural World and Genomic Journey" and "Genome Zone," the National Museum of Natural History's exhibition includes an education-based website and free educational resources and programs on genetics and genomics.

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National Museum of Natural History

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Exhibition Overview

June 13, 2013

Title: "Genome: Unlocking Life's Code"

Opening Date: June 14, 2013

Closing Date: September 1, 2014

Where: Smithsonian's National Museum of Natural History, Hall 23, Second Floor

Partners: The exhibition is a collaboration between the Smithsonian National Museum of Natural History and the National Institutes of Health National Human Genome Research Institute, a part of the U.S. Department of Health and Human Services.

Developed by: The exhibition was developed in association with Science North and designed by Design & Production, Inc. and Evidence Design.

Size: 4,400 square feet

Education Resources: The exhibition is supported by free educational resources, programs about genetics and genomics and an education-based Website: http://unlockinglifescode.org

Additional Website Resources: National Museum of Natural History: http://www.mnh.si.edu/exhibits/genome/
Smithsonian Institution: http://www.si.org
National Human Genome Research Institute: http://www.genome.gov

Supporters: The exhibition enjoys the generous lead support of the Life Technologies Foundation and other major sponsors, including Johnson & Johnson, Ancestry.com™ and The Brin Wojcicki Foundation.

The exhibition commemorates the anniversaries of two landmark, scientific events:

- The 10th anniversary of the Human Genome Project's first completely sequenced human genome in 2003 — the first complete blueprint of the human body.
- The 60th anniversary of James D. Watson and Francis Crick's discovery of DNA's double helix structure in 1953, the revolutionary discovery that laid the foundation for understanding how DNA encodes and copies genetic information to pass on from one generation to the next.

The completion of the Human Genome Project in 2003 represented a remarkable scientific catalyst. As a result, the field of genomics has advanced at a rapid pace, with new research breakthroughs occurring

nearly every week. This exhibition brings forth a multitude of innovative resources to encourage conversations about the ways that genomics affects our lives. Through hands-on interactives, 3-D models, custom animations, inspirational videos of real-life stories, artifacts, replicas, and educational content, the exhibition underscores that the genomics revolution has arrived. The exhibition will:

- Share information about foundation of DNA, the mysteries of the human genome and how it connects them to the natural world.
- Discuss how genomic science will influence people's day-to-day lives, in ordinary and extraordinary ways.
- Promote understanding about the human body, biology, health, disease and the latest advances in genomic medicine.
- Present new ways of considering biodiversity in the natural world.
- Illustrate the latest research in genomics, the many advances that are coming, and the major role genetic research will play in the National Museum of Natural History's future.

Meet Your Genome: Exhibition-at-a-Glance

From the moment visitors enter the exhibition, they will find themselves surrounded by an interactive, futuristic environment that parallels the pervasiveness of genomic science. The exhibition presents visitors with a window into genomics that transforms their perspective about themselves as individuals, as members of a family and a species, and as part of the diversity of life on our planet.

Visitors see first-hand how scientists use genomics to establish links between genes, specific diseases and traits. They can explore the latest developments in personalized medicine, prenatal testing, gene therapy and genomically guided drug therapy. In the process of exploring these developments, the exhibition clarifies the truth behind common misconceptions about genetics and genomics and invites visitors to consider the implications of the complex ethical, legal, social and environmental issues raised by genomic advances.

The genomic journey at the National Museum of Natural History begins with the Human Genome Project's landmark achievement in 2003 — the first complete sequence of the three billion DNA bases in a single human genome. The completion of the Human Genome Project allowed scientists to access the full human genetic code, rather than isolated genes, sparking a revolution in technology and biology. It once took years to sequence a single complex genome, but now, a mere decade later, scientists can sequence multiple genomes from across the tree of life in as little time as a week. Meanwhile, the price for sequencing an individual's genome is plummeting to $1,000 or less.

Today, technologies for exploring the genome continue to advance at breathtaking speed, reshaping and expanding our knowledge of the human body, health and disease, the future of medicine and the effect of human activity on the environment and its biodiversity. As visitors explore the exhibition, they will quickly see how the Human Genome Project has given rise to a modern era of genomic research technologies and that genomics will affect them personally, through rapid, low-cost genome sequencing for routine medical diagnoses and more completely informed treatment decisions.

"Genome: Unlocking Life's Code" is organized around three broadening themes and a fourth section of the exhibition which personalizes the story of how genomes are a part of visitors' own lives:

1. The Genome Within Us

As visitors walk into this gallery, they will immediately see a 9-foot wide projection with an animated video introducing them to the genome, including where and what a genome is in the context of the human body. Within this area, a 3-D model of a genome presents an overview about how a genome works.

- Visitors can learn how researchers sequence a genome and find meaning in the avalanche of data it provides. Visitors can even test their own sequencing skills with an interactive puzzle.

- Visitors can watch a four-part video, produced by History channel, about the Human Genome Project, the visionary scientists that lead the project and the genomic revolution. Through these short segments, visitors can hear scientists' views about the unfolding future of genomics.

- A news ticker display board provides an ongoing stream of recent developments in genomics via a network link with online sites such as Genome Web, American Association for the Advancement of Science, and the National Human Genome Research Institute's Twitter Feed.

- Visitors can also participate in a media interactive titled **"What's Your Take."** Guests and volunteers have the opportunity to interact with one another in the gallery to explore the ethical, legal and social implications of DNA sequencing advancements. Visitors can review responses at the interactive station to find out how their views compare with those of other visitors.

2. Your Genome, Your Health

In this gallery, museum-goers can discover the benefits of genome sequencing for healthcare and medicine. They can find out what DNA sequencing can reveal about health risks for disease and learn how lifestyle can influence the way genes function.

- **"You're A Super Organism!"** reveals that the human body is made up of trillions of vital microorganisms — called the human microbiome — that live among the body's cells. In this section, visitors see how sequencing technology unlocks new ways of thinking about themselves, leading to better understanding and treatments for disease.

- **"Solving Medical Mysteries"** features three videos showcasing real-life accounts from patients, researchers and clinicians involved in solving medical mysteries and complex diseases through genomics.

- **"Genes, Choices and Fate"** is an interactive puzzle that presents how genetic, environmental and random factors play into the health risks for certain diseases. Visitors can take a closer look at current research and targeted therapies for a range of diseases, including rare genetic conditions, contagious disease and cancer. They can also learn more about genomic based drug treatments through an interactive in which visitors decide if a patient can safely take a commonly-prescribed medicine.

- **"Explore Your Genes!"** offers visitors an opportunity learn about certain traits and diseases through a media interactive focused on the human body. It goes into greater depth about health risks like heart disease, physical traits such as hair color and the genes and chromosomes that affect these and other diseases and traits.

- **"Genomics and Family"** is a multimedia interactive that enables users to experience first-hand the benefits and challenges of sequencing their genome. Here they can create their own avatar and encounter questions, including: Would you have your own genome sequenced? Would you have a family member's genome sequenced? What about an unborn child's genome? Who controls these genetic records? Visitors can also find out what might lie ahead in the genomics age.

- **"DNA Detective Work"** allows visitors to gaze into the future. In this hands-on interactive, visitors play the role of an informed genomic clinician searching for the best treatment for high cholesterol, using genetically individualized drug therapy.

- The **"Your Genome, Your Health"** gallery also addresses pharmocogenomics and how rapid breakthroughs in medicine are preparing scientists to use genomic information to transform lives, safeguard health, root out deadly pathogens and even change people's health prospects for the future. Visitors can also find out more about cancer genomics and how scientists discovered that cancer is comprised of 200 different diseases, all triggered by different gene variants. In addition, they can learn how doctors detect mutations by comparing the genome sequences of tumor cells with those of normal cells, hoping to trace the cancer's evolution and find drugs that will stop malignant growth.

3A: Connections – Natural World

This third gallery area is designed to help visitors learn about the tools scientists are using today to sequence a wide diversity of organisms and preserve the genomes of earth's biodiversity before it is lost.

- Visitors can learn that every living thing on Earth has its own genome and that many genetic sequences of even the smallest and simplest organisms are also found in humans. Visitors can discover that by comparing genomes of different organisms, scientists are uncovering startling findings about our biology, Earth's biodiversity, evolutionary changes, and even genomic links to human disease. With many organisms nearing extinction, preserving the genetic blueprints of different species can be a race against time.

- Genomic connections with the natural world are addressed in the gallery through a series of stories about important National Museum of Natural History science efforts including:

    - **The Global Genome Initiative** aims to ensure the viability of Earth's genomic diversity by preserving genetic material from representatives of all forms of life on Earth. Global Genome Initiative scientists are coordinating the collection and storage of tissue samples from species around the world. This will allow future scientists to utilize DNA sequencing to assess planet's health, to better understand diversity and the role it plays in ecosystems.

    - **The Moorea Biocode Project** is barcoding all organisms from the depth of the coral reef to the top of the mountains on a small Pacific island in order to formulate a more complete picture of the diversity of the island ecosystem. In the process, scientists are developing ways to monitor diversity using genetic tools. This display gives visitors a window into the work National Museum of Natural History scientists are doing today and planning for the future.

- National Museum of Natural History specimens on display in the exhibition illustrate the forms of life currently being sequenced and what intriguing facts scientists have learned from this new tool.

- Visitors can discover how all life on earth shares the same genetic origins in "**Reading Nature's Code."** Visitors can navigate biodiversity in the tree of life and learn what we can do with genomic information from 15 different species that have had their genomes sequenced.

3B: Connections – Genomic Journey

Complementing fossil and archeological evidence, genomics shows that early Asian and European populations originated from small African groups who started moving to the Middle East about 60,000 years ago. Those small groups carried only a sliver of Africa's genomic diversity. Even today, the genomes of Asians and Europeans are less diverse than those of modern Africans. Our DNA also reveals evidence that ancient humans mated with other ancient human species that are now extinct. Yet, even after extensive migrations and adapting to many different environments, all humans are one species with no sharp boundaries dividing us into distinct races. This section of the gallery offers:

- An exciting interactive titled **"Exploring Our Genomic Ancestry"** where visitors can explore seven personal stories of people who have discovered more about their ancestry through genomics and how new genomic information has changed their sense of identity.

- **"In and Out of Africa"** is an interactive map that takes visitors on a genomic journey of the human species from Africa to the Middle East. Here they can discover their ancestors and their long history in Africa, reflected in the genomes of African people today.

Visitors can also unravel the past by learning how genomics offers new evidence to the story of human origins pieced together from fossils and archeological evidence. Casts of the original Neanderthal and Denisovan bones used in sequencing bring to life how so much information can be gleaned from such a small piece of evidence.

4. Genome Zone

Alongside the content areas of the exhibition, the **"Genome Zone"** presents visitors with a lively room, full of conversations, educational activities and hands-on learning experiences that personalize genomes. Guests can discover what unique traits they have at the "Trait Tree," explore how much information their genome can store despite its molecular scale at the "Genome in Time" and participate in a diversity of activities that all relate visitors to their own genomes in personal and tangible ways.

- The "**Trait Tree"** explores how all people are 99.9 % genetically similar, but highlights how the remaining genetic differences make every individual unique. Visitors can discover how their genomes affect four different traits. Then, they can trace the tree's branches to find other visitors who share their same four traits, inspiring visitors to ask questions about human individuality through genetic traits and identity. Photography for the "Trait Tree" and related materials by Rick Guidotti of Positive Exposure.

- **"Genome in Time"** captivates visitors with the sheer scale of information encoded in a single human genome. On June 14, the date of the exhibition's public opening, a single human genome sequence will begin scrolling across a video console. It will take one year — 365 days, exactly

— for all 6.2 billion bases to scroll through its entirety, from beginning to end. During the year, facts about the various genes, chromosomes, and alleles within the sequence will be featured in the exhibition. Yonder Biology created "The Genome in Time" as an artistic interpretation of the human genome.

- Several programs and activities will provide visitors with new experiences everyday in the "Genome Zone." Visitors may experience a film, isolate their own DNA or meet genomic scientists while exploring the exhibition.

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For images of the exhibition and other related photos, please visit http://www.newsdesk.si.edu/photos.

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June 13, 2013

The Human Genome Project: Frequently Asked Questions

On April 14, 2003, the National Human Genome Research Institute (NHGRI), the Department of Energy (DOE) and their partners in the International Human Genome Sequencing Consortium announced the successful completion of the Human Genome Project.

What is a genome?

A genome is an organism's complete set of deoxyribonucleic acid (DNA), a chemical compound that contains the genetic instructions needed to develop and direct the biological activities of every organism. DNA molecules are made of two twisting, paired strands. Each strand is made of four chemical units, called nucleotide bases. The bases are adenine (A), thymine (T), guanine (G) and cytosine (C). Bases on opposite strands pair specifically: an A always pairs with a T, and a C always with a G. The human genome contains approximately 3 billion of these base pairs, which reside in the 23 pairs of chromosomes within the nuclei of all our cells. The Human Genome's Project's principal task was determining the order or sequence of those As, Ts, Cs and Gs.

What is sequencing and how do you sequence a genome?

Sequencing means determining the exact order of the base pairs in a segment of DNA. Human chromosomes range in size from about 50 million to 300 million base pairs. One complete set of genomic instructions is about 3 billion base pairs. Specialized machines called DNA sequencers – the technologies have rapidly evolved over the last decade – use techniques of biochemistry to automatically determine the base pair order and deposit the read out in a computer.

Whose DNA was sequenced for the Human Genome Project?

This is intentionally not known to protect the privacy of the volunteers who provided DNA samples for sequencing. The sequence was derived from the DNA of several volunteers who came from Upstate New York. To ensure that the identities of the volunteers cannot be revealed, a careful process was developed to recruit the volunteers and to collect and maintain the blood samples that were the source of the DNA.

What does it mean when you say you've completed the Human Genome Project?

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The main goals of the Human Genome Project included the essential completion of a high-quality version of the human sequence, the creation of physical and genetic maps of the human genome and the mapping and sequencing of a set of five model organisms, including the mouse. All of these goals were achieved ahead of schedule and under budget.

Is the human genome completely sequenced?

Yes, within the limits of today's technology, the reference human genome sequence used in genome research is as complete as it can be. Only small gaps of DNA that could not be recoverable using current sequencing methods remain.

Who owns the human genome?

Every part of the genome sequenced by the Human Genome Project was made public immediately. Private companies have filed thousands of patents on human genes, including Myriad Genetics, Inc, which patented the *BRCA1* and *BRCA2* gene mutations that cause inherited forms of breast cancer. In 2013, the lawsuit over Myriad's patents headed towards a final resolution by the Supreme Court. The court's ruling in this case will set a binding precedent for the lower courts.

Who participated in the international Human Genome Project consortium?

The Human Genome Project could not have been completed as quickly or as effectively without the strong participation of international institutions. In the United States, contributors to the effort include the National Institutes of Health (NIH) and DOE. A majority of the actual genome sequencing was conducted at universities and research centers throughout the United States, the United Kingdom, France, Germany, Japan and China. For a complete list, go to http://www.genome.gov/11006939.

How much did the Human Genome Project cost U.S. taxpayers?

In 1990, Congress established funding for the Human Genome Project and set a target completion date of 2005. Although estimates suggested that the project would cost a total of $3 billion over this period, the project ended up costing NIH about $2.7 billion in FY 1991 dollars and was completed more than two years ahead of schedule. A 2011 report, updated in 2013, from the research firm Battelle Technology Partnership Practice, estimated that between 1988 and 2012, federal investment in genomic research generated nearly $1 trillion of economic output from an investment of $5.4 billion (in the HGP in 2012 dollars). This figure equates to a return on investment of 178:1 and total tax revenues from the genomics sector and suppliers of $54.8 billion by 2012.

Why was a portion of the NHGRI budget set aside for ethical considerations?

Five percent of the annual budget of the NHGRI is dedicated to examining ethical, legal and social implications (ELSI) related to human genome research, incorporating specific recommendations into the activities of NHGRI and providing guidance to policymakers and the public. NHGRI's ELSI program, within the Division of Genomics and Society, is considered unprecedented in biomedical science in terms of scope and level of priority and was considered critical for understanding the impact genomic knowledge might have on individuals and society.

What will the next 50 years of medical science look like?

Having the essentially complete sequence of the human genome is similar to having all the pages of a manual needed to make the human body. The challenge to researchers and scientists now is to determine how to read all these pages, understand how the parts work together, and discover the genetic basis for health and the pathology of human disease. Genome-based research will eventually enable medical science to develop highly effective diagnostic tools, to better understand the health needs of people based on their individual genetic make-ups and to design new and highly effective treatments for disease.

When can we expect new and better drugs?

It usually takes more than a decade for a drug company to conduct the kinds of clinical studies needed to win marketing approval from the Food and Drug Administration (FDA) but some advances have already been made. Today, FDA requires pharmacogenomic labeling information for the labels of 106 medications. That means the label alerts doctors to genomic information that should be considered before prescribing that drug to a particular patient. Before the Human Genome Project, only four drugs carried such a label.

How has the Human Genome Project affected biological research?

HGP has given biological researchers a powerful tool to understand the genetic basis of health and illness. Moreover, it has had an impact on the way biological research is conducted. Traditionally, it has been a very individualistic enterprise, with researchers pursuing medical investigations independently. The magnitude of both the technological challenge and the financial investment prompted the Human Genome Project to assemble interdisciplinary teams, encompassing engineering and informatics as well as biology; automate procedures wherever possible; and concentrate research in major centers to maximize economies of scale. Such large, interdisciplinary teams have become common since HGP's completion.

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Now that the genome is complete, what's next for NHGRI?

NHGRI's vision for the future was published Feb. 10, 2011, in the journal *Nature*. The new plan envisions scientists identifying the genetic basis of most single-gene disorders and gaining new insights into multi-gene disorders in the next decade. This should lead to more accurate diagnoses, new drug targets and the development of practical treatments for patients currently without therapeutic options.

For more detailed information on NHGRI, the Human Genome Project and the future of genomics, go to:

- The NHGRI Web site: www.genome.gov
- The NHGRI Strategic Plan: Charting a course for genomic medicine from base pairs to bedside http://www.genome.gov/Pages/About/Planning/2011NHGRIStrategicPlan.pdf

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Educational Activities and Public Programming Fact Sheet

Overview

The "Genome Zone," located in the north gallery of "Genome: Unlocking Life's Code," is an educational space where visitors can meet genomic scientists, participate in DNA based activities and view films about genomics. The "Genome Zone" will host events for all ages – from young children to full-grown science enthusiasts. The space will be the site for a series of hands-on educational activities and innovative public programs. A number of public programs will also take place at various locations around the Smithsonian.

Educational Activities

The following activities will provide visitors with new experiences everyday in the "Genome Zone".

Genes in a Bottle
Visitors will learn about how DNA is an integral part of every cell in their body. Visitors will extract DNA from their own cheek cells and make them visible through *Genes in a Bottle*. Using a pipette, visitors will transfer their suspended DNA into a bottle to take home.

Genome Bracelets
Children of all ages will be able to create a bracelet based on their favorite DNA sequence. Participants will build genetic bracelets by using simple pairings of nucleotide bases or by translating DNA's triplet code into an amino acid sequence — the building block of proteins.

Do you have a Supertaster's Super Powers?
Some people have more taste buds than others. These "supertasters" tend to find broccoli, coffee, and cabbage bitter. People with fewer taste buds often prefer spicy food. Visitors will be able test if they have the genes that make them a "supertaster".

Different Genes, Different Medicines
Everyone responds to medication differently. The same medication that works wonders for some people can cause adverse side effects in other people. Visitors will discover that their own genome influences whether they can taste a bitter substance or not and how this can relate to their health.

Wing It
Genomics is changing scientists' understanding of the tree of life. Visitors will sort butterflies using body shape and wing color and then discover how genomics can change the way scientists make decisions about relationships among different species.

The Scientist Is In
Accomplished scientists from the National Institutes of Health, the National Museum of Natural History and other research institutions will discuss ongoing genomic science with visitors. Visitors will have the

exciting opportunity to ask a scientist about what genomics is and how it is changing the way researchers can study life.

Genome Geeks
Genome geeks are young scientists with a passion for genomics and life on Earth. Genome geeks will engage visitors, young and old, to inspire other budding science-enthusiasts to pursue their own passions in biology.

Public Programming

To complement "Genome: Unlocking Life's Code," the National Human Genome Research Institute, the National Museum of Natural History, and The Smithsonian Associates have partnered to develop a series of nine educational programs, including lectures, symposia, discussion panels, and informal social gatherings. The programs will be offered to the public from September 2013 to July 2014 and will promote lively conversations among participants, genomic leaders, scientists, scholars and artists about the field of genomics. Programming is made possible thanks to generous grants and gifts made through the Foundation for the National Institutes of Health.

All events are ticketed. Tickets may be obtained from The Smithsonian Associates. Please visit www.unlockinglifescode.org, in the "Events" section for the latest information about these programs. Media may contact Lauren Lyons for more information at (202) 633-8614 or LyonsL@si.edu.

The Genomic Journey: Searching for Your Roots
September 2013

This program, presented in partnership with the National Museum of African American History and Culture (NMAAHC), provides an opportunity to see and discuss how genetic testing is used to analyze and understand an individual's ancestral history. The event features Henry Louis Gates Jr., who will reveal the ancestry of Lonnie Bunch, founding director of the NMAAHC and Gwen Ifill, managing editor and moderator of *Washington Week* and a senior correspondent for PBS's *NewsHour*. After the ancestral reveal, a panel discusses the promise and limitations of genomic research and ancestral inference genetic testing.

**The location and dates for the following public programs will be announced at a later date. Please visit www.unlockinglifescode.org in the "Events" section for the latest information about these programs.*

Real-Life Genome Stories
Doris Zallen, a professor with the Department of Science and Technology at Virginia Polytechnic Institute and State University, will facilitate small group discussions about the utility of genome sequencing in real-world health and ancestry cases. Zallen is the author of *Does It Run in the Family: A Consumer's Guide to DNA Testing for Genetic Disorders* and *To Test or Not to Test: A Guide to Genetic Screening and Risk.*

Genomics, Ethics and Theater
Using the theater for inspiration, the public, scientists and artists will be encouraged to engage in conversations about genomics and society.

Citizen Science, Social Media and Research
Leaders in consumer-oriented genetics will engage in a panel discussion about the ways people are using social media to access information on biomedical research and their personal health.

Genomics: Ethical? Legal? Socially Responsible?
Two panelists will debate the pros and cons of a controversial topic in genomics. The audience has an opportunity to discuss the issue in small groups, pose questions to the debaters and collectively vote on the most persuasive argument.

Decoding Our Past
How has decoding the genomes of Neanderthals, Denisovans, and Homo sapiens revealed new information about our past? In this lecture, a leading evolutionary geneticist will explore the evolution of Homo sapiens on the African continent, and also in other regions, during the past 200,000 years.

Genomes in Hollywood
Scientific breakthroughs in genomics have been featured prominently in popular television shows and movies such as *CSI*, *Jurassic Park* and *Gattaca*. A genome expert will explore the difference between fact and fiction in this entertaining program. Clips from various films and TV programs will be followed by explanations of the real science behind the make-believe.

Mingle Genomes at the Museum
Participants will connect with genomics, drinks and music in this evening program. During this event participants will be able to build their own genome avatar and send it on adventures to track how it reacts to the environment; determine if they are a "supertaster"; learn how glowing green fluorescent protein is used to trace the spread of pathogens; identify one of their genetic traits (a widow's peak, dimples, etc.) or become an expert on fun facts about genome research.

Raise a Glass to Genomics and Wine
Attendees will learn about the history of viticulture through a genomics lens. A wine tasting will accompany the program.

# # #

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Smithsonian
National Museum of Natural History

News

The Global Genome Initiative

June 13, 2013

The Global Genome Initiative (GGI) – organized by the Smithsonian Institution – is a collaboration to promote genomic research and research infrastructure worldwide and create a solid foundation for genomic research through a global network of biorepositories and research organizations.

GGI aims to ensure the viability of Earth's genomic diversity by preserving and barcoding numerous genomes of life on Earth. GGI network partners are coordinating the collection and storage of tissue samples from species around the world and utilizing DNA sequencing to assess planet's health, helping scientists break the codes of entire ecosystems and understand life's diversity. GGI will also increase access to genomic information from the key branches of the Tree of Life—expanding the NMNH's contribution to the preservation and knowledge of life on our planet.

Nitrogen freezers housed in the National Museum of Natural History's Biorepository. These freezers, along with others across the Global Genome Biodiversity Network, will be used to cryo-preserve 50% of the diversity of life in five years. Image by Donald E. Hurlbert, Smithsonian Institution.

Biodiversity genomics is at the forefront of innovation and discovery due to technological advances and the sequencing of the human genome in the last ten years. Genome-level information will revolutionize taxonomy, phylogeny, ecological research and monitoring, environmental change and health, biological conservation and wildlife management, invasive species management, agriculture, drug development and zoonotic disease forecasting, even reaching aspects of national security.

The Smithsonian biodiversity mission focuses on basic research in taxonomy, phylogeny, ecology and conservation. Biodiversity loss, habitat alteration, human demography and rapid environmental change make these challenges particularly urgent. We realize that an actionable, synthetic, deep understanding of the single genome that is Life on Earth is now feasible. Technologies to obtain genomic samples in the field, to curate genomic collections and to make them accessible to the research community are still rudimentary. Because biodiverse countries now manage their own patrimony, only mutually beneficial peer collaborations and partnerships such as GGI can realize these global research agendas.

GGI builds on the existing strengths of collaborators to federate data and adopt community standards and best practices that respect and incorporate the rights of provider countries. GGI provides the organizational support and advocacy for these activities. Work toward this effort includes:

- Expanding and networking frozen collections
- Developing pipelines for capturing, processing, preserving, generating, and analyzing genomes
- Expanding biotechnology and bioinformatics capacity
- Training future genomic researchers and technicians.

# # #

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Smithsonian
National Museum of Natural History

News

Laboratories of Analytical Biology (L.A.B.)

June 13, 2013

The Laboratories of Analytical Biology, or L.A.B., at the National Museum of Natural History is a new 12,000 square foot state-of-the-art genomics facility piloting cutting-edge biodiversity genomics on the National Mall. Located behind the scenes in the museum's research wing, the facility will propel the Smithsonian to the forefront of the life sciences, enabling scientists to deeply understand life on earth using the emerging field of genomics. L.A.B. is managed by Lee Weigt, director of the Laboratories of Analytical Biology at the Museum Support Center and on the National Mall.

When fully operational, L.A.B. will address urgent questions about the health of the Earth's environment and ecosystems, educate the next generation of STEM researchers in genomic techniques and expand the scope at which scientists can rapidly explore and discover nature's vast biodiversity. L.A.B. facilities will also play a key role in the museum's on-going biodiversity projects, including the Global Genome Initiative, a project which aims to ensure the viability of Earth's genomic diversity by preserving and barcoding numerous genomes of life on Earth.

Employing cutting-edge technology, biodiversity researchers at L.A.B. will produce many benefits for society and the planet, including improvements to conservation efforts, increased efficiency in the identification of invasive species, stronger ways to measure the impact of pollution on wildlife and enhancements in our understanding of climate change in treasured diversity hotspots, like coral reefs and rainforests.

L.A.B. integrates a host of genomic technologies in one space that will enable scores of researchers to extract and analyze information from genomic samples in a fraction of the time required in precursor research facilities. Innovatively designed to adapt to new needs and rapidly emerging technologies, the space will accommodate approximately 65 researchers at a time at the Natural History Building on the National Mall and an additional 40 at the Smithsonian's Museum Support Center in Suitland, MD. Through its vast size and flexible capabilities, L.A.B. will provide a space to inspire curiosity in the next generation of biodiversity scientists while providing them with the latest tools and skills necessary to employ genomics to discover and understand the diversity of life on Earth.

Made possible in part through a generous donation of equipment and supplies from the Life Technologies Corporation, L.A.B. researchers can sequence genetic materials using both capillary and next-generation DNA sequencers at the enormous scale critical to modern biodiversity research. Smithsonian scientists will be able to extract and amplify DNA from biological samples using robotic technologies. Through a complex of on-site computing technologies and a partnership with the University of Maryland's Lattice Project, L.A.B. will also provide researchers with access to high-speed computing clusters that can facilitate vast and intensive DNA-based data analysis. For more information about research opportunities at L.A.B. and other details about the facility's specifications, please visit http://www.mnh.si.edu/rc/lab/ .

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Smithsonian
National Museum of Natural History

News

June 13, 2013

"Genome: Unlocking Life's Code" Advisory Council

Eight genomic scientists were invited to serve as an advisory committee during critical development stages of the exhibition. Each scientist has a background in genomic science with a strong interest in communicating the wonder and importance of genomics to the world. During several stages of design and development, the council was asked to review the exhibition.

Joann A. Boughman, Ph.D.
Executive Vice President, American Society of Human Genetics

George Church, Ph.D.
Professor of Genetics, Harvard Medical School

Jim P. Evans, M.D., Ph.D
Clinical Professor, The University of North Carolina at Chapel Hill

Eric S. Lander, Ph.D.
Director, Broad Institute

Stephen Palumbi, Ph.D.
Director of the Hopkins Marine Station, Stanford University

Charmaine D. M. Royal, P.hD
Associate Research Professor, Duke University

Sarah Tishkoff, Ph.D.
David and Lyn Silfen University Associate Professor, University of Pennsylvania

Dennis Liu
Program Director, Howard Hughes Medical Institute

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Smithsonian
National Museum of Natural History

News

Exhibition Sponsors

June 13, 2013

Lead Sponsor

Life Technologies Foundation™

The Life Technologies Foundation™ is dedicated to advancing science education and changing perspectives on how the application of biology can address societal needs. The Foundation supports projects that advance life science education among today's educators and tomorrow's scientists.

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Acknowledgements

This exhibition is a collaboration between the Smithsonian National Museum of Natural History and the National Institutes of Health National Human Genome Research Institute, a part of the U.S. Department of Health and Human Services. The exhibition was made possible in part by financial support secured by the Foundation for the National Institutes of Health.

The Smithsonian's National Museum of Natural History is the world's most visited natural history museum. It also houses the world's largest collection of natural history specimens which is managed by a research staff of more than 100 PhD-level scientists.

The National Human Genome Research Institute supports research to study the human genome and its role in health and disease, and to examine the ethical, legal and social implications of genomics.

The exhibition was developed in association with Science North and designed by Design & Production, Inc. and Evidence Design.

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About Life Technologies Foundation™

The Life Technologies Foundation™ is the corporate giving, 501(c)3 entity of Life Technologies, a global biotechnology company that is committed to providing the most innovative products and services to leading customers in the fields of scientific research, genetic analysis and applied sciences.

The Foundation is dedicated to advancing science education and changing perspectives on how the application of biology can address societal needs. Since 2008, The Life Technologies Foundation has granted $10 million in charitable contributions through education and outreach around the world.

In keeping with Life Technologies' culture of giving and improving life, the foundation supports:

- Programs that accelerate the adoption and understanding of genomics through museum exhibitions and global science festivals
- Projects that advance life science education among today's youth through its own community-based education program, InnovatioNation™
- Initiatives focused on providing biological solutions to some of society's most pressing health challenges

# # #

Smithsonian
National Museum of Natural History

News

Kirk Johnson

June 13, 2013

Sant Director, Smithsonian National Museum of Natural History

Biography:

In October 2012, Kirk Johnson joined the Smithsonian Institution as the Sant Director of the National Museum of Natural History. As director, Johnson oversees more than 470 full-time employees, an annual budget of $94 million, seven scientific departments and a collection of more than 127 million specimens and artifacts — the largest collection at the Smithsonian and the most extensive of its kind in the world.

With more than 7 million visitors annually, and 30 million more on the web and through social media, the Natural History Museum engages an unparalleled audience. Johnson plans to enhance the museum's impact by supporting high-impact scientific research, compelling exhibits and programs, and well-curated and widely-used collections.

Johnson is a highly-respected paleontologist and his research focuses on fossil plants, the extinction of the dinosaurs and methods for dating prehistoric rocks and fossils. His is an advocate and ambassador of science known throughout diverse communities for his academic publications, popular books, museum exhibitions, interdisciplinary collaborative projects and his accessible public speaking style.

Before joining the Smithsonian, Johnson was Chief Curator and Vice President of Research and Collections at the Denver Museum of Nature & Science. During his time in Denver, Johnson oversaw the completion of the museum's first comprehensive collections and research plan, led expeditions that resulted in the discovery of more than 1,400 fossil sites on all continents, and led the installation of "Prehistoric Journeys," an exhibition about the history of life on Earth.

In addition to his duties at the National Museum of Natural History, Johnson is a member of numerous professional organizations, including the American Affiliation of Museums, the Geological Society of America, the Botanical Society of America, the Paleontological Society and the International Organization of Paleobotany. Johnson received a B.A. from Amherst College, an M.S. from the University of Pennsylvania, and a Ph.D. in geology and paleobotany from Yale University.

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Smithsonian
National Museum of Natural History

News

Elizabeth Duggal

June 13, 2013

Associate Director for Public Engagement, National Museum of Natural History
Director, International Museum Professional Education Program, Smithsonian Institution

Biography:

Elizabeth Duggal serves as the Associate Director for Public Engagement at the Smithsonian's National Museum of Natural History and as the Director of the Smithsonian Institution's International Museum Professional Education Program, which spans the entire institution, including 19 museums and 9 research centers.

As an Associate Director, Duggal oversees all public engagement for the Museum of Natural History —an internationally renowned institution that serves as the steward of the world's most extensive natural history collections. In providing strategic leadership for public engagement, Duggal manages a 90-person staff to ensure that the functions and activities that form the public face of the museum reach and engage large, diverse audiences through meaningful exhibitions, outstanding learning experiences, and effective outreach programs. She oversees the planning and development of all museum exhibitions, educational programs, communications, marketing, visitor services and digital media programs and manages a budget of tens of millions of dollars. For the Natural History Museum, she has also directed numerous highly successful fundraising efforts.

In her other, pan-Institutional role, Duggal serves as the Director of the wider Smithsonian Institution's International Museum Professional Education Program, pursuing opportunities for the Smithsonian to provide museum professional education services across the globe. Duggal previously served as the Associate Director for Museum Resources at the Smithsonian's National Museum of the American Indian, and was responsible for the museum's overall planning and management of financial and human resources for both the federal and private sector.

Previously, Duggal served as development executive for the British Museum Development Trust in London, where she headed the museum's International Friends and Patron's membership program. She also chaired the museum's first royal charity gala, directing events in the U.S. with the royal family.

Duggal has worked as a management consultant and held positions in several international institutions, including The Mortgage Corporation Ltd.— a subsidiary of Salomon Brothers International Inc, Fidelity Investment Services Ltd., American Express Europe Ltd., and Crocker National Bank.

Duggal studied at the Sorbonne University in Paris, graduated Magna Cum Laude from Tufts University, and received a graduate business degree from The Wharton School at the University of Pennsylvania. She serves as co–chair of the Board of Directors for the U.S. National Committee of the International Council of Museums (ICOM-US) and Board member of Children's Hospital in Washington, D.C. and The Royal Oak Foundation, New York. Duggal is of American and British nationality.

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Smithsonian
National Museum of Natural History

News

Jonathan A. Coddington

June 13, 2013

Associate Director for Science, National Museum of Natural History
Senior Scientist and Curator of Arachnids & Myriapods

Areas of Responsibility

Overall leadership and administration of the National Museum of Natural History research and collections activities, including seven scientific departments comprising over 300 staff, the Laboratories of Analytical Biology, the Collections Program (care, registration, digitization), Academic Services to interns, graduate students, fellows, research associates and collaborators, emeritus scientists, etc., high-level liaison and hosting of resident Federal Agencies (USDA, Commerce, Interior, Defense) and strategic initiatives (Encyclopedia of Life, Consortium for the Barcode of Life , Integrated Taxonomic Information System), and field stations (Smithsonian Marine Station at Fort Pierce and Carrie Bow Cay, Belize). Support and curatorial partnerships with Exhibits, Education, and other outreach programs and the Office of Advancement, especially for the National Museum of Natural History's strategic initiatives. Support and liaison for Operations, Informatics. Curation of Arachnida and Myriapoda.

Priority Projects

National Museum of Natural History Strategic Initiatives, including the Global Genome Initiative (co-lead), Deep Time, Recovering Voices, and Ocean (Sant Chair, Ocean Portal). Advancement goals for research and collections apart from strategic initiatives. Maintaining excellence in research and collection management. Coordinating sequencing of four arachnid genomes. Genetic algorithms to estimate species richness, revisionary and phylogenetic work on spiders.

Areas of Expertise

Systematics, Biodiversity, Evolution, Behavior, Arachnology.

Previous Experience

Research scientist and Curator, Dept. Entomology. Former Chair of Entomology, Invertebrate Zoology, and Vertebrate Zoology.

Education

M. A., Ph.D. Harvard University (1978 and 1984); B.S. Yale University (1975).

Number of Direct Reports

14 (and ~135 second-line supervisees)

Time with Smithsonian

28 years

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Smithsonian
National Museum of Natural History

News

June 13, 2013

National Human Genome Research Institute Leadership Biographies

Brief biographies of leaders in the National Human Genome Research Institute collaboration with Smithsonian's National Museum of Natural History's launch of Genome: Unlocking Life's Code. Full biographies available on www.genome.gov and at the URLs below. For more information, call the NHGRI Communications Office, (301) 402-0911.

Eric D. Green, M.D., Ph.D. is the director of the National Human Genome Research Institute (NHGRI), the largest organization in the world solely dedicated to genomic research. Immediately prior to this appointment in 2009, he was the scientific director of NHGRI, a position he had held since 2002, and director of the NIH Intramural Sequencing Center. For two decades, Dr. Green has been at the forefront of efforts to map, sequence and understand the genomes of eukaryotes — organisms with membrane-bound nuclei, including significant, start-to-finish involvement in the Human Genome Project. He earned an M.D. and Ph.D. in cell biology from Washington University School of Medicine in St. Louis and a B.S. in bacteriology from the University of Wisconsin at Madison. For more information: http://www.genome.gov/27535200/.

Laura Lyman Rodriguez, Ph.D., is the director of the NHGRI Division of Policy, Communications, and Education. She works to develop and implement policy for research initiatives at NHGRI, design communication and outreach strategies to engage the public in genomic science and prepare health care professionals for the integration of genomic medicine into clinical care. Dr. Rodriguez received her B.A. with honors in biology from Washington and Lee University in Lexington, Va., and a Ph.D. in cell biology at Baylor College of Medicine in

Houston. She served as administrative director at the Baylor Institute for Immunology Research after graduating in 1996, and it was through this work — helping to establish that institute and its laboratories — that Dr. Rodriguez became interested in clinical research policy. For more information: http://www.genome.gov/26524442/.

Vence L. Bonham, Jr., J.D., is the chief of the NHGRI Education and Community Involvement Branch (ECIB) and associate investigator in the Social and Behavioral Research Branch. As chief of ECIB, Mr. Bonham is responsible for structuring how NHGRI reaches out to and engages various communities, including those who are underserved in biomedical research participation. In addition to his work in the Social and Behavioral Research Branch, Mr. Bonham serves as the Senior Advisor on Genomics and Health Disparities. He received his B.A. from Michigan State University in Lansing and his J.D. from the Ohio State University Moritz College of Law in Columbus. For more information: http://www.genome.gov/11508940/.

Carla Easter, Ph.D., is the deputy chief of the NHGRI Education and Community Involvement Branch. Previously, she was director of outreach for Washington University School of Medicine's Genome Sequencing Center in St. Louis. Dr. Easter conducted post-doctoral research at Washington University School of Medicine on the virulence factors associated with *Streptococcus pyogenes*. Dr. Easter earned her B.S. degree in microbiology from the University of California, Los Angeles, and her Ph.D. in biology with an emphasis on molecular genetics from the University of California, San Diego. For more information: http://www.genome.gov/27545549/.

# # #

Smithsonian
National Museum of Natural History

News

Media only: Randall Kremer (202) 633-2950; kremerr@si.edu
Kelly Carnes (202) 633-2950; carnesk@si.edu

Media website: http://newsdesk.si.edu

June 2013

Fact Sheet

National Museum of Natural History

Director: Kirk Johnson
Total Full-Time Employees: 475
Annual Budget (Federal and Trust) FY 2013: $94 million
Approximate Number of Artifacts/Specimens: 127.3 million
Total museum size: 1.32 million square feet
Public space size: 325,000 square feet
Visitors (2012): 7.38 million

Background

The Smithsonian's National Museum of Natural History is the most visited natural history museum in the world. Opened in 1910, the museum on the National Mall is dedicated to maintaining and preserving the world's most extensive collection of natural history specimens and human artifacts. It also fosters significant scientific research and educational programs and exhibitions that present the work of its scientists to the public.

Research and Staff

The museum is home to scientific staff and research associates who conduct expeditions and studies worldwide that contribute to the advancement of scientific knowledge. This work enhances everyday life in ways that yield benefits to society, including the development of medicines, improvement of the world's food supply, management and preservation of important species and habitats, and the identification of invasive species.

Staff includes Smithsonian scientists; collaborating research associates and fellows; and a professional team of educators, exhibition developers, collections managers, designers, information specialists, building managers, administrators, security personnel and support staff.

The scientific staff is organized in seven departments: anthropology, botany, entomology, mineral sciences, invertebrate zoology, paleobiology and vertebrate zoology. Interdisciplinary research programs bring together scientists from the museum's departments and research institutions throughout the world. These programs address topics of current importance to society, such as biological diversity, global climate change, molecular systematics for enhancing the understanding of the relationship between living things, ecosystem modeling and the documentation and preservation of human cultural heritages.

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A number of affiliated U.S. government agencies contribute to the museum's strength as a research center. These include the Department of Interior (Fish and Wildlife Service and U.S. Geological Survey), Department of Agriculture (Systematic Entomology Laboratory), Department of Commerce (National Marine Fisheries Service Systematics Laboratory), National Oceanic and Atmospheric Administration and the Department of Defense.

Collections

The museum is the steward of the world's largest assemblage of natural history items, with more than 127 million objects and specimens in its collections. The Smithsonian's Museum Support Center in Suitland, Md., provides state-of-the-art conditions for storage and conservation of collections, as well as a library and advanced research facilities.

The museum provides off-site access to the physical collections through an active museum loan and exchange program. The website (www.mnh.si.edu) provides public electronic access to departmental databases, online exhibitions and up-to-date information about museum programs.

Permanent Exhibitions

Permanent exhibitions display some of the best-known museum objects in the world. The "Janet Annenberg Hooker Hall of Geology, Gems and Minerals" showcases the Hope Diamond and other treasures of the National Gem Collection. It also encompasses re-created mines and galleries that present important research in mineral chemistry and physics; plate tectonics, seismology and the study of volcanoes; and planetary science.

The 15,000-square-foot "David H. Koch Hall of Human Origins" exhibition focuses on the epic story of how the human species evolved over 6 million years, adapting and surviving during an era of dramatic climate change, and features more than 285 early-human fossils and artifacts, lifelike full-size reconstructions of several hominid species and 23 interactive experiences, including a morphing station where visitors can see what they would look like as early humans.

The "Sant Ocean Hall," featuring male and female giant squids and an exact replica of a living North Atlantic right whale, is a one-of-a-kind interpretive exhibition that demonstrates how the ocean is intrinsically connected to other global systems and the daily lives of people around the world.

"Butterflies + Plants: Partners in Evolution", a permanent exhibition, innovatively combines traditional and experiential learning to provide visitors a rare, up-close look at how butterflies and plants have evolved and diversified together for millions of years.

"Eternal Life in Ancient Egypt" showcases more mummies than have ever been on display in the museum's history. The exhibition combines rare artifacts and cutting-edge research tools to illuminate how Smithsonian scientists have pieced together the lives of ancient Egyptians through their burial practices and rituals in preparation for their eternal life.

Featured in the Dinosaur Hall are a Triceratops, the giant Diplodocus and the FossiLab, a glass-enclosed lab that allows visitors to watch the museum paleontologists and trained volunteers extract fossils from rock and make fossil casts and molds.

The O. Orkin Insect Zoo offers visitors a variety of exhibits and live insects—as well as daily tarantula feedings—and plenty of hands-on activities.

Among the other permanent exhibitions are "Life in the Ancient Seas," Fossil Mammals and Ice Age, Osteology, the "Kenneth E. Behring Family Hall of Mammals," and "African Voices."

Education

The museum is dedicated to bringing definitive scientific content to audiences in person and throughout the world using digital and social media in addition to the museum's websites, video conferences and hands-on learning activities that help visitors to experience the excitement of discovery first-hand. Innovative facilities pioneered by the museum include the Discovery Room, where visitors are able to examine objects up close, and the Forensic Anthropology Lab, where visitors can investigate an authentic forensic case using the museum's collections. Visitors to the museum can also immerse themselves in live animals in the Insect Zoo and Butterfly Pavilion.

About the Museum

The Smithsonian's National Museum of Natural History, located at 10th Street and Constitution Avenue N.W., Washington, D.C., is the world's most visited natural history museum and is open every day from 10 a.m. to 5:30 p.m. with extended evening hours in the summer. It also houses the world's largest collection of natural history specimens which is managed by a research staff of more than 100 PhD-level scientists. Learn more at www.mnh.si.edu or on the museum's social media platforms.

# # #

Smithsonian
National Museum of Natural History

News

June 13, 2013

National Human Genome Research Institute Fact Sheet

In 1989, the National Institutes of Health (NIH) established the National Human Genome Research Institute (NHGRI) (then called the National Center for Human Genome Research) with one bold goal: to sequence the 3 billion DNA letters that make up the human genetic instruction book. With its partners, NHGRI led the International Human Genome Project (HGP) to completion in April 2003. Thus, the history of the HGP, genomics and NHGRI are inextricably intertwined.

Completion of the HGP was a magnificent achievement, but it was just the first step toward fulfilling the goal of improving human health through genomic research. In its 24-year history, NHGRI has actively investigated the basis for inherited susceptibility to numerous diseases as well as seeking to understand the tiny fraction of the genome -- one-tenth of a percent across the 3-billion-base genome -- that distinguishes one human from another.

The enterprise, with overall funding of approximately half a billion dollars in fiscal year 2013, is guided by a series of overlapping five-year strategic plans. The most recent one, *Charting a course for genomic medicine from base pairs to bedside*, articulates a new vision for the future of genomics research and charts the path towards an era of genomic medicine. Published in 2011, the plan envisions scientists being able to identify genetic bases of most single-gene disorders and gaining new insights into multi-gene disorders in the next decade. The goals are more accurate diagnoses, new drug targets and the development of practical treatments for many who currently lack therapeutic options.

While the strategic plan describes areas of research focus for the entire genomics community, NHGRI is organized into three functional programs to implement the plan, including: the Office of the Director, which provides guidance to scientific programs and oversees the general operation of the institute; the Extramural Research Program, which issues grants to institutions and individuals; and the Division of Intramural Research, which is home to the institute's in-house, genetics and genomic research laboratories.
The four divisions of NHGRI's Extramural Research Program award and administer grants for basic genomic research and technology development, as well as major activities such as large-scale genome sequencing; efforts to move genomic technologies and approaches into clinical applications and care; and research related to societal issues relevant to genomics research, including incorporating and extending the activities of the institute's Ethical, Legal and Social Implications (ELSI) research program. Under these broad categories are 24 different research programs (http://www.genome.gov/27534285). The National Advisory Council for Human

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Genome Research helps determine program priorities for NHGRI and performs second-level peer review for grant applications when it meets three times a year.

The Division of Intramural Research conducts research to unravel the genetic basis of human disease. Fifty investigators in the division's seven branches undertake high-risk efforts using genomic sequence data from humans and other species to pinpoint potential disease-causing changes in genes (http://www.genome.gov/10000010). Genes studied by NHGRI's researchers have been implicated in cancer, diabetes, premature aging, hereditary deafness, and various neurological, developmental, metabolic and immunological disorders. The scientific director leads the division – which is located on the main NIH campus in Bethesda, Maryland, the Bayview campus in Baltimore, Maryland, and the Twinbrook complex in Rockville, Maryland -- with input from its Board of Scientific Counselors. The clinical director oversees clinical research.

To support its intramural and extramural research efforts, NHGRI has developed vast databases, intricate technologies and innovative methods to accelerate genome research and its application to human health. NHGRI also supports the training of investigators, as well as the dissemination of genome information to the public and to health professionals.

Challenges remain, but the fundamental goals have not changed since the beginning of the Human Genome Project and the creation of the institute. Genomics and related large-scale biological studies will, in ways not previously available, lead to a profound understanding of human biology and disease, to unimagined advances in medical science and to powerful new ways for improving human health.

# # #

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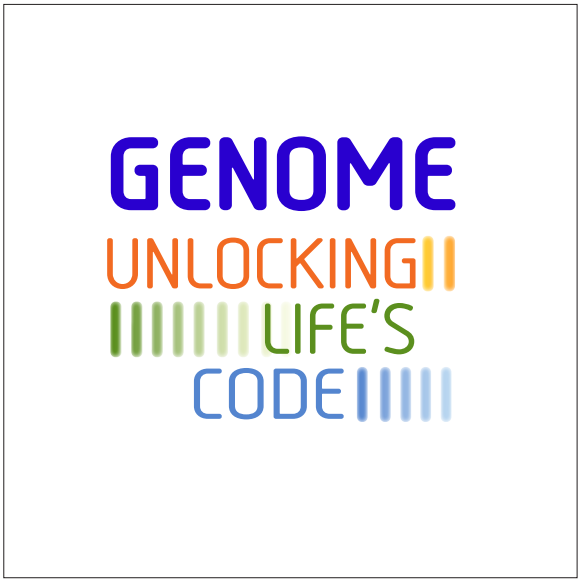
GENOME
UNLOCKING
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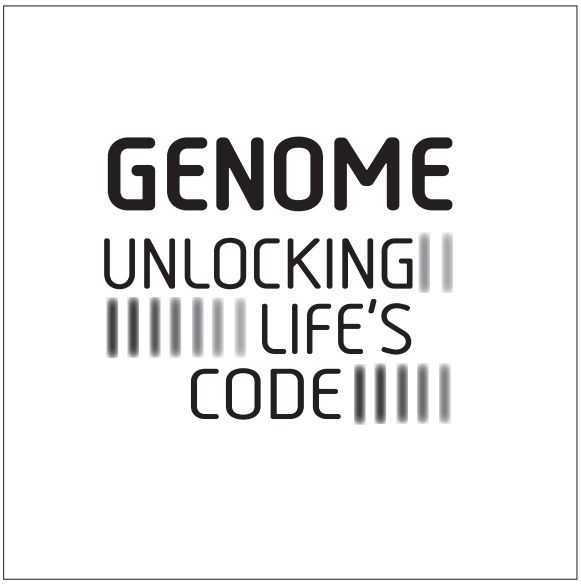
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