Located on a 157-acre campus on the Hudson River, the Lamont-Doherty Earth Observatory (LDEO) is one of the world’s leading research centers seeking fundamental knowledge about the origin, evolution and future of the natural world. More than 300 research scientists study the planet from its deepest interior to the outer reaches of its atmosphere, on every continent and in every ocean. From global climate change to earthquakes, volcanoes, renewable and non-renewable resources, environmental hazards and beyond, Observatory scientists provide a rational basis for the difficult choices facing humankind regarding the planet’s stewardship.

Bus from Morningside Heights

Buses depart for the LDEO campus in Palisades, N.Y., from 120th Street (between Amsterdam and Broadway, in front of Teachers College) every 15 minutes beginning at 9:15 a.m. with the last shuttle departing at 1:15 p.m.

Buses return to 120th Street (between Amsterdam and Broadway, in front of Teachers College) from LDEO every 15 minutes beginning at 11:00 a.m. with the last shuttle departing at 4:30 p.m.

Shuttle Bus from IBM Palisades Conference Center, Route 9W
People arriving in cars or vans should park at the Dolce Palisades Conference Center on Route 9W just north of the LDEO campus. Shuttle buses run continuously from 10:00 a.m. to 4:00 p.m., arriving and departing from the Geoscience Building at LDEO. Persons with special needs or questions should call LDEO Events at 845-365-8998.

Parking is complimentary thanks to the generous support of the Dolce Palisades Conference Center.

Coach USA Schedule
Port Authority Terminal to Palisades, N.Y.: 9:15 a.m., 11:22 a.m., 12:22 p.m., and 2:22 p.m.
GW Bridge Station to Palisades, N.Y.: 9:40 a.m., 10:40 a.m., and 1:40 p.m.
Palisades, N.Y., to Port Authority Terminal: 10:58 a.m., 11:58 a.m., 1:58 p.m., 2:58 p.m., and 3:58 p.m.
Palisades, N.Y., to GW Bridge Station: 12:58 p.m. and 2:58 p.m.

Alumni Hospitality Area
LDEO and Columbia University Alumni
All LDEO and Columbia faculty, staff, and alumni are invited to a special hospitality suite in the J. Lamar Worzel Seminar Room in Lamont Hall, open from 10:00 a.m. until 4:00 p.m.

FOR THEIR SAFETY, IT IS ESSENTIAL THAT CHILDREN BE SUPERVISED AT ALL TIMES.
EXHIBITS

1  WELCOME TENT/ GIFT SHOP TENT
Receive campus maps and information on exhibits. Kids -- Pick up your Science Passport!
Sign up for "Walking Tours of the LDEO Campus. The 45-minute tours, limited to groups of 20 people each, depart from the front of the Welcome Tent at 10:30 a.m., 11:30 a.m., 12:30 p.m. and 1:30 p.m.

LDEO GIFT SHOP: Purchase LDEO T-shirts, baseball caps, water bottles and more!

2  EARTH 2CLASS WORKSHOPS FOR TEACHERS AND STUDENTS
“E2C” is a unique professional development program designed to improve the knowledge and teaching skills of teachers and students through interactive workshops with LDEO research scientists. E2C provides monthly Saturday sessions that focus on cutting-edge LDEO discoveries, curriculum and educational technology integration, and networking. Our website, http://www.earth2class.org, contains a wide variety of resources for educators and students.

4 mini-workshops (20 minutes each) featuring selected E2C programs will be held at:
11 am: Professional Development Opportunities for Teachers at Lamont & Elsewhere
   Michael J. Passow, E2C Founder & Organizer
1 pm: Use Graphic Novels to Understand Scientific Ocean Drilling
   Michael J. Passow, E2C Founder & Organizer
2 pm: Explore the Ocean with American Meteorological Society Maury Project Modules
   Diane Soehl Lennon, AMS Maury Project Teacher Trainer
3 pm: Professional Development Opportunities for Teachers at Lamont & Elsewhere
   Michael J. Passow, E2C Founder & Organizer

Dendro Eco-Hike: Exploring Lamont’s Forest History through Tree-Ring Analysis - Lamont Tree Ring Laboratory scientists and E2C teachers will lead hikes that introduce you to our outdoor campus laboratory, the Lamont forest. Find out how we use dendrochronology (the study of tree rings) to understand environmental changes. Walks are approximately one hour in length and require shoes appropriate for the woods. Limited to groups of 15, the tour departs from the front of the Geoscience Building at 10:30, 11:00, 11:30, 1:00, 1:30, and 2:30. Visit http://www.earth2class.org/docs/lamont%20walk.pdf

3  CORE REPOSITORY
The Lamont-Doherty Core Repository stores thousands of cores, rocks and sediments taken from beneath the ocean floor. Deep-sea sediments contain fossils of marine animals, volcanic glass, cosmic spherules, and other unusual materials unique to a marine environment (such as manganese nodules). Deep-sea samples also hold a permanent record of magnetic history, revealing to scientists the ever-changing magnetic orientation of the poles. See how we find evidence of climate change, cosmic impacts and earthquakes in these sediments. Visit http://www.ldeo.columbia.edu/core-repository.

4  CENTER FOR INTERNATIONAL EARTH SCIENCE INFORMATION NETWORK (CIESIN)
CIESIN is a research and data center that studies human interactions with the environment. In our tent you will find our online Superfund mapper that can map a wide range of population and environmental data near Superfund sites across the country. Teachers and students will be interested in the CHANGE Viewer, which uses CIESIN and NASA data to let you explore how climate change may affect human health and other socioeconomic issues in various parts of the world. We will also have poster versions of our popular map of the month series of posts from Columbia’s State of the Planet blog highlighting our global and national research interests. Kids can play a “CIESIN- blitz” mapping game where they collect information on all our displays.
Our researchers study earthquakes, the structure of the Earth, and the large-scale motions and deformation of the tectonic plates. SG&T scientists also serve the nation and the world by applying their research and providing advice to national and international organizations in two critical areas: reducing society’s vulnerability to natural hazards, and verifying international treaties governing nuclear weapons testing.

**Ocean Bottom Seismology (OBS) Laboratory: Recording Earthquakes on the Seafloor** - Lamont hosts the Ocean-bottom Seismometer Instrument Facility, which designs, builds and operates a fleet of 60 seismometers. These instruments are dropped on the seafloor at sites around the world where they record earthquakes for a year before being recovered. An instrument will be on display to demonstrate how we meet the challenges of pressure, corrosion, bio-fouling, and trawling to detect and record micrometer-scale seafloor movements.

**Deformation of the Earth after the Greatest Deep Earthquake ever Recorded (2013)** - We analyze the first ever GPS observations of static surface deformation from a deep earthquake: the 24 May 2013 Mw 8.3 Sea of Okhotsk event. Previous studies of deep earthquake sources relied on seismology, and might have missed evidence for slow slip in the rupture. We observed co-seismic static offsets on a GPS network of 20 stations over the Sea of Okhotsk region. The seismic moment calculated from static offsets is only 7% larger than the seismological estimate from GCMT. Thus GPS observations confirm shear faulting as the source model, with no significant slow slip component. Our data indicate slip extending for tens of kilometers across most of the sub-ducting Pacific slab thickness.

**What’s Up with Rockland Weather?** - Rockland County has been unusually wet for more than a decade. The historical record casts doubt on whether that pattern will continue indefinitely, with implications for the domestic water supply and for the proposed construction of a desalination plant in Haverstraw.

**Lamont-Doherty Cooperative Seismographic Network (LCSN)**

**Make Your Own Earthquake** - Experience your footsteps and body motions being detected by a sensitive seismometer on the ground! See a portable seismograph in use for small earthquake detection.

**Real Time Monitoring of Earthquakes in the Eastern US** (Seismology 201) - Lamont-Doherty is operating a 45-station seismographic network in the northeastern United States to monitor earthquakes and to mitigate earthquake hazards in the region - including greater New York City. The seismic network is supported by National Earthquake Hazards Reduction Program administered by US Geological Survey. See how the ground motion in this region are gathered in real-time by the Internet, satellite and cell phone modems! The signals are processed to detect and locate seismic events.


**Seismic Sound Lab: Sights and Sounds of Earthquakes and Global Seismology** (1st Fl. Conference Room) - Experience the sounds and animations of earthquakes and seismic waves as though you were deep inside the Earth. Our movies of earthquakes through time, and of seismic waves moving through and around the planet, illustrate why earthquakes occur, how the Earth responds to them, and what they teach us about the planet. In one exhibit, we will compare earthquakes in California, Haiti, Sumatra, Russia and Japan. In another exhibit, experience 4 days (in a few minutes) of earthquakes in Oklahoma induced by human activity. In a third exhibit, listen to the Earth on the day of your birth (your Birthquake!)
6  **BIOLOGY AND PALEO ENVIRONMENT (BPE)**

The Biology and Paleo Environment Division (BPE) is a diverse group of oceanographers, geologists, geochemists, biologists and environmental scientists who pursue research in two connected efforts. First, biology - examining fossils to uncover clues about Earth’s past environment. Second - understanding how the modern environment— through its oceans, atmosphere and land—affects present-day biology.

**Coral Reef Biology – Creating Coral-based Ocean Reconstruction** - Learn how to examine your own coral core banding and reconstruct past sea surface temperature or salinity in the coral reef.

**Polar Bingo** - Guess which Arctic or Antarctic wildlife you have on your bingo card! Learn what they look and sound like.

**Remote Underwater Exploration** - Learn how scientists use “Brinson,” a remote operated vehicle (ROV), to search for life deep beneath Arctic ice.

**The Artistic Oceanographer** - Hands-on activities show the different kinds of marine phytoplankton and their strategies for surviving in the ocean. Design and choose your own phytoplankton and survival strategies while viewing live phytoplankton.

**Gear Tie-Down Challenge**
Can you keep your scientific research gear safe & standing on a rolling ship on the high seas? Come try your hand at gear tie-down to see what it’s like to work at sea! See examples of fieldwork at sea, learn some knots, and test your skills at the gear tie-down challenge!

7  **GEOCHEMISTRY**

The Gary C. Comer Geochemistry Building is Lamont-Doherty’s state-of-the-art laboratory building. Researchers in the Geochemistry Division seek to understand Earth’s environments by studying its history—and the processes, past and present, that have governed these environments. Using advanced chemical and isotope analyses, Division scientists study samples of air, water, biological remains, rocks and meteorites in order to elucidate a broad range of scientific issues.

**The Race for Safe Water** - Learn more about the race for sufficient and safe water in Rockland County and Bangladesh— Visit our website: superfund.ciesin.columbia.edu/Rocklandwater/

**What’s in Your Well Water?** - Private well water testing is the responsibility of well owners. In the US, 43 million people use private wells. However, many do not test their water. Learn about the need to test water, using test kits with examples drawn from research in New England and New Jersey.

**Thermal Ionization Mass Spectrometer (TIMS) Lab** (Room 122) - How do we know how Earth’s chemical composition and ocean circulation changed in the past? How acidic was seawater hundreds of thousands of years ago, and what was climate like at that time? Much of this information can be teased out of rocks and fossil remains of ocean creatures accumulated in seafloor sediments. In the TIMS Lab, samples are heated to thousands of degrees to analyze the Strontium, Neodymium and Boron isotopes that help us with our quest to answer these questions.

**Lamont Doherty's Secondary School Field Research Program (SSFRP)** brings New York City high school students, college students and high school science teachers to Lamont to do research in Piermont Marsh and in Lamont-Doherty Labs. This exhibit is a presentation of their projects and results. Students of the program are particularly interested in talking with anyone, who like them, is interested in pursuing careers in science, math and engineering.
Biking, Breathing & Heartbeats: Measure your breathing rate at rest and while doing different exercises.

Smoke, Stoves & Sustainability: Try on the latest equipment for measuring personal exposures to air pollutants in research studies. Learn about the improved stoves being promoted to reduce carbon emissions, increase sustainability and improve health.

Shrinking Glaciers: A Chronology of Climate Change: Scientists at Lamont-Doherty Earth Observatory are investigating how glaciers and ice sheets behaved in the past and exploring the connections between the climate system, glaciers, and society. By reconstructing the past ebb and flow of glaciers, we hope to better understand the widespread retreat of glaciers today. The group will be available to answer questions about glaciers and climate in general.

8 VOLCANOES!
Come create your own eruptions! Hands-on exhibit featuring volcanoes of different eruptive intensity, volcanic rocks, and volcano research. Special Trash Can Plinian eruption every 30 minutes.

9 SEISMOGRAPH MUSEUM
Walk underneath the Lamont-Doherty cafeteria and see the collection of old and new earthquake monitoring instruments used at LDEO over the years. You can see your footsteps being detected and measured by sensitive seismometers. See over-60-years-old seismographs still working to monitor earthquakes!

10 POSITIVE FEEDBACK-FIELD TRIP: SALTY FOLK – a work-in-progress
PositiveFeedback presents Superhero Clubhouse again this year with a sneak preview of an original musical production which tells the story of the New York harbor through the lens of the original “native New Yorkers” – the oysters. Learn about the symbiotic relationship between oysters and humans, how environmental destruction through pollution and overharvesting caused the decline of the oyster population, and discover the current efforts to restore the oyster population of New York. Music, animals, and history! Created by Jeremy Pickard & Nate Weida in collaboration with environmental scientists and oyster experts. Salty Folk is a production of Superhero Clubhouse.
Work-in-progress showings in 105 Oceanography Building at 12pm; 1:30pm; 3pm
Running time: Approximately 25 minutes
Appropriate for Audiences of all ages (Families: best for children 5 & Up)

11 OCEAN AND CLIMATE PHYSICS (OCP)
Climate change is a crucial factor that has influenced human history over the ages. The division of Ocean and Climate Physics (OCP) works to understand Earth’s climate system and its natural and human-induced changes. Our scientists delve into the mysteries of Earth’s climate to document its change and to build an understanding of its controlling forces.

New Visualization Lab - Room 205
Demonstration of various aspects of geophysical flow.

Salt Water Tasting: Guess the salinity of different water samples and which bodies of water on Earth they best represent.

Pan Evaporation Experiment: Examine and test the effects of wind speed on evaporation.
Oceanographic Instruments: Demonstrations of the instruments and techniques used to monitor our changing oceans
**Atmospheric Chemistry:** LDEO Atmospheric Chemistry Group will be talking about how atmospheric scientists use satellites to learn more about U.S. air pollution, the Antarctic ozone hole and atmospheric composition around the globe (and we'll have cool NASA flip lenticular postcards to distribute!), playing an online game called SmogCity2 to save a city from harmful air pollution, and making small particulate collectors for visitors to bring home and get a sense of the large particles that hang out in the air outside their windows!

**Thermohaline Circulation:** Demonstration of density-driven flow in a tank of water.

**12 EARTH SCIENCE LECTURES and ACADEMIC RESOURCES**
Monell Building, See Lecture Schedule below

**13 INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE & SOCIETY (IRI)/AGRICULTURE & FOOD SECURITY CENTER**
IRI scientists work to improve the lives of people in developing countries through the development and smart application of climate information and forecasts.

**Farmer’s Game:** Come play a simple 20-minute table game in which you’re a farmer in Ethiopia who has to decide whether to buy drought insurance and make other decisions about your livelihood. Ages 8 and up are welcome to participate. Run times are 11:15 and 12:15. This game is similar to those we play with farmers around the world to teach the concepts of index insurance.

**Disaster Manager Game:** We’ll put you in the shoes of a disaster manager who has to make decisions about preparing for extreme weather based on the climate information that’s available. Run times are 1:15 and 2:15. This game is led by the Red Cross Red Crescent Climate Centre for decision makers around the world to teach the use of climate information.

**Photos from the Field:** A special exhibit of IRI scientists’ photos and videos from the field.

**Agriculture Food & Security Center**
The Center mobilizes science and technology to advance sustainable agricultural intensification on the ground, with a particular emphasis on tropical areas but including developed countries as appropriate to our comparative advantage. Our approach emphasizes field-based systems research that identifies biophysical limitations and constraints to production and focuses on the agronomic tools and practices to overcome them, as well as their effects on livelihoods and the environment.

**14 MARINE GEOLOGY & GEOPHYSICS (MG&G)/Marine Operations**
Fifty years ago, with the purchase and refit of a 200’ pleasure yacht renamed the Vema, Maurice Ewing inaugurated Lamont’s exploration of the largely unknown terrain beneath the world’s oceans. Today, members of the Marine Geology and Geophysics (MG&G) Division remain explorers at heart, motivated by curiosity to understand these remote and forbidding parts of our planet.

**Mantle Plumes & Continental Breakup**
The hot, flowing and sometimes melting interior of the Earth has a huge effect on the surface. Extra hot mantle mantle upwellings, called plumes, produce enough magma to create big volcanoes like the ones now erupting in Hawaii and Iceland. When new plumes rise as blobs, or “plume heads,” from the core-mantle boundary they produce gigantic amounts of magma lava that can cover millions of square kilometers Lamont stands on top of the Palisades Sill that was in the middle of one of these “Large Igneous Provinces” 200 million years ago. At the same time North America began to rift away from Africa. Other continental breakup events, like Greenland pulling away from Eurasia, happen just when Large Igneous Province form.
**GeoMapApp & Earth Observer**: Use these apps to explore our planet from the comfort of your computer or iPad. Examine the details of seafloor topography, add layers to show earthquakes and volcanoes, discover how polar sea ice changes with time. Also, learn how to import your own data – ideal for school projects – and how to save the maps for your school report! GeoMapApp is free!


**Arctic Sea Ice & Eco-Systems**: The Last Arctic Ice Refuge – Polar bears, ringed seals and other Arctic species rely on floating sea ice, part of an Arctic environment that is rapidly changing. Explore the Arctic of the future through this hands-on activity that demonstrates the impact of sea ice loss. Where will the ice stay the longest? Can we protect this ice area as a refuge for Arctic species?

**Eco-Chains** – How are plankton, krill, walrus, polar bears and other marine species connected to sea ice? How can industrialization, overfishing, or green energy choices affect these linkages? Play this unique card game based on connections between the natural world and human influences.

**Life in Antarctica**! Join scientist from Antarctica’s Palmer Long Term Ecological Research Network to learn what lives in Antarctica. Learn how it is changing and why. Make a craft. Teacher materials available.

**Why Studying Greenland Matters**: What is a degree or two among friends? A one or two degree change in air temperature is not really noticeable to most people, but the same amount of temperature increase in the ocean can have significant impacts. Atlantic ocean water warmed by a degree or two is moving up to the glaciers through Greenland’s deep fjords – causing weakening and accelerated melt.

**Holes in the Ice**: Meltwater channels on the top of the Greenland ice sheet collect in surface ponds that suddenly collapse resulting in more water movement down to the base of the icesheet. This lubricates the bottom and sends the ice towards the ocean, where it pushes up to the surface filled with glacial till.

**Get your hands into the polar regions**! Learn how glaciers flow using “glacier goo” and see how ice pushes down the land in Greenland by checking out physical models of the ice and ice surfaces.

**Using Sound Waves to Image Geology Below the Ocean** - In our experiment, we show that as we pop balloons underwater, they produced sound waves. These waves travel through water and are then picked up and recorded by the hydrophone (underwater microphone). The sound waves moved at a speed of 3355mph!! Sound is a wave that sets into motion microscopic particles in the medium. Various characteristics of that motion (e.g., how fast it spreads and which path it takes) depend on the composition and structure of the material. Therefore, by measuring the intensity and speed of a sound wave we can often tell something about the properties of the material it passed through. Scientists use sound to ‘see through’ materials that we cannot see through with our eyes, for example, deep water or even solid earth!

**Floods, Earthquakes & Cyclones: Studying Natural Hazards in Bangladesh** - Using videos, posters and maps, scientists discuss their projects studying these natural hazards across the globe.

**Office of Marine Operations** - This exhibit focuses on R/V Langseth’s 2014 US Atlantic East Coast Science Cruises including NJ Margin Sea Level, USGS Extended Continental Shelf Mapping, and GeoPRISMS Eastern North American Margin project. These projects involve looking at historical rates of sea level change, mapping limits of US natural resources, and looking at rifting of the Atlantic Ocean basin and more. There is general information on the Langseth, a newly-constructed model of the vessel, and immersion “Gumby” suits for kids of all ages to try on.
15 TREE-RING LABORATORY
Join tree-ring scientists to learn how they use ancient trees to learn about historical climate, geology, and ecology to better understand the changes happening today. For the past several decades, Tree-Ring Laboratory scientists have led expeditions to stunningly picturesque and remote places around the world in search of long-lived, sensitive trees. Visit the Tree-Ring Laboratory to meet the scientists, examine tree-ring samples and view a new of field photography.

16 BATHTUB SCIENCE
Feel how a bathtub full of cornstarch and water can be used to understand the dynamics of the solid Earth.

17 LDEO CHILD DEVELOPMENT CENTER
Hands-on activities for young children and information about on-site child care in the Bright Horizons day care center.

Lamont-Doherty Earth Observatory is a unit of the Earth Institute, Columbia University.

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LECTURES AT OPEN HOUSE
Featuring Lamont-Doherty Earth Observatory and Columbia University Professors, Researchers and Scientists

Monell Building Auditorium
10:45 am  How We Can Achieve A Global Climate Change Accord
Jeffrey D. Sachs

11:45 am  Superstorm Sandy and Climate Change: Predictions and Responses, Short-term and Long
Adam Sobel

12:45 pm  Sewage Contamination and Water Quality in the Hudson River: The LDEO/Riverkeeper Partnership
Andy Juhl

1:45 pm  EarthScope Rolls off the Edge of North America: Imaging the Deep Earth
James Gaherty

3:00 pm  Career Panel: Insights from Lamont-Doherty Alumni
Moderated by Dennis Adler, Ph.D. ’82, Strategist, Clarin Road Asset Management, LLC
Zahid Aziz, Ph.D. ’11, Project Engineer, Sadat Associates, Inc.
Jishu Deng, Ph.D. ’97, Quantitative Researcher, JP Morgan
Ellen Kappel, Ph.D. ’85, President, Geo Prose
Emma Rainforth, Ph.D. ’05, Professor, Ramapo College of New Jersey

Gary C. Comer Geochemistry Building
Seminar Room, 1st Floor
10:30 am  Uplift, Flank Collapses and Mega-Tsunamis in the Cape Verde Archipelago
Ricardo Ramalho

11:30 am  Environmental Aspects of Gas Production by Hydraulic Fracturing
Martin Stute

12:30 pm  Life on the Margin – Floods, Earthquakes & Sea Level Rise at the World’s Largest Delta
Michael Steckler

1:30 pm  Dust in the Wind – The Role of Dust in the Earth
Gisela Winckler

2:30 pm  How Weather Controls Climate
Andrew Kruczkiewicz & Petro Ceccato
Marine Biology/Seismology Building
Seminar Room, 2nd Floor
10:30 am Does Anybody Really Know What Time it Is?
James Davis

11:30 am Impacts of Warming on Migratory Songbirds
Natalie Boelman

12:30 pm Exploding Volcanoes and Disappearing Glaciers: Hiking Up Kilimanjaro – Africa’s Biggest Mountain
Andrew Goodwillie

1:30 pm Earthquake Prediction in the Shadow of Chaos
Bruce Shaw

2:30 pm How Vegetation Controls Climate
Alexis Berg

Geoscience Conference Room 1st Floor
Earth2Class (E2C) Mini-Workshops
11:00 am Professional Development Opportunities for Teachers at Lamont & Elsewhere
Michael J Passow

1:00 pm Use Graphic Novels to Understand Scientific Ocean Drilling
Michael J Passow

2:00 pm American Meteorological Society Maury Project Modules
Diane Soehl Lennon

3:00 pm Professional Development Opportunities for Teachers at Lamont & Elsewhere
Michael J Passow