NORTHEAST PLANETARY DATA CENTER. P. Neivert and P. H. Schultz, Department of Earth, Environmental and Planetary Sciences, Brown University, 324 Brook St, Box 1846, Providence, RI, 02912; peter_neivert@brown.edu.

Introduction: The *Northeast Planetary Data Center* (NEPDC) is housed in the Planetary Geology Group, part of the *Department of Earth, Environment, and Planetary Science* (Fig. 1). It is separate from the research areas in order to provide free and open access for faculty, visitors, researchers, students, and educators without interfering with ongoing mission research. Through a Memorandum of Agreement with NASA, Brown funds the Data Center Manager and provides more than 1500 square feet and provides various facility services resulting in Institution-to-NASA leveraging that exceeds 1:1. Our goal is to assist, not to "do." Our primary objectives fall under several different functions:

Curation: update and consolidate duplicates, rescue/preserve primary mission products, and create stereo imaging products for display.

Research: Upgrade computers, scanning selected impact experiments for general access, participate in RPIF instructional workshops, and develop an NEPDC e-bulletin.

Education: provide large-format prints for displays, engage regional educators through our e-bulletin, provide materials for classroom activities, and assist in planetary geology workshops throughout the region.

Outreach: support planetary themed exhibits through a partnership with the Museum of Natural History, hosting special events relevant to PGGP, host open houses for the community, and supply media for press inquiries.

Curation: The *NEPDC* houses an extensive collection of hard-copy photographs (450,000), map products (>5000), and supporting materials (>3000 books/documents) from nearly all the NASA lunar and planetary missions from Ranger to now (e.g., Mariner, Viking, Lunar Orbiter, Apollo, Magellan, Galileo, etc.), as well as digital sets (3000 CD/DVD's) and supporting computer access. Materials include negatives, contact prints, enlargements, large-format mosaics and selected mission products that are not considered archival products but reference materials to be used. Nevertheless, we maintain a policy of use on site, rather than through loans. Most prints and negatives/positive-transparencies are 2nd generation distributed during or soon after planetary missions. These products are housed in large format cabinets and files and are easily accessed with guidance by the Data Manager or Director. As the first-wave of "planetary explorers" retire, the RPIF system provides a logical place to save otherwise lost materials. For example, we've rescued discarded collections and archives (USGS, Menlo Park) and received collections, such as a meteorite sample teaching set and various NASA materials from Bevan French.

Many holdings are not readily available at comparable resolution in digital form. For example, silver emulsions contain silver grains less than 0.5μm across, whereas most available high-resolution scans are at 5μm. Each single digital image of an Apollo pan frame at this resolution would require more than 0.6 Tb in storage capacity. Equally important, such images are readily available for layout and work with other digital formats, as well as supplemental high-resolution scans of selected areas. Experience demonstrates that both high-resolution and synoptic views are required for detailed geologic studies. In addition, certain image products may require days to generate, yet they are readily available here, whether as hard-copy products or in-house large-format prints.

Research: We assist researchers through special products including large-format prints for displays, mosaics and print outs upon request, and information about access to planetary data products. As a research user facility, users can maintain privacy by working in adjacent areas with designated storage areas. The facility provides materials in support of proposal preparation and mission planning or analysis. Over the last decade, we provided such materials for the *Curiosity Rover*, *LCROSS*, *M^3*, *Mars Science* Laboratory, Mars *Sample Lander*, *CRISM, Aladdin*, information for planning an asteroid defense mission, and various press releases for newly released research results. We have supported research projects by visitors from various institutions and departments including *Engineering*, *Physics*, *Vernadsky Institute*, *Harvard*, and *Rhode Island School of Design* (*RISD*). Students also use the Data Center area as their "home base" for research dealing with planetary surfaces. We have supported visiting researchers from around the world including Canada, Russia, Japan, India, Argentina and France. Because our collections represent unique materials, they require more than just where they are but also what they can be found. We can explain how to use them and what else might be available, whether in hard or digital formats, the reason why the materials are not simply housed in a library.

Higher Education: The NEPDC provides materials, displays, and workspace for various classes at Brown including: *Mars, Moon Earth*; *Planetary Geology*; *Planetary Impact Cratering*, *Galilean Satellites of Jupiter*; *Hydrological Cycle on Mars*; and

Planetary Volcanism. In addition, we provide material for astronomy classes (Physics Department) upon request. The *Rhode Island School of Design* (*RISD*) makes annual visits to the NEPDC in order to access materials in support of their *Extreme Design* course, and Brown engineering students in a systems engineering class have visited in order to constrain their proposed missions. Computers in the Data Center are also available for class projects or assignments.

Pre-College Education: One of our mandates is to bring results of planetary research into the classroom. We do this through partnerships with other programs/institutions, on-site classroom visits, on-site classes, and educator workshops. We partner with several institutions involved in pre-college education such as the *NASA Rhode Island Space Grant Consortium*; *NSF GK-12* Program Brown University *Summer Programs*; *Roger Williams Museum of Natural History* (*MNH*, Providence), *Cormack Planetarium*; and *Ladd Observatory* (at Brown). One of our most significant pre-college (and outreach) collaborations has been with the *MNH* and their frequent educator workshops. Our Data Center provides materials (prints, maps, lithographs) and resources (information about current missions) for various educator workshops and *Summer Space Camps*. Such educator workshops are typically linked to an ongoing exhibit in the museum's designated "*NASA Room*" where we provided content and products (*see below*). The Director (as well as other faculty and graduate students from the Planetary Geology Group) supports these workshops through presentations and preparation of new materials. Graduate students often use the facility to support one-week courses for high school students focusing on planetary themes through the *Brown Summer Program*. Hence, this facility provides a focal point for classroom visits and presentations including high-school classes throughout the region (e.g., Moses Brown, Wheeler School, Central Falls Middle School, Woonsocket, etc.).

Public Support: Another requirement is to hold open houses each year. We do this both through on-site open houses but also through annual "home-grown" planetary-themed exhibits through partnership with the *MNH*. Examples include: *Icy Worlds and the Discoveries of DAWN & New Horizons*, *A New Perspective on Mars: Mars 3D*, *Mission Moon: Past, Present, Future*, *Saturn*: *Images from the Cassini-Huygens Mission*, and *Trekking across Mars with Curiosity.* Beyond RI, we have supported exhibits at the *Musee d'art Moderne and Astronef Planetarium* in Saint-Etienne, France and *From the Moon*: *Mapping and Exploration* at the Halsey Institute (College of Charleston). Such exhibits broaden exposure to the NEPDC resources and planetary materials and reach well beyond the space available, on campus with an annual exposure now exceeding 38,000 visitors and 10,000 students (over 250,000 in the last 5 years). The *NEPDC* is clearly acknowledged in the entranceway with brochures made available. The *MNH* staff use such exhibits as tools for educator workshops and school-group lessons. Through the *NEPDC*, we also provide public lectures to community groups (e.g., astronomy and gem/clubs, *Stellafane Convention,* Vermont) throughout New England. The NEPDC is frequently used as a backdrop for press releases or international documentaries and we host timely events, such as the encounters, launches, landings, and NASA press events.

Other Activities: Through a special group arrangement, each RPIF was able to purchase a *Magic Planet* that is used to illustrate different planets on a sphere. This capability also has led to developing new NASA images for projection not only in this system but also for Full-Dome projections at the *Cormack Planetarium* (Providence). Finally, the NEPDC has been a leader in developing, generating, and expanding the use of 3D printing (Fig. 2). Over the last 5 years, we've converted DEM data into formats suitable for 3D printing and tested a variety of printing systems. Such models go beyond just tools for public awareness or teaching. They provide new perspectives that inform or demonstrate processes that can lead to new insights [1]. Over the last two years, we've supplied these data for NASA's website, as well as our own. As a sole presenter at the national GSA 3 years ago [2], this year a special poster session with more than 15 contributors [3] highlighted the use of 3D prints in different disciplines. With these data, we've also evolved into adapting these products with *Oculus Rift* in order to provide complete immersion experiences with a laptop.

References: [1] Horowitz, S. and Schultz, P. H. (2014), *Jour. of Geo. Educ.* 62, 138-145; [2] Horowitz, S. A. and Schultz, P. H. (2015), *Geol. Soc. of Amer.*, Baltimore, #29-2; [3] Horowitz, S. A. and Schultz, P. H. (2015), *Geol. Soc. of Amer.*, Baltimore, #30-10.

Fig. 1: Panoramic view of the Northeast Planetary Data Center showing large panoramic print of Gale Crater, Magic Planet, and lay-out space.

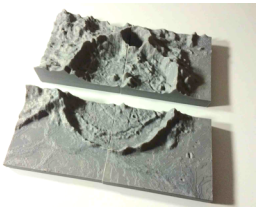

Fig. 2: Model of the lunar crater Gassendi generated from a 3D printer using LOLA data used to illustrate igneous modification of an impact crater.