A Way to Categorize Programs that Bring Data to the Classroom
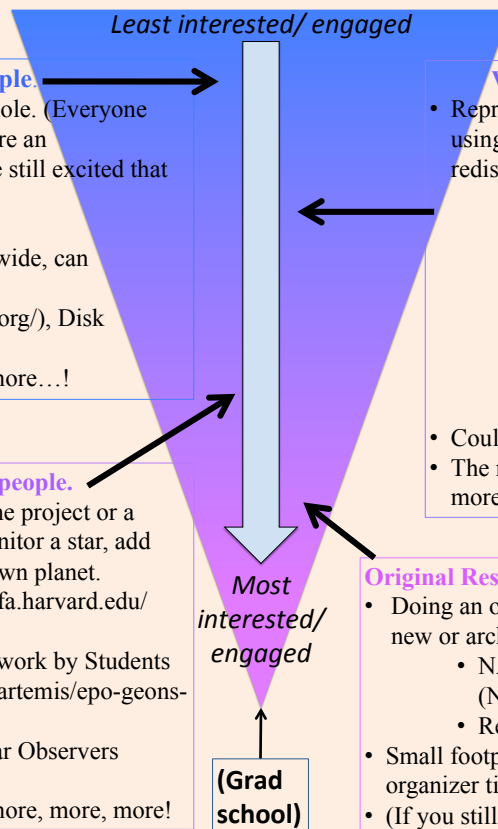
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ABSTRACT: Getting high-quality astronomical data in the grade 7-12 classroom has become much easier than ever before as a result of wide availability of the Internet in schools, easily accessible professional astronomy archives, and research-grade robotic telescopes. Especially in the context of new science standards in the US, schools need to be moving towards more project-based learning and incorporating more authentic scientific inquiry, so demand for programs that use real data is only expected to grow. In this poster, **I suggest a funnel as a way to think about the 'ecosystem' of projects** getting astronomical data into the hands of teachers, students, and the public.

- Wide variety of programs using astronomy data in the classroom → **ecosystem of programs**; this can also be a **funnel** to draw down the most interested participants.
- I see 4 broad categories in this ecosystem; different audiences, challenges, goals.
- **ALL are important and valid and worthy; each has a different footprint and reaches different people.**
- All the programs I know of that get real data into the hands of grade 6-12 teachers and students are collected here: http://nitarp.ipac.caltech.edu/page/other_epo_programs I welcome all contributions and corrections.

Funnel of interest

Least interested/ engaged

Most interested/ engaged

(Grad school)

Simplest citizen science – reaches many people.
- Doing something small to contribute to the whole. (Everyone plays a small role; participation does not require an understanding of the bigger picture; people are still excited that they are participating.)
- Can engage 100,000+ people per year.
- Young children through senior citizens, worldwide, can participate.
  - Zooniverse (https://www.zooniverse.org/), Disk Detective, etc.
- The most enthusiastic participants may want more…!

Working with Real Data – reaches fewer people.
- Reproductions of done projects or simple projects, using real data (professional or good amateur); ex: rediscover Hubble's Law using data.
  - SDSS Voyages (http://voyages.sdss.org/)
  - Research Based Science Education for Undergraduates (RBSEU; http://rbseu.uaa.alaska.edu/)
  - Pulsar Search Collaboratory (PSC; http://pulsarsearchcollaboratory.com/)
  - International Astronomical Search Collaboration (IASC; http://iasc.hsutx.edu)
- Could be a lab exercise or independent work.
- The most enthusiastic participants may want more, more…!

Contributing Real Data – reaches even fewer people.
- Doing a project using new data collected for the project or a combination of new and archival data. Ex: monitor a star, add new data to prior monitoring, and find the known planet.
  - MicroObservatory (http://mo-www.cfa.harvard.edu/MicroObservatory/)
  - Geomagnetic Event Observation Network by Students (GEONS; http://cse.ssl.berkeley.edu/artemis/epo-geons-program.html)
  - American Association of Variable Star Observers (AAVSO; https://www.aavso.org/)
- The most enthusiastic participants may want more, more, more!

Original Research – reaches very few people.
- Doing an original research project using professional-quality new or archival data.
  - NASA/IPAC Teacher Archive Research Program (NITARP; http://nitarp.ipac.caltech.edu)
  - Research Experiences for Teachers (RETs)
- Small footprint: very few people per year. High ratio of organizer time per participant.
- (If you still want more, it might be time to look at grad school. ☺)

- **Feeding the funnel**: Referrals to other programs in the ecosystem can help broaden the entire community of trained teachers and students.
- How to keep participants engaged after your program? If limited resources, what fraction goes to 'repeat customers'? Refer them to other projects in the ecosystem!
- One project alone can't populate the whole funnel; different levels require vastly different approaches and time investments per participant. **But we can reach everyone as a group!**
- **Broaden the funnel**: engage under-represented minority and differently-abled audiences.

Standalone lessons "reach up the funnel" – they are useful to those who find it on their own. Materials provide advertising for the program. The more interaction a project requires (more organizer time per participant), or the more integrated/specific the materials are for the project, the more difficult it is to distribute the material widely independently of the project.