Grand Challenges Modules for Freshmen Engineering Courses and Outreach
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Examples of Engineering Grand Challenges Module Content

### Provide Access to Clean Water
[https://nanohub.org/resources/27268](https://nanohub.org/resources/27268)
- Students sample water from around campus and perform
  - Bacterial growth before and after filtration using various media including silver nanoparticle paper
  - Chemical tests with Bluetooth enabled Exact iDip Photometers and phone app
  - Discussion of recent local and national water issues
  - Data sets used to teach Excel skills, significant figures, precision and accuracy

### Restore & Improve Urban Infrastructure
[https://nanohub.org/resources/27312](https://nanohub.org/resources/27312)
- Includes roads, buildings, bridges, utilities, and internet infrastructure
  - Importance of coatings
  - Photoactive paint
  - Hydrophobic coatings
  - Anti-graffiti paint
  - Insulation
  - Aerogels
  - Strength of materials
  - Biomimicry
  - Nanoscale structure
  - Discussion of current issues

### Reverse Engineer the Brain
[https://nanohub.org/resources/27050](https://nanohub.org/resources/27050)
- Lively discussion of science fiction versus science fact and engineering ethics
- Students perform two-point distinction tests on hands and arms
- Visualizing brain waves and communicate via blinking with consumer grade EEG headsets
- Magnets, filings, and ferrofluid probes are used to detect hidden objects encased in a plaster of Paris “brain.” Demonstrates importance of nanotechnology for tumor detection and treatment

### Make Solar Energy Economical
[https://nanohub.org/resources/24553](https://nanohub.org/resources/24553)
- Students conduct experiments on inexpensive solar panels in sun and shade
- Learn how to use a multimeter
- How to calculate power
- Students watch Delicious New Solar Technology1 video and then make and test solar cells using similar procedure
- Students summarize and reflect on what they have learned from activities, presentations, and online research in a team lab report

### ABET Alignment (Access to Clean Water)

| a. Mathematics, science, and engineering | Calculation of $[CaCO_3]$, $[H^+]$, $[OH^-]$ |
| b. Conduct experiments, analyze data | Testing of local water sources, analysis of class data set, lab activity and analysis |
| d. Multidisciplinary teams | Team lab project and report |
| e. Professional and ethical responsibility | Importance of access to clean water grand challenge |
| g. Communication | Written report including tabular and graphical communications |
| h. Societal context | Importance of access to clean water grand challenge |
| i. Life-long learning | Changes in water supply, development of new technologies |
| j. Contemporary issues | Flint MI and Tri State Water Wars |
| k. Modern engineering | Improved Excel skills, use of test strips and meters |

(c, e not addressed)

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