

# How SMALL is small?

## Educator Guide



### ACTIVITY: HOW SMALL IS SMALL?

#### Big Idea:

Show students the vast size differential of nanoscale compared to visible scale objects.

#### Guiding Question

How big a difference is there in size between nanoscale and visible scale objects?

#### Note To Classroom Educator:

We are so glad you have chosen to welcome a content expert into your teaching environment to share their excitement about engineering and STEM careers with your students. Use the resources provided in this guide to prepare your students before the visit, assist the content expert during their visit, and for follow-up with your students after the visit to make this experience as impactful and productive as possible.

Be sure to have a conversation with your classroom visitor at least one week in advance of their scheduled visit to discuss the timing for their arrival, including security and general visitor protocol for your school or teaching environment. Let them know how much time they will have (if any) in your educational environment to set up before the instructional period begins. Let the content expert know how many students are in your class and inform them about the technology availability and capabilities in your classroom. For example: Do you have a way to show a streaming video? Do you have a projector or a smart board? Is your classroom set up for mac or PC use?

Share any classroom management techniques you use during instruction so your classroom visitor can communicate effectively with your students. Example: "I clap three times to refocus my students' attention when they get off task." "I whisper directions as a signal for my students to quiet down." The content expert will be interacting with the whole group of students at times and will also want them to work in small groups during his/her visit. Please divide the classroom into well-thought-out working groups of 3-4 students each before the classroom visit. Let the classroom visitor know how many small groups there will be so they bring enough supplies for each group.

#### Prepare Your Students For The Classroom Visit

Visit [www.classroom-engineering.org](http://www.classroom-engineering.org) and open How Small is Small activity, to see the classroom visitor's detailed instructions for using this activity with your students.

Use all or some of the pre-visit resources below to engage your students with the nanoworld and to help them understand scale.



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### Background Information for the Classroom Educator

Nanoscale—Things that are very, very small; too small to see with a standard microscope.

S.E.M. (Scanning Electron Microscope)—This is a sophisticated microscope that enables scientists to view objects at the nano level.

Nanotechnology is the precision placement, measurement, manipulation, and modeling of individual or small groups of atoms or molecules.

### Pre-Visit Resources and Activities

- Use the National Geographic Mysteries of the Unseen World collection [http://education.nationalgeographic.com/education/mysteries-unseen-world/?ar\\_a=1](http://education.nationalgeographic.com/education/mysteries-unseen-world/?ar_a=1) to engage students and provide some context and relevant background information:
  - Media Spotlight: National Geographic: Nanoscience—A New Frontier  
[http://education.nationalgeographic.com/education/media/nanoscience/?ar\\_a=1](http://education.nationalgeographic.com/education/media/nanoscience/?ar_a=1)
    - Short video: Substances in the nano world behave differently, leading to ideas that may revolutionize medical treatments, including those for cancer.
  - Media Spotlight: National Geographic: Nano World—Try These Particles on for Size  
[http://education.nationalgeographic.com/education/media/nano-world/?ar\\_a=1](http://education.nationalgeographic.com/education/media/nano-world/?ar_a=1)
    - Short video: The technology that lets us look into the incredibly small nano world enables scientists to prove years of scientific discovery and create amazing nano devices.
  - Activity: National Geographic: Properties of Matter—Macro to Nano Scale  
[http://education.nationalgeographic.com/education/activity/properties-matter-macro-nano-scale/?ar\\_a=1](http://education.nationalgeographic.com/education/activity/properties-matter-macro-nano-scale/?ar_a=1)
    - Through a series of video and hands-on demonstrations, students explore and discuss how certain properties of matter change at the nanoscale.
  - Article: National Geographic: Smart Shirts—Nanotechnology will change the way we think about our clothes  
[http://education.nationalgeographic.com/education/news/smart-shirts/?ar\\_a=1](http://education.nationalgeographic.com/education/news/smart-shirts/?ar_a=1)
- Pre-teach relevant vocabulary: pygmy shrew, protozoa, molecule, atom, quark, hydrophobic, nanotechnology, macro, micro, nano, sequence, silicon dioxide, and nanoparticle.
- Show and discuss some comparison examples from the nano scale:  
[http://www.nano.gov/sites/default/files/nanoscale7\\_0.jpg](http://www.nano.gov/sites/default/files/nanoscale7_0.jpg)
- Provide examples of current nanotechnology:  
<http://www.nanoprotect.co.nz/what-is.htm>  
<http://www.nanotech-now.com/current-uses.htm>

### Post-Visit Resources and Activities

- Review relevant vocabulary/concepts: pygmy shrew, protozoa, molecule, atom, quark, hydrophobic, nanotechnology, macro, micro, nano, sequence, silicon dioxide, and nanoparticle.
- Extend the pictorial timeline with additional macro, micro, and nano images.
- Activity: Butterfly images (1 at macro scale, 1 at micro scale, and 1 at nano scale)  
<http://www.nnin.org/sites/default/files/files/Lesson%2B3%20v2.pdf>

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### For Further Exploration

- Future of Nanotechnology  
<http://science.howstuffworks.com/nanotechnology4.htm>
- Hydrophobic Dry Nanotechnology Demonstration  
<http://www.youtube.com/watch?v=i4J6uC22Hwo>

### National Standards Alignment

- National Science Education Standard: (K-4) Standard A-1: Abilities necessary to do scientific inquiry
- National Science Education Standard: (K-4) Standard E-2: Understandings about science and technology
- Math Standard: Measurement: (preK-4) Standard 2: Apply appropriate techniques, tools, and formulas to determine measurements