Magnet Detector

Demo instructions

Be confident when talking about the lab - you know more than they do!

Stick to the positive messages NSCL wants to convey:

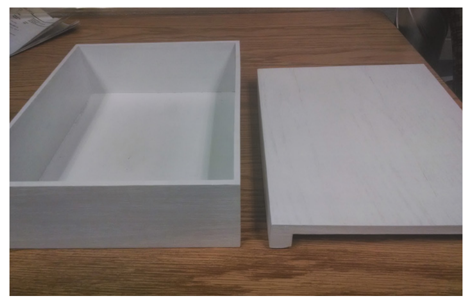
- *We do world-class research (top 3 for rare isotope)*
- *We educate new nuclear scientists (#1 grad program in US)*
- *Our safety record is excellent*
- *We are good for Michigan: high-tech jobs and federal funding*
- *If you're not sure of an answer, it's OK to say "I don't know"*

Thanks for volunteering! This demo is a pretty simple way to show people how scientists "observe the unobservable". You'll need some or all of the following equipment (provided by Zach Constan, outreach coordinator):

- Wooden Detector box
- Geiger counter
- Aluminum plate
- Rad source (mantle or plate)
- Iron filings
- Glass marble
- Ball Bearing
- Neodymium sphere magnet
- 2x plastic half-pipes
- Roll of tape

Before the demo

Remove the lid from the box. Pour some iron filings into the box and shake or tap it to make them settle. Put the plastic barrier in the box over the filings (protects visitors). Make sure there's a clear space about twice the size of the box - often, the easiest way to set up an experiment is to place the box next to the lid while you're working.



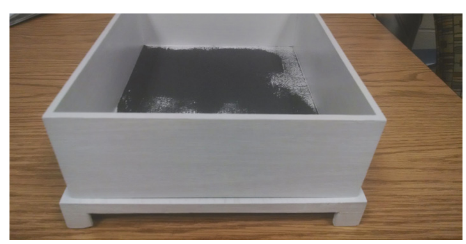
During the demo

Everything is made of tiny particles called atoms (you, me, the floor, the air...), and the nucleus of the atom is incredibly small, so you can't see it. But how do we know it's there?

Show them the neodymium magnet!

You can see this magnet, but if I put it under this box... (Put the magnet under the lid) *You can't see it now, so how do you know it's there? Nuclear scientists use detectors that react to the presence of nuclei - you can't see nuclei, but you can see how they affect the detector. We need a detector for this magnet.*

Take the magnet out, put the box with iron filings on top of the lid.



Do you know what these are? Iron filings are tiny bits of metal that are so light, they are easily affected by magnetic fields. They will be the detector.

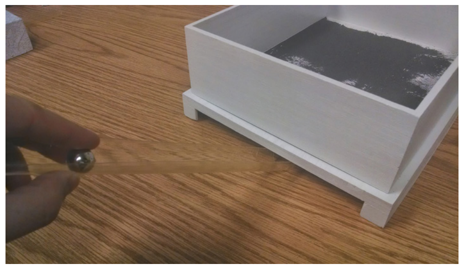
Roll the magnet underneath. *Now do you see where it is? Not only that, you can see its path! Some detectors can do that for the nucleus. Instead of iron filings, they might generate light or electricity in reaction to the nucleus - that's how you know where it is.*

During the demo con't

Remove the magnet. Show them the glass marble. *Will your detector be able to show you where this goes? Why?*

Roll the glass marble underneath. *No effect, as you expected! Is there a way this detector could observe this glass marble?*

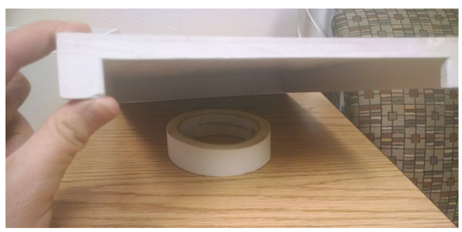
Put the plastic half-pipe on the table with the magnet near one end. Place the lid over it so the magnet is nearly centered underneath and the pipe sticks out. Use the other half-pipe as a ramp to roll the glass marble under the lid and into the magnet.



The iron filings didn't move for the glass marble, but they show how the magnet was affected by it! Some nuclear detectors work like this to detect neutrons, which are neutral and have very little interaction with other particles.

What if there's something else under there that you want to see, but doesn't affect the iron filings? You could see how it affects your magnet!

Put the roll of tape on the table and the lid over it with the tape centered underneath. Use the half-pipe as a ramp to roll the magnet under the lid, aiming at the tape.



How do you know there was something in the way? Was that object heavier than your magnet? What else could you find out about the object with more tries? Real detectors can be used to measure the size and shape of nuclei based on how things bounce off of them!

We made this demonstration with materials bought at the store. Where do you think real nuclear detectors come from? Scientists imagine them, engineers design them, chemists create the materials, machinists shape the parts... nuclear science needs lots of people with different skills to work!

If you have time, show them a real nuclear detector - the Geiger Counter (in the business card box). *The radioactive source (thorium lantern mantle or piece of Fiestaware plate) emits alpha and beta radiation (in harmless amounts), which create electric current when they hit this tube. The aluminum plate blocks nearly all of the radiation.*

If you are getting lots of questions and have more people waiting, encourage them to take Zach's card and send email!

Cleaning up

Remove the plastic barrier, tilt the box and let all the iron filings slide down into one corner. Warning: they tend to go all over, so be careful! Take the lid off the filings container and pour them back in. Try to fit everything back in the box the way you found it.