Activity: Making Inferences

From what we can see, the universe doesn't add up. Estimates based on the amount of matter detected from Earth suggest that our universe should be rapidly expanding. But studies of the spectral fingerprints of stars don't show this expansion. That's why scientists believe there is a good deal of matter we can't see. Even though this dark matter is undetectable, its gravitational force produces the universe expansion pattern we detect.

This activity page will offer:
• An exploration in "black box" inquiry
• An arena for critical observation and analysis
• A chance to engage inference skills

Making Guesses
Much of what we theorize about the universe is based on inferences. Scientists make these inferences based on hard data collected from Earth-bound instruments. In this activity, you'll get to act like a scientist and make guesses.

Materials
• Cardboard pizza box
• Magnets
• Graph paper
• Tape
• Steel ball bearing

Procedure
1. Work in teams of two. Take a cardboard pizza box and an assortment of magnets.
2. Use scissors to carefully remove the lid of the box.
3. Cover the inside bottom with graph paper. Develop a coordinate numbering system that will allow you to identify any location on the grid.
4. Turn the box over. Use tape to secure a variety of magnets to the underside of the box.
5. Turn the box right-side up. Exchange boxes with another team.
6. Place a steel bearing in the box.
7. Determine the location of the magnets by observing the behavior
of the rolling ball.
8. Record the most likely location using the coordinate system labeled on the graph paper.
9. When you have identified the positions of the magnets, turn the box over. How close were to you identifying each position?

Questions
1. What sorts of clues did you use to uncover the placement of the hidden magnets?
2. How did the magnets affect the movement of the steel bearing?
3. Would a larger box make the task easier or more difficult? Explain.

**Bonus Activity: Shaping Up**
Create a basic geometric shape out of scrap cardboard. Secure the shape in the center of a pizza box with tape. Place a marble or small ball in the box.
Close the box and tape the lid shut. Exchange the mystery box with another student. Without opening the box, try to figure out the identity of the hidden geometric shape.

**Bonus Activity: Shakin' It Up**
Obtain several small plastic canisters (not transparent!). Add a spoonful of a material such as dried beans, rice, gravel or salt to each container. Mark the containers and seal them with tape. Exchange sets with another student. Without opening the film canisters, can you infer the contents of each?

**Bonus Activity: Create Your Own Inference Test**
See if you can hide an object in some kind of container that can not be detected simply through normal vision. To infer facts about your hidden object, what kinds of inferences must be made and which of our senses, tools and understanding of scientific disciplines (physics, chemistry, geology, etc.) must be used?
Web Connection

Cosmos in a Computer
http://archive.ncsa.uiuc.edu/Cyberia/Cosmos/CosmosCompHome.html
This site, known as "cosmos in a computer," offers background on the universe, including animated clips of its evolution.

Dark Matter
http://astron.berkeley.edu/~mwhite/darkmatter/dm.html
This site presents a basic overview of dark matter.

HubbleSite-Universe
http://hubblesite.org/discoveries/hstexhibit/universe/
This site discusses the Hubble space telescope and its role in cosmology.

Activity 1: Grades 9-12
Making Inferences Questions & Answers

1. What sorts of clues did you use to uncover the placement of the hidden magnets? (Sounds made by rolling steel bearing, the feeling of the marble as it moved in box.)

2. How did the magnets affect the movement of the steel bearing? (The magnets exerted a force that redirected the path of the steel bearing. If the magnet was strong enough, it stopped the bearing's motion completely.)

3. Would a larger box make the task easier or more difficult? Explain. (More difficult. Since there would be a greater area for the bearing to move within, there would be less frequent interaction with the magnetic fields.)

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Retrieved & adapted 11/19/08 from:
http://nsdl.org/resource/2200/20061003231623280T