

Dark Energy Demonstrations

Activities:

- Activity 1: Contents in the Universe
- Activity 2: Dark Energy & Acceleration of the Universe

Materials:

- Jar of beans or beads (various colors)
- Bags of balloons
- Balloon pump
- Stickers or markers

ACTIVITY ONE: CONTENTS OF THE UNIVERSE

Objective(s):

- The universe is made up of mostly dark energy and dark matter.
- The matter we see (visible matter or atoms) makes up only a small fraction of our universe (~5%).

Materials:

- Jar of beans or beads (various colors for the fraction of each. Example: Green beads 5% in jar to represent visible matter, brown beads 25% in jar to represent dark matter, black beads in jar 70% to represent dark energy.)

Hook:

- *Are you curious about what's going on here? (point to the jar of beads)*
- *Would you like to learn about dark energy and/or dark matter?*
- *Have you ever wondered how much of the universe we can see with our eyes?*
- *Are you curious about how much of the universe we don't understand completely?*

Ask: What color in this jar represents the matter we can see with our eyes? (point to jar) How about the other colors? (point to jar)

Explain: This represents all the contents of the universe as we know it. The lightest color represents all the matter we can see (like you and me, everything on Earth, plants, animals are all made of atoms). While the darkest color (most likely black) of beads represents dark energy. The second darkest color represents dark matter.

Ask: What percentage of the universe (out of 100) do you think is the visible matter we can see? (point to the light color beads in the jar) What percentage out of 100 do you think is dark energy? dark matter? (point to the darker color beads)

Explain: Visible Matter (light color beads) make up only 5% of the contents of the known universe. Dark matter makes up around 25% of the universe (second darkest color beads). Dark energy makes up almost 70% of the universe (darkest color beads). Therefore, around 95% of the universe we don't fully understand.

End:

Remember that everything, including you, is within this contents of the universe

ACTIVITY TWO: EXPANSION OF THE UNIVERSE

Objective(s):

- The universe is expanding at an accelerating rate, causing galaxies and galaxy clusters to move away from each other.
- The acceleration is caused by what we call *dark energy*.
- There are different theories for how this acceleration will effect the universe (ie. How the universe will end). For example: the “*Big Rip*” or the “*Big Crunch*.”

Materials:

- Balloons
- Balloon pump
- Stickers or markers

Hook:

- *Are you curious about how our universe is changing over time?*

Ask: (Point to balloon) Would you like to draw your own galaxies on this balloon? (or have dots or small spirals drawn on the balloon already, depending on the age/capability of the students)

Low and No-touch provision: The facilitator draws the dots or puts stickers on the balloon.

Explain: This balloon is the universe, and this is what it looks like right when the Big Bang occurred at the beginning of time

Ask: (pick up the balloon pump) If I begin time by pumping up this balloon, what will happen to the universe (or the balloon)? (Students might say: It will get bigger) What would happen if I started pumping up the balloon faster (Students might say: It will get even bigger or even pop)

Explain: After the Big Bang the universe started to expand (inflating the balloon) at an accelerating rate (pumping up the balloon faster). Over time this expansion got faster and faster caused by a mysterious energy we call dark energy. We don't know exactly what dark energy actually is, but we can infer it's there from other observations of galaxies we can see. For example: If you go to bed and your backyard is dry and you wake up in the morning and see puddles on the ground, you can infer that it rained last night. Even though you did not directly observe the rain.

Ask: Do you notice anything different about the galaxies/dots on the balloon? (Try to point out that the dots are now farther apart from each other)

Explain: As the universe expands this causes galaxies and galaxy clusters to move farther and farther away from each other.

Ask: What will happen if I keep pumping up the balloon? (Students might say: It will pop!) (take the balloon off the pump and hold it up) What might happen if I let go of the balloon? (Students might say: It will fly around / lose air / get smaller)

Explain: Different theories of how our universe will end (there are others! And we don't know exactly what will happen, again these are theories!). The "Big Rip" will result in the expansion rate continuing to accelerate and eventually pull contents of the universe (ie. Stars, galaxies etc.) away from each other, "ripping" things apart (like the balloon popping). The "Big Crunch" will result in the opposite of the "Big Rip" in that the universe will stop expanding and collapse back down to how the universe started with the Big Bang (like the balloon deflating and looking like what it did at the beginning of the demonstration).

Note: You can assure students that this will be WAY after (billions of years, perhaps even humanity) we are gone!!