# Cosmic Collisions

## A Pre-Visit Information Guide for Teachers

**Meets Next Generation Science Standards: 5-PS2-1, 5-ESS1-1,2, MS-PS2-1,4,5, MS-LS4-1, MS-ESS1-1,2,3**

This may be the first visit to the Planetarium for many of your students. We have found that both cognitive and affective learning can be increased when teachers use structured activities before and/or after the visit to create a context for the experience and link with the classroom instruction. In this guide we have provided some interesting facts about the Cormack Planetarium and include background information about the astronomy content that will be presented in ***"Cosmic Collisions."*** We encourage teachers to conduct pre-visit and post-visit classroom discussion and activities with their classes to make the most of their field trip experience.

## ABOUT THE CORMACK PLANETARIUM:

- In a planetarium, objects in the universe are projected, as they exist at any time in space.
- These celestial objects are projected onto a dome-shaped ceiling so it appears that one is looking up into the night sky.
- Our Star Projector is capable of displaying images of over 7,000 stars…many more than anyone can see without the aid of a telescope. Planets, comets, satellites and the Milky Way and Andromeda Galaxy can also be projected.

## COSMIC COLLISIONS:

**The universe is dynamic.** Everything in the universe changes. All **stars**, including our Sun, are born, shine for millions to billions of years, run out of fuel, and die. **Galaxies** can grow by cannibalizing their neighbors. Even the universe itself is evolving: it grew from a tiny, dense fireball over 13 billion years ago and continues to expand.

**Collisions in space release enormous amounts of energy.** Massive impacts — some as violent as the explosion of 10 thousand billion, billion, billion, billion atomic bombs — are the natural outcome of the motion of celestial objects. Collisions smash **asteroids** apart, created our Moon, power the stars, and build giant galaxies. For us, the most important impacts occur when particles smaller than atoms collide and rearrange matter, releasing **energy** as light and heat. That's what's happening by the trillions, every second, inside our Sun — and in other stars as well.

**Collisions transform.** Everywhere in the universe, collisions smash things apart, bring them together, and generally leave **planets**, stars, and galaxies very different than they were before. Earth is no exception: life has been transformed — maybe even made possible — by collisions. Notably, sixty-five million years ago an Everest-sized asteroid smashed through Earth's atmosphere, contributing to the extinction of 85% of Earth's species, including most dinosaurs. Yet this catastrophe gave rise to new ecological niches — including the one humans now occupy.

**The cosmic scale of time and space is huge.** There's a reason it's called space. Our Solar System is billions of miles across: to us a vast and largely empty expanse, but tiny compared to the typical distance between stars. Light from the most distant galaxies can travel for billions of light-years before it reaches us, and a light-year (the distance that light can travel in a year's time) is

nearly six trillion miles! Time scales are also huge. The universe is 13.7 billion years old. Our Solar System, the Sun and the Earth, came into existence 4.5 billion years ago. The ancestors of humans may have walked on Earth 6 million years ago — an immense stretch of time, but less than 0.2% of the age of the universe. And, like the collisions that power the Sun, cosmic events can occur in the blink of an eye.

**The laws of physics are the same throughout space and time.** Fundamental physical forces, such as **gravity** and **electromagnetism**, operate everywhere to keep the universe in constant motion. The same laws that pull a fly ball down towards the field also pull giant galaxies towards each other. The processes we can observe from our perch on Earth — like the **Aurora Borealis**, planetary impacts, and galaxies colliding — are happening through-out the universe, just as they have since the Big Bang and always will. The universality of nature's laws makes it possible to under stand things that happened far away and very long ago, and to predict how celestial bodies will move and change in the future.

**The Earth system has natural defenses.** Produced by the rotation of the planet's liquid outer core, the Earth's magnetic field shields us from energetic particles in the **solar wind** that streams off the surface of the Sun at more than a million miles an hour — and which can damage DNA in living organisms. The atmosphere also protects us: most of the tons of rock and dust from space that collide with Earth every day burn up through friction before they hit the ground.

**We can use knowledge and technology to protect us.** Collisions with bigger objects, like **comets** and asteroids, are extremely rare, but they do happen. However, unlike the dinosaurs, we know why collisions happen and can see what's coming. Scientists have been mapping the sky in ever-greater detail to track any possible threat while it's still many years away. Our knowledge — and perhaps our ability to navigate the solar system — could help us protect our planet in the future.

## SUGGESTED CONCEPTS TO REVIEW INCLUDE:

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| METEORITE | ORBIT | PLANET FORMATION |
| COMET | SOLAR WIND | SOLAR SYSTEM |
| MOON | AURORA BOREALIS | IMPACTS |
| ASTEROID | MAGNETOSPHERE | GALAXY |

## ACTIVITIES:

Teachers are encouraged to conduct pre-visit and post-visit classroom discussions and activities with their classes to make the most of their experience. This show was produced by the American Museum of Natural History. Please visit the website of the Cosmic Collisions Educator Guide for more information and activities:
http://www.amnh.org/education/resources/rfl/web/cosmicguide/before.html