

BLACK HOLES: COSMIC ENIGMAS

DISCOVERY

Black holes are among the most mysterious objects in the universe. The pull of gravity in a black hole is so strong that nothing can escape. Vast amounts of matter are squeezed into a single point with infinite mass.

Black holes are created when large stars run out of fuel and collapse under the weight of their outer shells. Initially proposed in the late 1700s, it wasn't until the 1970s that scientists saw the first indirect evidence of black holes through high-energy X-rays from distant stars.

A black hole's *event horizon* is its "point of no return." Even at the speed of light, nothing can escape a black hole's grip past the event horizon.

INNOVATION

Black holes are extreme regions where the laws of nature are pushed to their limits – so they are ideal places to test physical theories, in order to see if/how those theories break down.

Some black holes spin and give off *gravitational waves*, which are ripples in the fabric of space and time. Many other astronomical objects, such as binary stars and supernovae, also emit gravitational waves. These waves are different than the electromagnetic waves (i.e., light) that astronomers have traditionally used to learn about the cosmos. Thanks to the development of large-scale gravitational wave detectors, we have a new window into the universe.

Perimeter researchers specializing in *strong gravity* study waves generated in regions of space and time that have intense gravitational fields. These regions are treasure troves of information about parts of the universe that are inaccessible to light (such as black holes), and about the very early universe.

IMAGINATION

We have learned a lot about black holes, yet many mysteries remain. What lies at the centre of a black hole? What can the study of gravitational waves tell us about black holes, and about the origins and structure of the universe?

