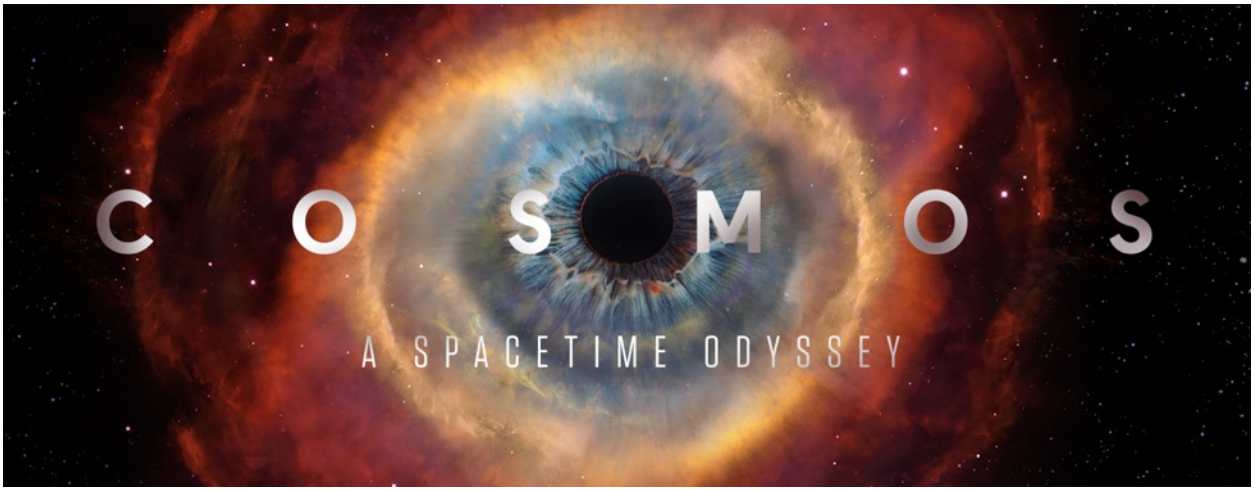

Quests and Discussions for Students, Episode 12

Written by Ann Druyan
Produced by Cosmos Studios

Overview
Episode 12, “The World Set Free,” explores our long history of alternative energy exploration, the forces which have thwarted it, and issues a challenge: for our species to rise to the occasion in ways we’ve done before, to seize a magnificent vision of the future.

Grade Levels
6-12

Episode Summary
Our journey begins with a trip to another world and time: We bask on an idyllic beach during the last perfect day on the planet Venus before a runaway greenhouse effect wreaked havoc on the planet, boiling its oceans and turning its skies a sickening yellow.

We tour the rubble in the Ship of the Imagination before traveling to Earth to climb the heights of a titanic edifice built by a tiny creature, the microscopic coccolithophore. The White Cliffs of Dover, its masterpiece, is revealed to be massive carbon vault.

Charles David Keeling discovered in 1958 that the Earth is breathing – a single breath takes a whole year. This leads us to a brief history of Earth’s atmosphere and a forensic exploration of the various hypotheses about global warming.

We take a dog for a walk at Drew Point, Alaska for an unforgettable illustration of the difference between weather and climate.

Awareness of global warming and the technology of alternative energy are nothing new. We take the Ship of the Imagination to intervene at some critical time travel nodes. A highlight is the glorious 1878 Paris Exposition where Augustin Mouchot uses his solar concentrator dish to power printing presses and ice-making machines. Then we’re off the

Maadi, Egypt of 1913, where Frank Shuman is demonstrating his massive and effective solar powered machinery for irrigating the desert.

We grapple with the conundrum of our failure to take what science is telling us to heart. We evoke the memory of other, far more “impossible”, challenges and touch on the unanticipated “gift” of Apollo – the concept of Earth in the vastness of space. The Ship of the Imagination takes off in hot pursuit of the Apollo 8 capsule on its way to the Moon.

We conclude with a breathtaking vision of the magnificent future that is scientifically and technically within our grasp, if we will only awaken and seize it.

Discussion Topics

- Discuss what great changes in the history of civilization have been brought about by climate change.
- How can we know that the climate change we’re observing is brought about by human activities?
- Natural events, both geological and astronomical, can also bring about climate change. What are some examples of this phenomenon?
- How did an intermission in one of the ice ages that Earth has experienced bring about change that affected you personally?

Online Resources

http://warmingworld.newscientistapps.com

Using this interactive online mapping tool, students can see historical global climate change from a personal perspective: by mapping how temperatures have changed over time in the very place they live (or other locations of their choosing).

https://www.youtube.com/watch?v=uSoWjC2bW2Y

Extreme sports and the extreme beauty of the Banaue Rice Terraces of the Philippines meet in this Red Bull short with wakeskater Brian Grubb. Agreements were made with local citizens to respect their traditions and culture. Ensuring protection of the environment was made a priority throughout the project.

Relevant Scenes from COSMOS

- Act One: The Heaven and Hell of Venus
- Act Two: A Detailed Diary in the Snows of Yesteryear
- Act Three: This Is Not a Disposable World
- Act Four: The Sun Belongs to All of Us
- Act Five: Shuman's 1913 Solar Plant
- Act Six: The World We Could Have

For a deeper dive, more subjects touched on in Episode 12:

- History of the planet Venus
- Venera 9 spacecraft
- Microscopic coccolithic role in White Cliffs of Dover
- Seasonal terrestrial respiration
- Keeling curve
- Climate record in 800,000 year old glaciers in Greenland and Antarctica
- Thermal infrared signature of Earth
- Volcanic activity and greenhouse gases
- Global temperature maps since 1800's
- Prediction of global warming by Svante Arrhenius in 1896

- Verification by Guy Callendar in 1938
- Carl Sagan's PhD thesis on runaway greenhouse effect on Venus in 1960
- Difference between weather and climate
- Significance of loss of sea ice and permafrost
- Solar energy output
- Solar technology at the 1878 Paris Exposition
- Solar power plant in Egypt in 1913
- The photo-electric effect
- The nature of photons
- The invention of agriculture
- The ancient Banaue Rice Terraces of the Philippines

Has **COSMOS: A SpaceTime Odyssey** been a helpful and entertaining resource in *your* classroom? Consider purchasing it on DVD or Blu-Ray!

Available for sale on June 10, 2014

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