Animation Script

futurum
Inspiring the next generation

Making nuclear-powered space travel a reality
Dr Austin Lo

To make the most out of this script, you could:

- Stick it in your notebook as a record of watching Austin's animation
- Pause the animation and make notes as you go
- Add your own illustrations to the sheet
- Create your own animation to accompany it
- Add notes from classroom discussions
- Make notes of areas you will investigate further
- Make notes of key words and definitions
- Add questions you would like answered – you can message Austin through the comments box at the bottom of his article: **futurumcareers.com/making-nuclear-powered-space-travel-a-reality**

SCRIPT:

Most of our electricity is generated by heating water and turning it into high-pressure steam which spins turbines, creating mechanical energy that is converted into electrical energy by generators. However, these systems require a lot of parts, space and ongoing maintenance.

Dr Austin Lo, Chief Research Officer at GenAlpha Nuclear Technologies, is developing a new, compact system, called SPACE-TEC, that converts nuclear radiation into electricity without any moving parts. Such a system would open up a huge range of new applications for nuclear energy – not least as a power source for the spacecraft of the future.

SPACE-TEC is based on thermionic energy conversion, or TEC, a process that involves heating up a special 'emitter' metal to very high temperatures, causing it to lose electrons. These electrons then travel across a very small gap to a 'collector' metal, creating an electrical current.

However, most TEC systems are limited by the space-charge effect, which causes electrons to build up around the surface of the emitter, creating an electric field that blocks any further electrons from being emitted. Most systems counteract this effect using a low-temperature plasma that aids the flow of electrons from emitter to collector. Unfortunately, creating this plasma uses up energy from the emitted electrons, meaning less energy is available

to convert into electricity. As a result, current TEC systems have a typical efficiency of below 7%, and have few applications beyond research laboratories.

To reduce these inefficiencies, SPACE-TEC uses a number of innovative solutions, including using nuclear radiation to heat the emitter and to create the plasma without using energy from the emitted electrons. Higher gas pressures within the SPACE-TEC system create an environment in which this nuclear radiation naturally creates the low-temperature plasma needed to conduct the electrons, meaning more energy is available to be received by the collector.

SPACE-TEC also uses specialised metal foams as the emitter and collector. These highly-porous metal 'sponges' are full of tiny holes and channels that give them a huge overall surface area, meaning there are more places for electrons to escape from the emitter and to be collected at the collector.

Thanks to these innovations, SPACE-TEC could be used to create nuclear power plants that are quick and easy to construct and transport. Not only could these smaller, simpler, cheaper power plants help us transition away from dirty fossil fuels, but they could also revolutionise space travel.

In space, it's ideal to have a lightweight, compact power source with no moving parts that might need ongoing maintenance. SPACE-TEC could therefore be the ideal system to power future space stations, rovers, or even settlements on the Moon or Mars.

What could you achieve as a nuclear engineer?