Jet Propulsion Laboratory
California Institute of Technology | Education

π IN THE SKY 11

Beam a video from space to Earth. It's possible with pi!

EXPLORE MORE: go.nasa.gov/PiDay

RECEIVER RIDDLE

In December 2023, NASA transmitted the first ultra-high-definition video from deep space using new technology known as Deep Space Optical Communications, or DSOC. DSOC uses an infrared laser to transmit data at a much higher rate than current radio transmitters. The 15-second video, featuring a cat chasing a laser, was beamed to Earth from the Psyche spacecraft at a rate faster than many terrestrial internet connections.

DSOC's transmission had to travel 30,199,000 km to reach Earth. Even traveling at the speed of light, that takes a long time! And all that time, Earth was still moving along its orbit. That meant that the team needed to aim the laser transmission at where Earth would be when the signal arrived. Given this, **how many kilometers ahead along Earth's orbit did the team need to aim the laser?**

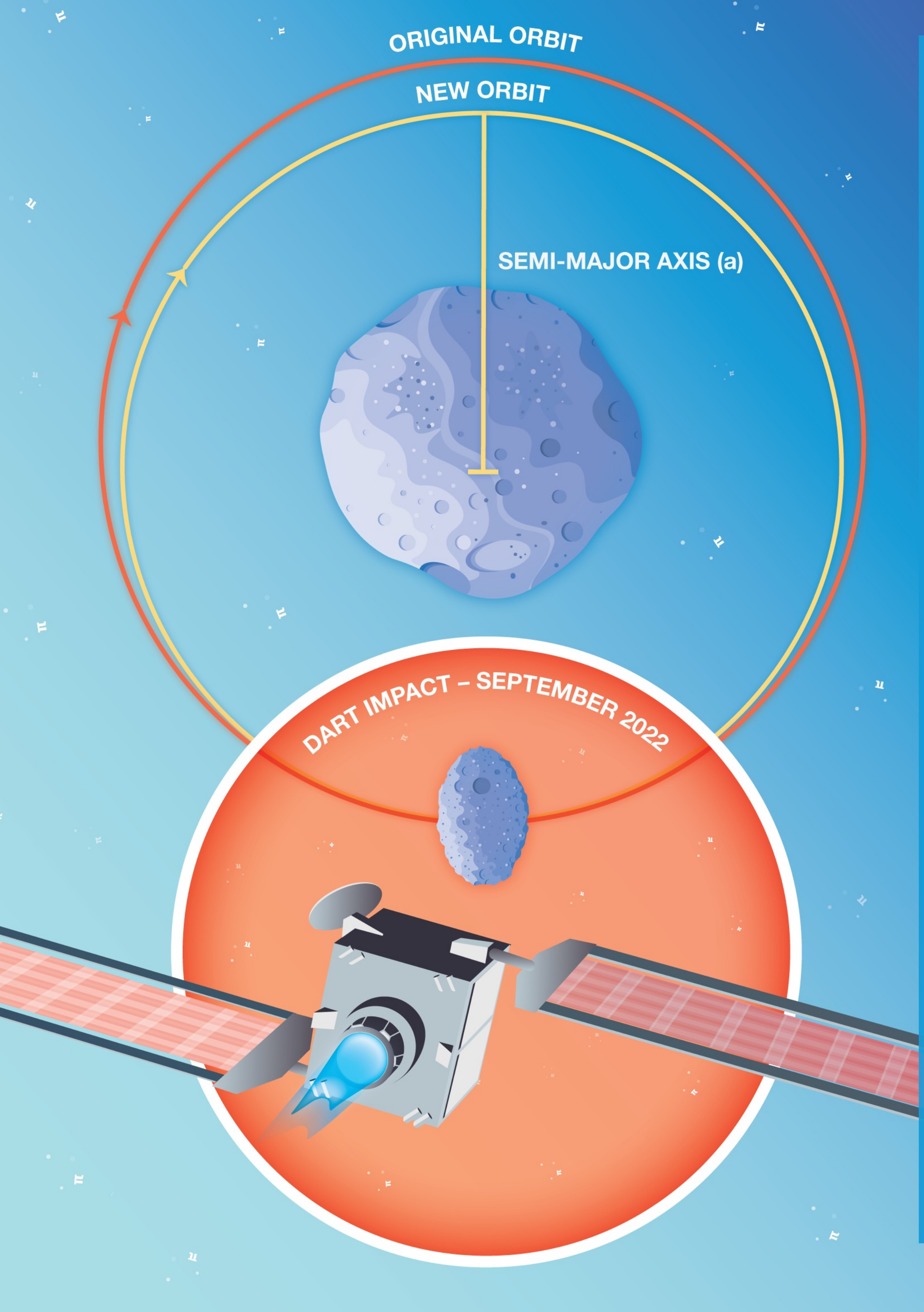
LEARN MORE
go.nasa.gov/DSOC

Jet Propulsion Laboratory
California Institute of Technology | Education

π IN THE SKY 11

Size up an asteroid's orbit. It's possible with pi!

EXPLORE MORE: go.nasa.gov/PiDay



DARING DEFLECTION

The asteroid Dimorphos has a mass of about 4.3 billion kg and orbits the larger Didymos asteroid, which has a mass of 560 billion kg. In 2022, the DART spacecraft impacted Dimorphos to see if it was possible to change its orbit.

Before the impact, Dimorphos orbited Didymos every 11 hours and 55 minutes at a distance of 1.16 km in a nearly circular orbit with an eccentricity (e) of 0. After impact, Dimorphos orbited Didymos every 11 hours and 23 minutes with an eccentricity of 0.02. Use Kepler's third law to **calculate the semi-major axis (a) of the new orbit, given that $T = 2\pi\sqrt{(a^3/GM)}$.**

T = orbital period in seconds
a = semi-major axis in meters
G = gravitational constant (6.674×10^{-11} $N{\cdot}m^2/kg^2$)
M = total mass of the binary system.

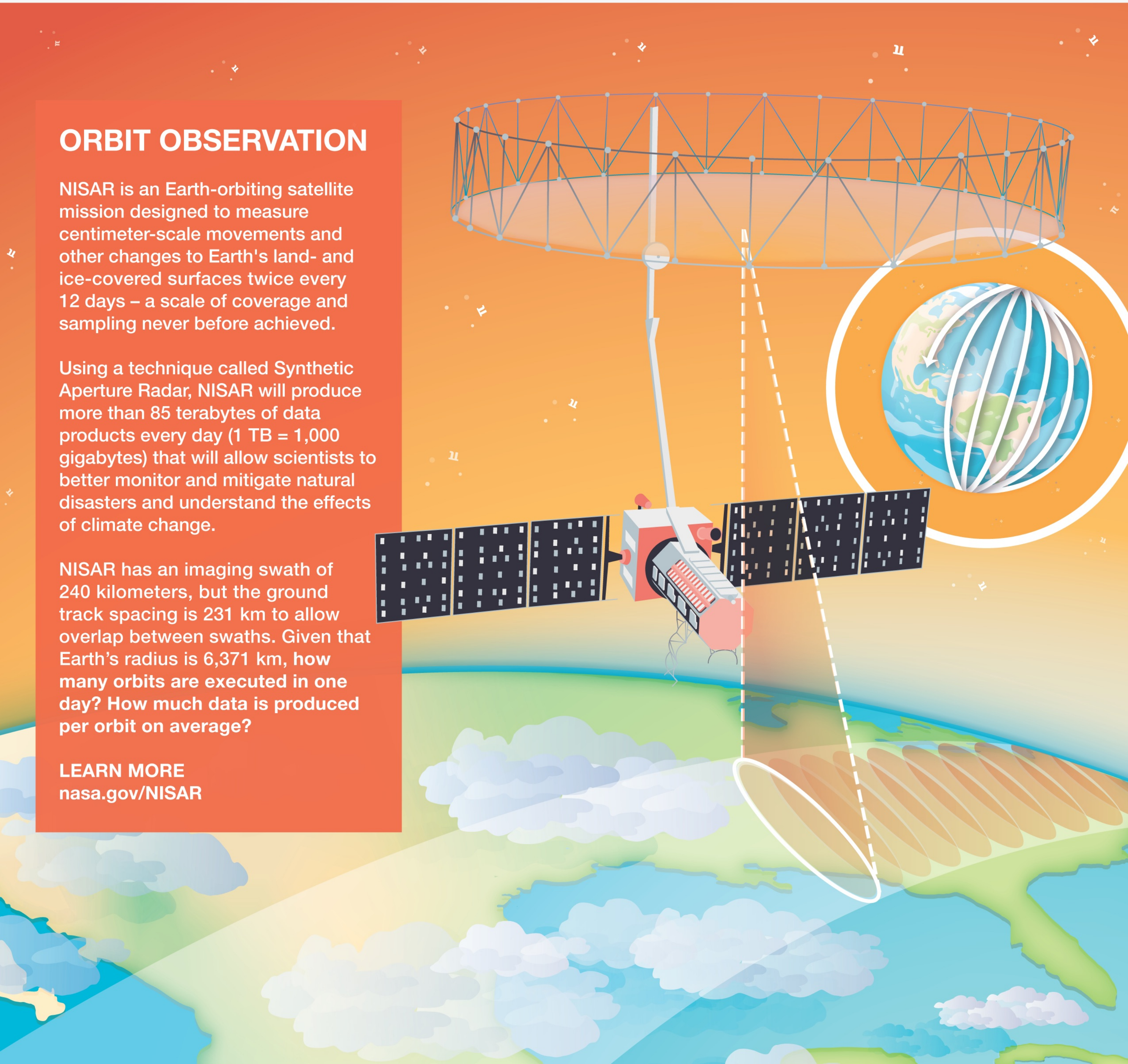
Use the semi-major axis and eccentricity to **calculate Dimorphos' farthest distance from Didymos (apoapsis = a(1+e)) and closest distance to Didymos (periapsis = a(1-e)). How do these differ from the circular orbit?**

LEARN MORE
nasa.gov/DART

π IN THE SKY 11

Determine how much data an Earth orbiter can collect. It's possible with pi!

EXPLORE MORE: go.nasa.gov/PiDay



ORBIT OBSERVATION

NISAR is an Earth-orbiting satellite mission designed to measure centimeter-scale movements and other changes to Earth's land- and ice-covered surfaces twice every 12 days – a scale of coverage and sampling never before achieved.

Using a technique called Synthetic Aperture Radar, NISAR will produce more than 85 terabytes of data products every day (1 TB = 1,000 gigabytes) that will allow scientists to better monitor and mitigate natural disasters and understand the effects of climate change.

NISAR has an imaging swath of 240 kilometers, but the ground track spacing is 231 km to allow overlap between swaths. Given that Earth's radius is 6,371 km, **how many orbits are executed in one day? How much data is produced per orbit on average?**

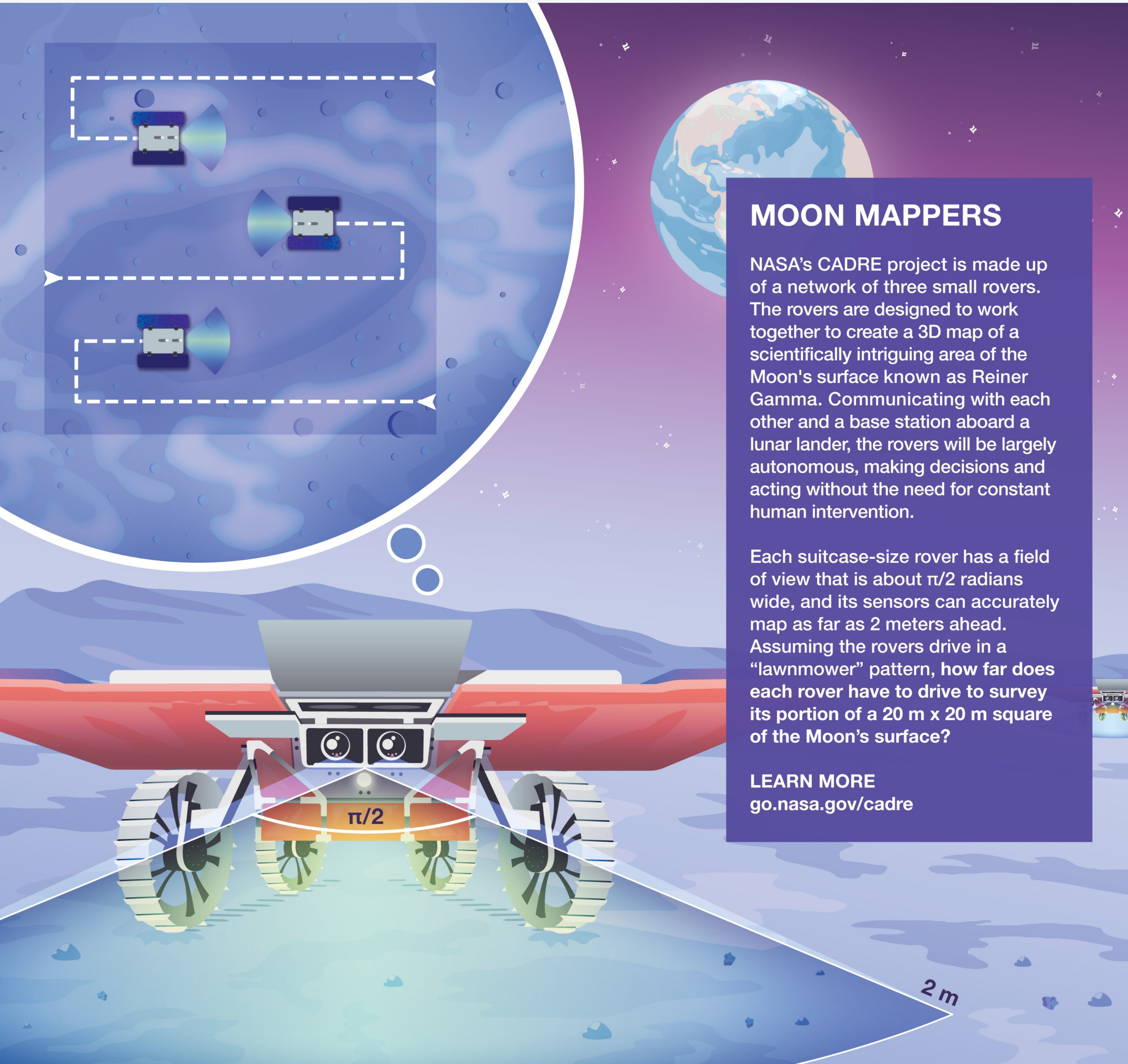
LEARN MORE
nasa.gov/NISAR

Jet Propulsion Laboratory
California Institute of Technology | Education

π IN THE SKY 11

Measure the driving distance for a team of lunar rovers. It's possible with pi!

EXPLORE MORE: go.nasa.gov/PiDay



MOON MAPPERS

NASA's CADRE project is made up of a network of three small rovers. The rovers are designed to work together to create a 3D map of a scientifically intriguing area of the Moon's surface known as Reiner Gamma. Communicating with each other and a base station aboard a lunar lander, the rovers will be largely autonomous, making decisions and acting without the need for constant human intervention.

Each suitcase-size rover has a field of view that is about π/2 radians wide, and its sensors can accurately map as far as 2 meters ahead. Assuming the rovers drive in a "lawnmower" pattern, **how far does each rover have to drive to survey its portion of a 20 m x 20 m square of the Moon's surface?**

LEARN MORE
go.nasa.gov/cadre