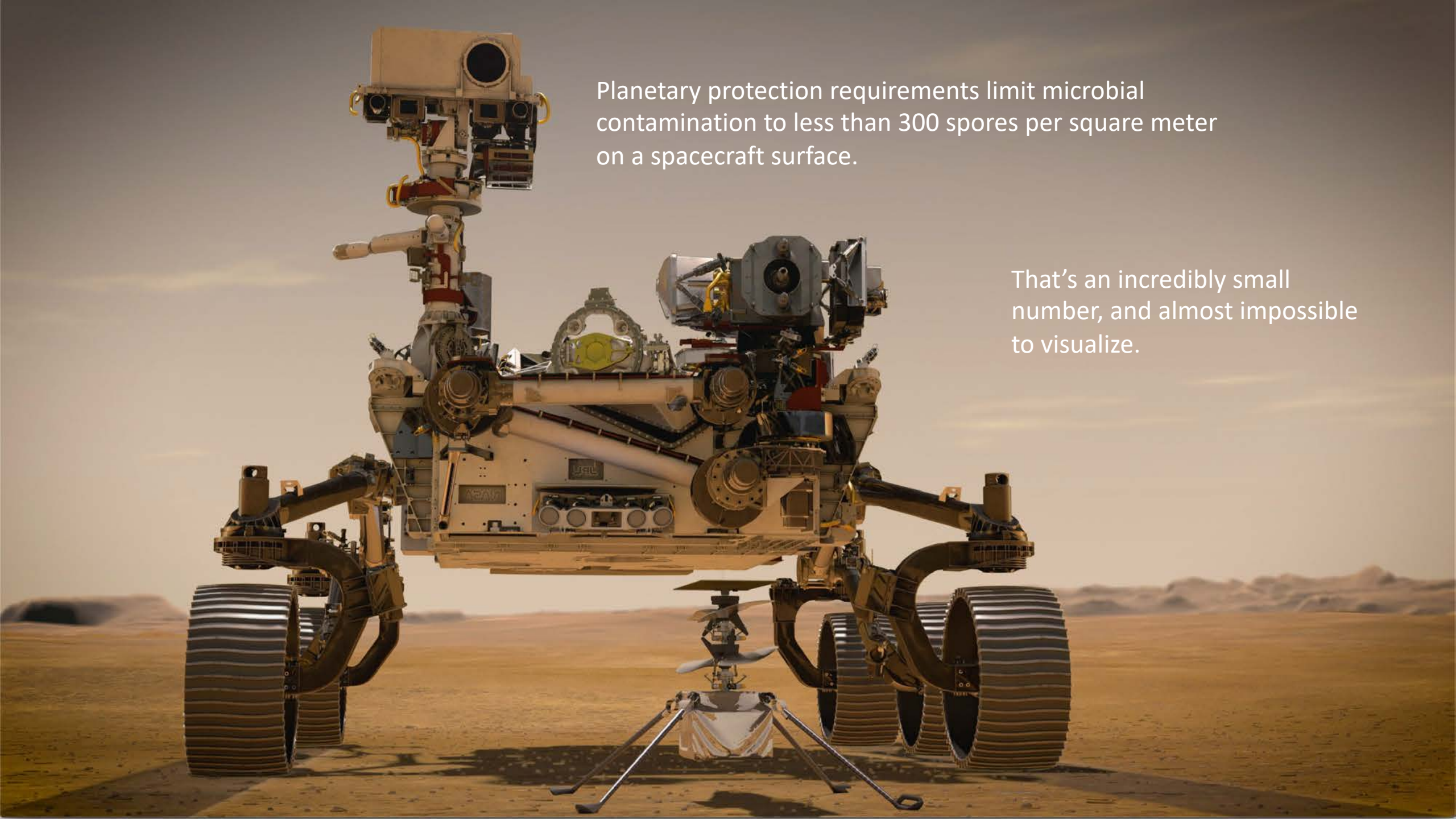




Just how small is a spore?
A visualization of spacecraft contamination

A microscopic image showing a large number of small, oval-shaped bacterial endospores. The spores are stained a deep purple color and are scattered across the field of view. Some spores are seen in pairs, while others are single. The background is a light, slightly grainy blue-grey color.

An endospore (spore) is a resting
state some bacteria enter when
conditions get tough

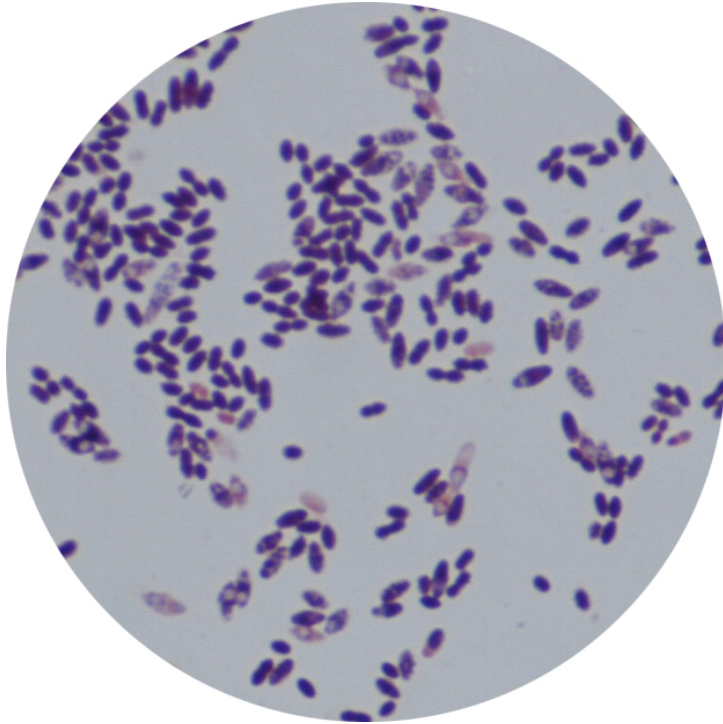


Planetary protection requirements limit microbial contamination to less than 300 spores per square meter on a spacecraft surface.

That's an incredibly small number, and almost impossible to visualize.

Spores are tiny – barely 1 micron across.
That's one millionth of a meter: 10^{-6} m.

For comparison, a poppy seed is 1mm across,
a thousand times bigger!



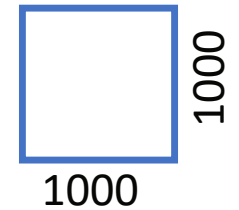
What if we scale a spore up to the size of a poppyseed?

300 spores per square meter. Here's a square meter..



If a spore is magnified to the size of a poppyseed,
we need to magnify the area – one square meter - 1m^2 by the same amount

A poppy seed is 1000x the diameter of a spore,
but in cross-section, that's $(1000)^2 = 10^6$ x the area



That's a million square meters, or 1 square kilometer!



So 300 spores/m² scales to 300 poppy seeds/10⁶ m²



Central Park is 4km x 0.8km

Let's change the area into something more familiar (unless you live in Manhattan): a soccer field.

The MLS San Jose Quake's field size of 105m x 68m = 7140m² in area. How many soccer fields in 1 km² ?

$$\frac{1,000,000}{7140} = 140 \text{ soccer fields}$$

$$\frac{300 \text{ poppyseeds}}{140 \text{ fields}} = 2.1 \text{ per field}$$

So 300 poppyseeds spread over 140 football fields means two seeds per field!



San Jose Earthquakes:
18,000 crowd
105m x 68m field

Perseverance rover depositing sample cannisters for their eventual return to Earth. A maximum contamination of 300 spores/m², or 3×10^5 spores over the entire rover, ensures that the samples contain markers for life from Mars, and not from Percy's planet of origin.

