Flipping Physics Lecture Notes:

Deriving the Acceleration due to Gravity on any Planet and specifically Mt. Everest.

We have two equations for the force of gravity acting on an object. When an object is near the surface of a planet, we can set the two equal to one another:

$$F_g = m_o g = \frac{G m_1 m_2}{r^2} \Rightarrow m_o g = \frac{G m_o m_p}{\left(R_p + altitude\right)^2} \Rightarrow g_{planet} = \frac{G m_p}{\left(R_p + altitude\right)^2}$$

We just solved for the acceleration due to gravity on planet Earth (or any planet for that matter). Notice the acceleration due to gravity is not actually constant. ☺

Let's determine the acceleration due to gravity on Mt. Everest. In order to do so, we need some known values:
The mass of the Earth is 5.9723 x 10^{24} kg.♥
The radius of the Earth at Mt. Everest is 6.3735 x 10^6 m.
The altitude of Mt. Everest is 8,848 m. The top of Mt. Everest is 8,848 meters above sea level.

$$\Rightarrow g_{Mt.Everest} = \frac{\left(6.67\times10^{-11}\right)\left(5.9723\times10^{24}\right)}{\left(6.3735\times10^{6}+8848\right)^2} = 9.77468 \approx \boxed{9.77\frac{m}{s^2}}$$

So yes, the acceleration due to gravity is not constant on the surface of planet Earth, however, it is pretty darn close.

Please note: The Earth is not a perfect sphere; it is an oblate spheroid. Its equatorial radius is larger than it's polar radius. The larger equatorial radius is caused by the rotation of the planet and it's own inertia.

- The Equatorial radius of the Earth is 6.378 x 10^6 m.
- The radius of the Earth at the poles is 6.357 x 10^6 m.
- The average radius of the Earth is 6.371 x 10^6 m.
- In order to determine the radius of the Earth at Mt. Everest, we need to know the latitude of Mt. Everest. It is 27.986065° North.♣
- We can use the latitude of Mt. Everest to determine the radius of the Earth at Mt. Everest. It is 6.3735 x 10^6 m.♦

World record holder Javier Sotomayor, 1993, Salamanca, Spain:

$\Delta y = 2.45m;\ a_y = -9.80\frac{m}{s^2};\ v_{fy} = 0$ at top of path

$$v_{fy}^2 = v_{iy}^2 + 2a_y\Delta y = 0^2 \Rightarrow v_{iy}^2 = -\left(2\right)\left(-9.80\right)\left(2.45\right) \Rightarrow v_{iy} = \sqrt{-\left(2\right)\left(-9.80\right)\left(2.45\right)} = 6.92965\frac{m}{s}$$

If he jumped instead on Mt. Everest: $v_{iy} = 6.92965\frac{m}{s};\ a_y = -9.77\frac{m}{s^2};\ v_{fy} = 0$ at top of path

$$v_{fy}^2 = v_{iy}^2 + 2a_y\Delta y = 0^2 \Rightarrow v_{iy}^2 = -2a_y\Delta y \Rightarrow \Delta y = \frac{v_{iy}^2}{-2a_y} = \frac{\left(6.92965\right)^2}{-\left(2\right)\left(-9.77\right)} = 2.45752 \approx 2.46\text{m}$$

He would have been able to jump about 1 mm higher! But what about the oxygen tanks, snow, etc?

♥ https://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html
♣ http://www.latlong.net/place/mount-everest-nepal-14.html
♦ https://rechneronline.de/earth-radius/