The first boxes of **Lucky Charms** cereal contained marshmallows in the shapes of pink hearts, yellow moons, orange stars, and green clovers. The lineup has changed occasionally over the years, beginning with the introduction of blue diamonds in 1975. Purple horseshoes joined the roster in 1984, followed by red balloons in 1989, rainbows in 1992, pots of gold in 1994, leprechaun hats in 1996 (temporarily replaced the green clovers), orange shooting stars in 1998 (added blue, green, yellow, purple, and red in 2011), and an hourglass in 2008.

**Lucky the Leprechaun** has added another shape to **Lucky Charms** cereal. It’s a “magical” golden hemisphere that increases in size when you add milk. Lucky claims the volume increases at a rate of 10.0 mm$^3$/sec. Find the rate at which the radius of this golden hemisphere increases when the radius is 3 mm.

Use the formula for the volume of a hemisphere, $V = \frac{2}{3} \pi r^3$.

\[
\frac{d}{dt} [V] = \frac{d}{dt} \left[ \frac{2}{3} \pi r^3 \right]
\]

\[
\frac{dV}{dt} = 2\pi r^2 \frac{dr}{dt}
\]

\[
\frac{dV}{dt} = 2\pi r^2 \frac{dr}{dt}
\]

\[
\frac{10 \ mm^3/sec}{2\pi (3 \ mm)^2} = \frac{dr}{dt}
\]

\[
\frac{dr}{dt} = \frac{10}{18\pi} \ mm/sec = \frac{5}{9\pi} \ mm/sec \approx 0.18 \ mm/sec
\]