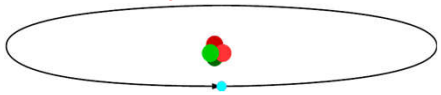
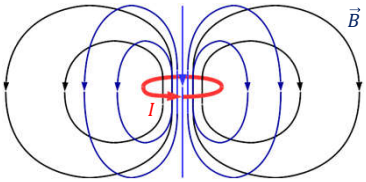
Source of Magnetism in Nature
Simple Current Loops

- Electrons orbiting atoms



- Spinning electrons

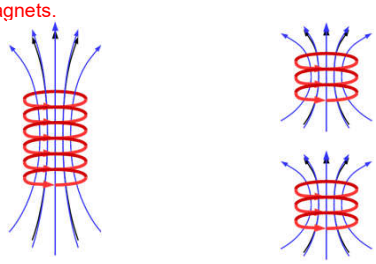
Source of Magnetism in Nature
Simple Current Loops



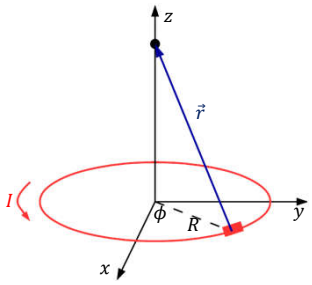
(Note that $\vec{B}$ is up inside the loop and down outside of the loop.)

Source of Magnetism in Nature

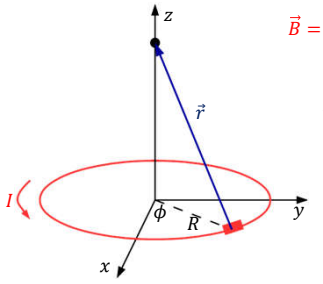
Cutting a magnet into two pieces creates two magnets.



Magnetic Field of a Current Loop (along axis)



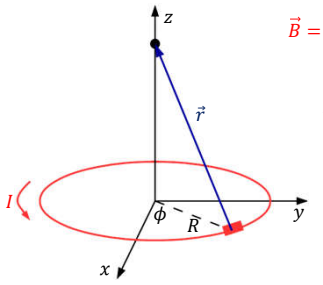
Magnetic Field of a Current Loop (along axis)



$$\vec{B} = \frac{\mu_0 I R^2}{2(R^2 + z^2)^{3/2}} \hat{k}$$

What if $z \gg R$?

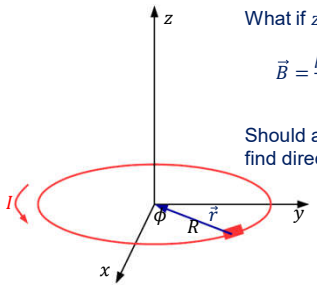
Magnetic Field of a Current Loop (along axis)



$$\vec{B} = \frac{\mu_0 I R^2}{2(R^2 + z^2)^{3/2}} \hat{k}$$

What if $z = 0$?

Magnetic Field of a Current Loop (along axis)

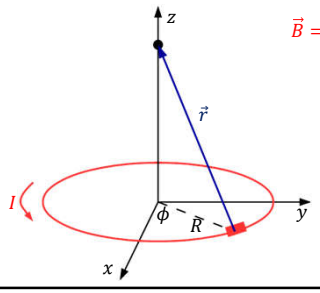


What if $z = 0$?

$$\vec{B} = \frac{\mu_0 I}{2R}\hat{k}$$

Should also be able to find directly by applying $d\vec{B} = \frac{\mu_0}{4\pi}\frac{d\vec{s}\times\hat{r}}{r^2}$.

Magnetic Field of a Current Loop (along axis)



$$\vec{B} = \frac{\mu_0 I R^2}{2(R^2 + z^2)^{3/2}}\hat{k}$$

What if there are N loops?