1. Vectors
- Vectors have a magnitude and direction
- We most often represent vectors using the format \( \langle x, y, z \rangle \) or \( x\mathbf{i} + y\mathbf{j} + z\mathbf{k} \).
- The magnitude, or length, of a vector in the \( \langle x, y, z \rangle \) format can be easily found to be \[ \sqrt{x^2 + y^2 + z^2} \]

2. Dot Product
- The dot product, \( \mathbf{a} \cdot \mathbf{b} \) of vectors \( \mathbf{a}, \mathbf{b} \) is always equal to \( |a||b|\cos(\theta) \), where \( \theta \) is the angle between the vectors. Note that the dot product is always a number, rather than a vector.
- If \( \mathbf{a}, \mathbf{b} \) are perpendicular, \( \mathbf{a} \cdot \mathbf{b} = 0 \).
- If \( \mathbf{a}, \mathbf{b} \) are parallel, \( \mathbf{a} \cdot \mathbf{b} = |a||b| \).
- \( |\mathbf{a}|^2 = \mathbf{a} \cdot \mathbf{a} \).
- \( \langle x_1, y_1, z_1 \rangle \cdot \langle x_2, y_2, z_2 \rangle = x_1x_2 + y_1y_2 + z_1z_2 \)

3. Cross Product
- The cross product of two vectors is always perpendicular to both.
- The magnitude of the cross product is equal to the area of the parallelogram determined by the vectors.
- The direction of the cross product can be ascertained by using the "right-hand rule."
- The cross product can also be calculated as \( \langle a, b, c \rangle \times \langle d, e, f \rangle = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a & b & c \\ d & e & f \end{vmatrix} \)}