Bring these concepts into tangible reality for your mind!

Chapter 1: Foundation: What are vectors and how do we work with them?

1.1, 1.4, 1.5, 1.6 — What is a vector? these sections answer this question

1.2 - how do I add + subtract vectors and see the result? (parts of 1.4 + 1.5 as well)

1.3 - multiplying vectors by scalars

1.9 + 1.12 - multiplying two vectors, two ways!

1.8, 1.10 + 1.11 - Describing basic 2D + 3D objects in terms of vectors
- OR using vectors as the basic building blocks for 2D, 3D space.

I Functions of scalars whose result is a vector:

Chapter 2: Parametrized curves in 2D, 3D space and their derivatives

Note: a "vector function of a single variable" is a parametrized curve.

2.1 + 2.2: What is it, how do you see it?

2.1 + 2.2: how do you take a derivative and what does the derivative mean?

2.2 + 2.3 how do you get the velocity & acceleration, of a parametrization?

2.2: the arclength of a curve?

2.3: the curvature of a curve?

2.2 + 2.3: tangents and normals to a curve?

II Functions of several variables whose result is a scalar:

Chapter 3:

3.1 + 3.6: Scalar fields and differentiating scalar fields

Ex: $f(x,y,z) = x^2 + 2y + zx\cos y$

3.1: Answers what is a scalar field, what are the level curves of a s.f. (i.e. how do you see a scalar field) and what is the gradient (what are the derivatives?) of a scalar field.

3.6: Laplacian (of a scalar field)

III Functions of several variables whose result is a vector:

Chapter 3:

3.2 – 3.5: vector fields and their derivatives

3.2: **What is a vector field** and how do you "see it" (graphing v.f.'s and flow lines)

3.3 + 3.4: differentiating a v.f. – divergence + curl

Integration of scalar + vector fields over curves, surfaces, and volumes:

4.1 – Line integrals – or how to integrate a vector field along a curve

4.7: Integrating scalar fields (or the normal component of a vector field) over a surface (notice: $\vec{F}\cdot\vec{n}$ is a scalar field)

4.8: Integrating scalar fields over volumes (notice: $\vec{\nabla}\cdot\vec{F}$ is a scalar field)

Chapter 4: implications / using integration to understand vector fields

IV 4.2 + 4.4: Conservative fields, and the connection between conservative and irrotational fields.

V 4.9: The divergence theorem + Stokes' theorem!

Connecting the behavior of a vector field within a region to the behavior on the boundary of the region.

Skills needed:

- Know when a region is a domain, simply connected, bounded, closed, oriented.
- know how to describe a volume, surface, or curve in terms of vectors — i.e. know how to parametrize them!
- know how to orient a surface or curve and how to find the boundary of a surface or volume.