\( \mathbf{F} = \langle P, Q \rangle \) where \( P \) and \( Q \) have continuous first partial derivatives on a domain \( D \) in \( \mathbb{R}^2 \), and
\[
P_y = Q_x
\]
on all of \( D \)

\( \mathbf{F} = \langle P, Q, R \rangle \) where \( P, Q \) and \( R \) have continuous first partial derivatives on a domain \( D \) in \( \mathbb{R}^3 \), and
\[
P_y = Q_x, \quad P_z = R_x, \quad Q_z = R_y
\]
on all of \( D \)

Green’s Thm
(simply connected \( D \))
Set \( P = f_x \) etc and just compute
Stokes’ Thm
(eg. \( D = \mathbb{R}^3 \))

\[
\int_C \mathbf{F} \cdot d\mathbf{r} = 0
\]
for every closed path in \( D \)

\[
\int_C \mathbf{F} \cdot d\mathbf{r}
\]
is independent of the path \( C \) between two points of \( D \)

**I.** Pick a basepoint.
**II.** Use \( \int_C \mathbf{F} \cdot d\mathbf{r} \) in order to define a function \( f \).
**III.** Verify that \( \nabla f = \mathbf{F} \).

The Fundamental Theorem:
\[
\mathbf{F} = \nabla f
\]
implies that
\[
\int_C \mathbf{F} \cdot d\mathbf{r} = f(\mathbf{r}(b)) - f(\mathbf{r}(a))
\]

\( \mathbf{F} \) is conservative means
\[
\mathbf{F} = \nabla f
\]
where \( f \) is some function defined on \( D \)