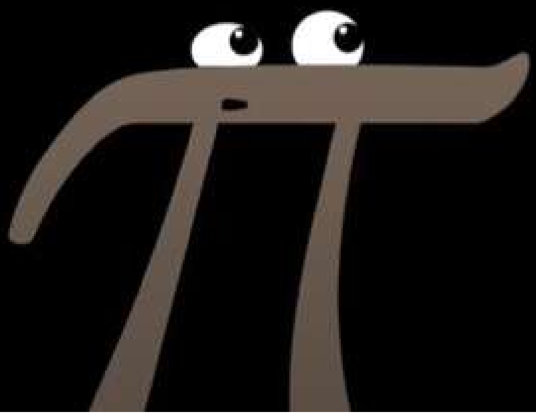
$$\text{div}\,\mathbf{F} = \nabla \cdot \mathbf{F}$$

$$\text{curl}\,\mathbf{F} = \nabla \times \mathbf{F}$$

$$\begin{bmatrix} \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} \end{bmatrix} \cdot \begin{bmatrix} \mathbf{F}_x \\ \mathbf{F}_y \end{bmatrix} = \overset{\text{div}\,\mathbf{F}}{\boxed{\frac{\partial F_x}{\partial x} + \frac{\partial F_y}{\partial y}}}$$

$$\begin{bmatrix} \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} \end{bmatrix} \times \begin{bmatrix} \mathbf{F}_x \\ \mathbf{F}_y \end{bmatrix} = \overset{\text{curl}\,\mathbf{F}}{\boxed{\frac{\partial F_y}{\partial x} - \frac{\partial F_x}{\partial y}}}$$



Fundamental Theorem of Calculus

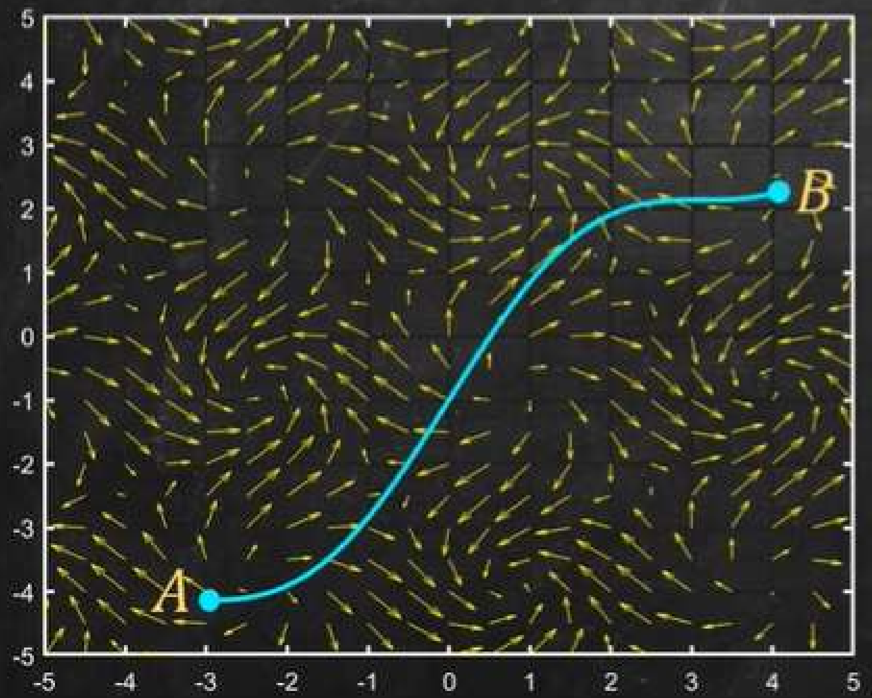
If $f(x)$ differentiable on $[a, b]$

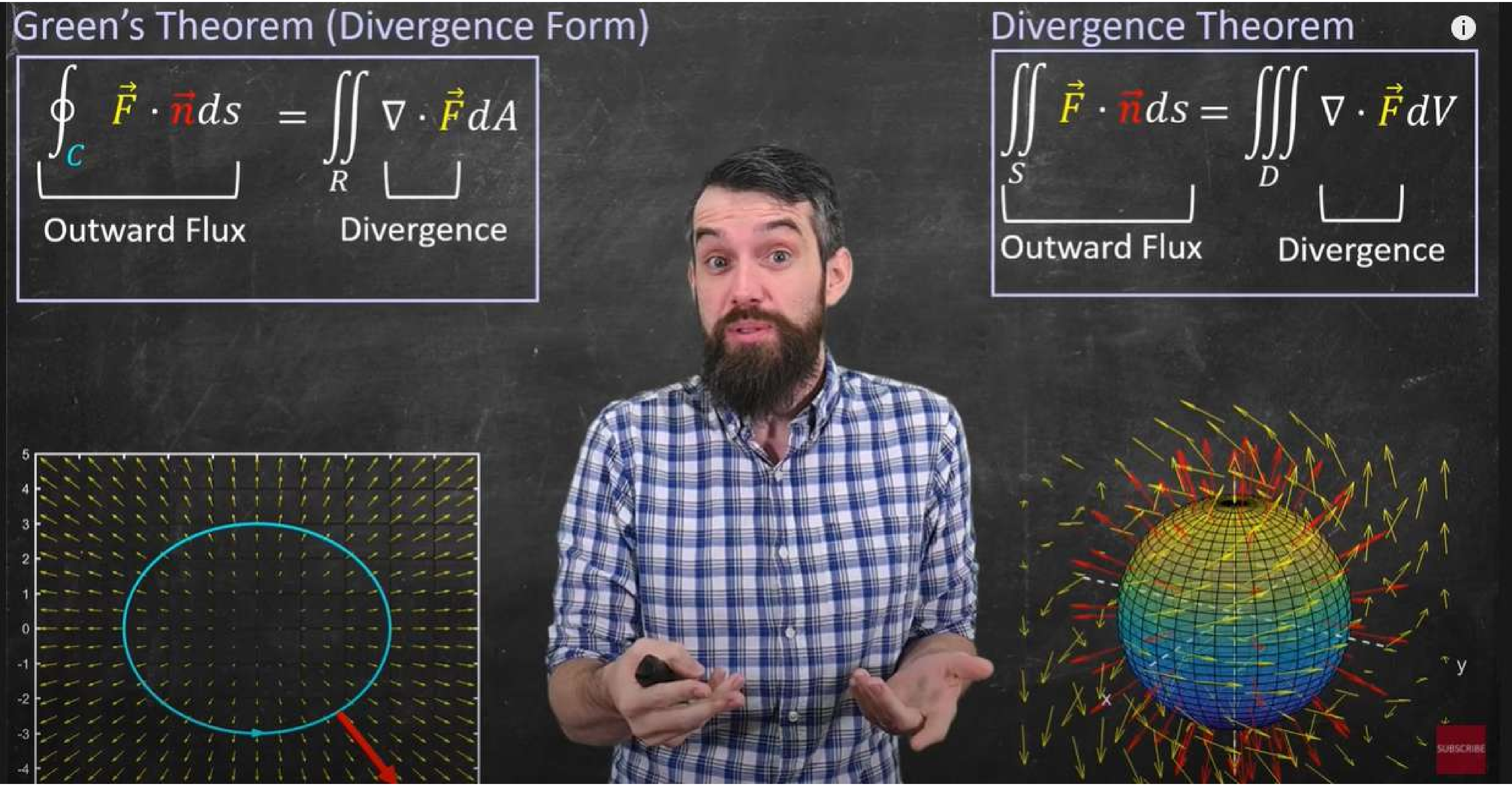
$$\int_a^b f'(x)dx = f(b) - f(a).$$

Fundamental Theorem of Line Integrals

For continuous $\vec{F} = \nabla f$

$$\int_C \vec{F} \cdot d\vec{r} = f(B) - f(A)$$





Green's Theorem (Divergence Form)
$\oint_C \vec{F} \cdot \vec{n}\, ds = \iint_R \nabla \cdot \vec{F}\, dA$
Outward Flux
Divergence
Divergence Theorem
$\iint_S \vec{F} \cdot \vec{n}\, ds = \iiint_D \nabla \cdot \vec{F}\, dV$
Outward Flux
Divergence
5
4
3
2
1
0
-1
-2
-3
-4
x
y
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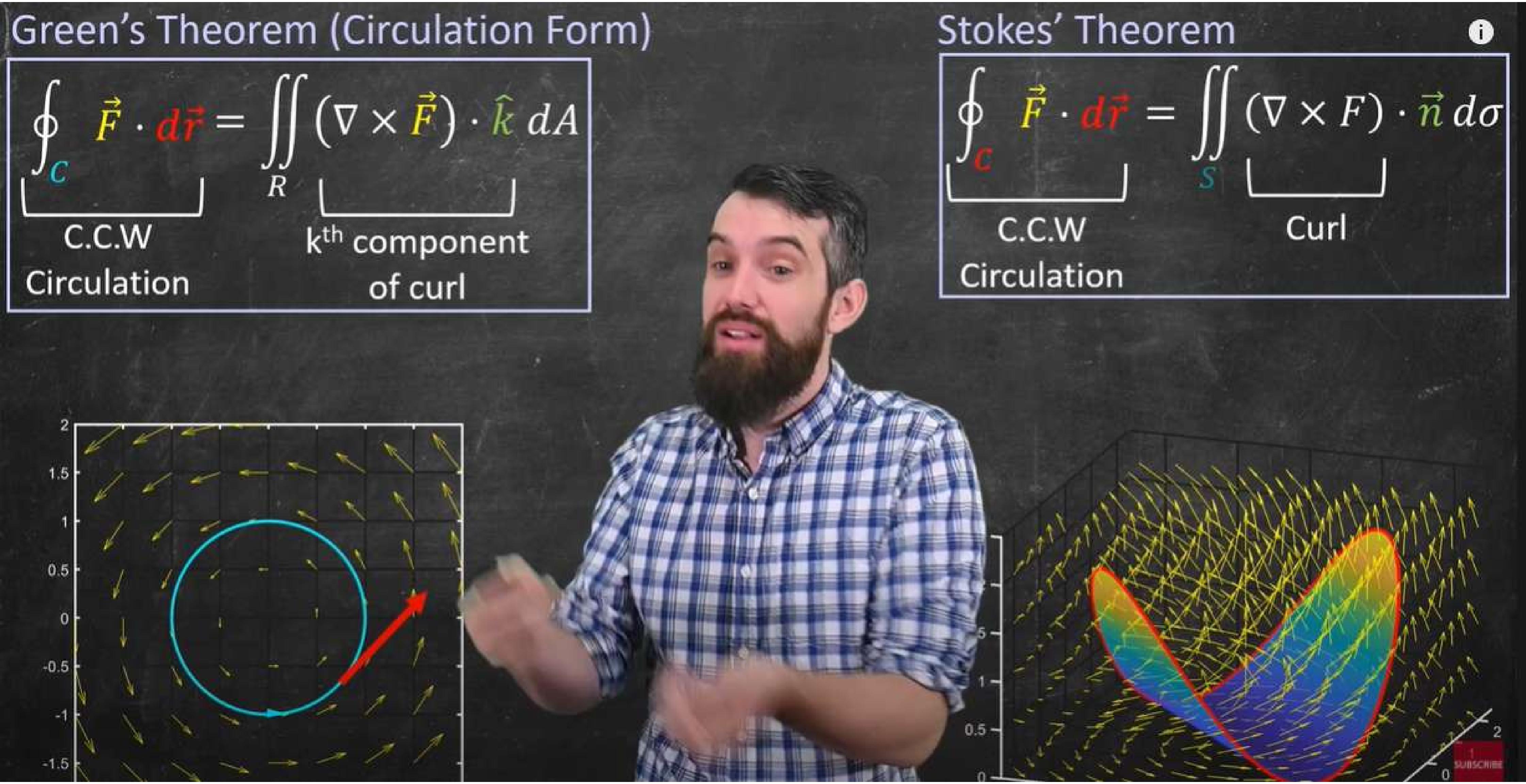
Green's Theorem (Circulation Form)
$\oint_C \vec{F} \cdot d\vec{r} = \iint_R (\nabla \times \vec{F}) \cdot \hat{k}\, dA$
C.C.W Circulation
k^th component of curl
Stokes' Theorem
$\oint_C \vec{F} \cdot d\vec{r} = \iint_S (\nabla \times F) \cdot \vec{n}\, d\sigma$
C.C.W Circulation
Curl

Unifying Principle

Integrating a differential operator acting on a field over a domain is the same as adding the field components along the boundary