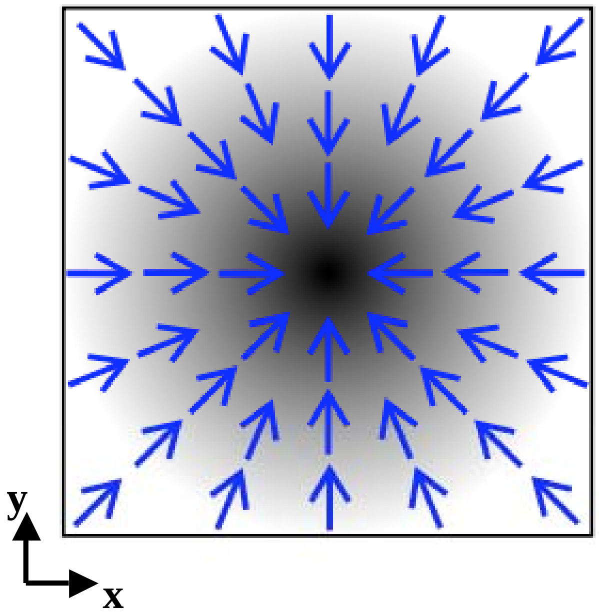
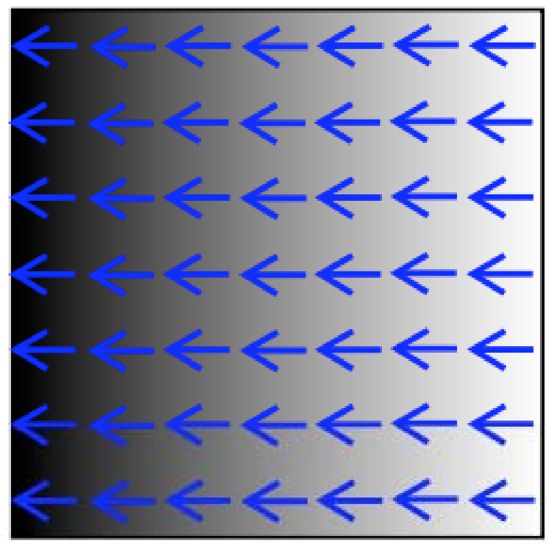
The <u>gradient</u> ($\vec{\nabla}$) is a <u>vector</u> that points in the direction of the greatest rate of change of a scalar (temperature) or vector (wind) field. It always points towards larger values!





Now let's assume the arrows above are <u>wind vectors</u>, instead of gradient vectors, and <u>consider</u> the sense of <u>divergence</u> of the wind field:

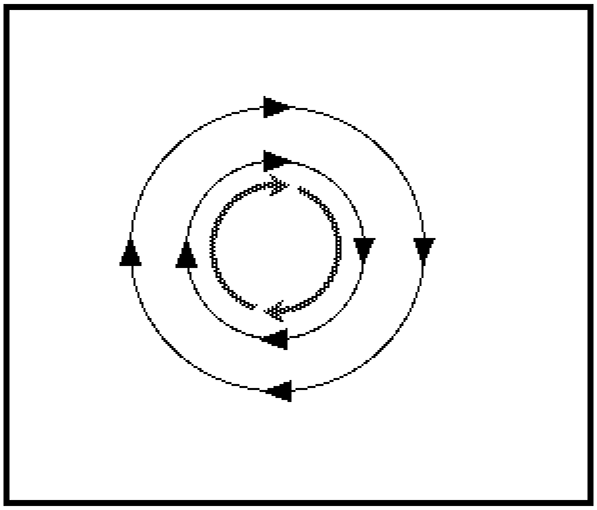
<u>Right</u>: No Divergence, $\vec{\nabla} \bullet \vec{V} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$**, because** $v = 0$

and $\frac{\partial u}{\partial x} = 0$

<u>Left</u>: Convergence, $\vec{\nabla} \bullet \vec{V} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} < 0$**, because** $\frac{\partial u}{\partial x} < 0$

and $\frac{\partial v}{\partial y} < 0$

Vertical Vorticity: $\zeta = \hat{k} \bullet \left(\vec{\nabla} \times \vec{V}\right) = \dfrac{\partial v}{\partial x} - \dfrac{\partial u}{\partial y}$

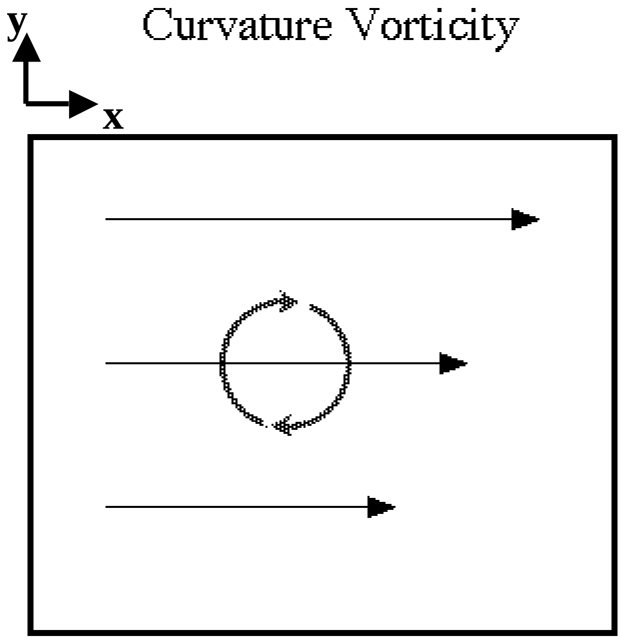


$$\frac{\partial v}{\partial x} < 0 \quad \text{and} \quad \frac{\partial u}{\partial y} > 0$$

$$\zeta < 0$$

Clockwise / Anticyclonic (Northern Hemisphere)

Curvature Vorticity



$$\frac{\partial v}{\partial x} = 0 \quad \text{and} \quad \frac{\partial u}{\partial y} > 0$$

$$\zeta < 0$$

Anticyclonic

Shear Vorticity

We can now look at some real world examples!