Choose a strategy to complete each problem.

- Compute directly (parameterize S)
- Use Stokes' Theorem
- Use Divergence Theorem
- Use a bonus trick (close S and use Divergence Theorem OR switch to a better surface)

1. Suppose $\mathbf{F}(x, y, z) = (x^3 - e^y)\mathbf{i} + (y^3 + \sin z)\mathbf{j} + (z^3 - xy)\mathbf{k}$ and S is the surface of the solid bounded above by $z = \sqrt{4 - x^2 - y^2}$ and below by the xy-plane, oriented outward. Compute $\iint_S \mathbf{F} \cdot d\mathbf{S}$.

2. Compute the flux of $\mathbf{F}(x, y, z) = y\mathbf{j} - z\mathbf{k}$ through S, where S is the surface of the cube bounded by the planes $x = 0$, $x = 2$, $y = 0$, $y = 3$, $z = 0$ and $z = 4$, oriented outward.

3. Let S be the part of the cone $z^2 = x^2 + y^2$ that lies between the planes $z = 1$ and $z = 3$. Compute $\iint_S x^2 z^2 \, dS$.

4. Compute $\iint_S \operatorname{curl} \mathbf{F} \cdot d\mathbf{S}$, where $\mathbf{F}(x, y, z) = \langle x^2yz,\ yz^2,\ z^3e^{xy} \rangle$ and S is the part of the sphere $x^2+y^2+z^2 = 5$ that lies above the plane $z = 1$, oriented upward.

5. Let $\mathbf{F}(x, y, z) = y\mathbf{i}+z\mathbf{j}+x\mathbf{k}$ and let S be the surface $z = 6-x^2-y^2$ where $z \geq 2$, oriented upwards. Compute $\iint_S \mathbf{F} \cdot d\mathbf{S}$.

6. Find the surface area of the portion of the cone $z = \sqrt{x^2 + y^2}$ that lies inside the cylinder $x^2 + y^2 = 2x$.