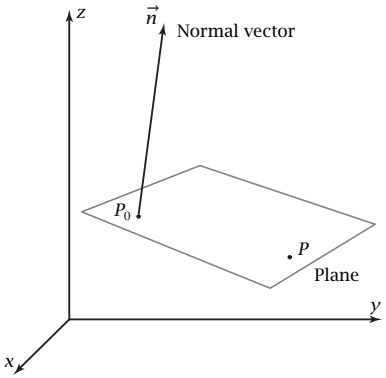
Name: _____ Group Members: _____

Exploration 10-5a: Equation of a Plane Normal to a Vector

Date: _____

Objective: Given a point on a plane and a vector normal to the plane, find a Cartesian equation of the plane.



The figure shows, in general, a plane and its normal vector (vector perpendicular to the plane). Assume that the normal vector is $\vec{n} = 3\vec{i} + 7\vec{j} + 10\vec{k}$ and that it starts at point $P_0(8, 9, 4)$ on the plane.

1. Let $P(x, y, z)$ be a (variable) point on the plane. Draw displacement vector $\overrightarrow{P_0P}$.
2. Explain why the dot product $\vec{n} \cdot \overrightarrow{P_0P}$ equals 0.
3. Write $\overrightarrow{P_0P}$ in terms of the coordinates $P_0(8, 9, 4)$ and $P(x, y, z)$.
4. Substitute the answer to Problem 3 and the components of $\vec{n}$ into the equation $\vec{n} \cdot \overrightarrow{P_0P} = 0$. Simplify the result.
5. The equation in Problem 4 is a Cartesian equation of the plane shown. By observing the pattern in the answer, show how you can get the equation *quickly.*
6. Use the equation of the plane to find the z-coordinate of the point for which $x = 5$ and $y = 2$.
7. Find the x-intercept of the plane, the value of x where the plane crosses the x-axis.
8. Explain what is meant by a *variable* point in the plane.
9. What did you learn as a result of doing this Exploration that you did not know before?