A vector space is a nonempty set of objects V, called *vectors*, which have two operations defined: *addition* of vectors and *multiplication by scalars* (real numbers), subject to the ten axioms listed below.
The axioms must hold for all vectors $\vec{\mathbf{u}}, \vec{\mathbf{v}}, \vec{\mathbf{w}} \in V$ and for all scalars c and d.

1. $\vec{\mathbf{u}} + \vec{\mathbf{v}} \in V$
2. $\vec{\mathbf{u}} + \vec{\mathbf{v}} = \vec{\mathbf{v}} + \vec{\mathbf{u}}$
3. $(\vec{\mathbf{u}} + \vec{\mathbf{v}}) + \vec{\mathbf{w}} = \vec{\mathbf{u}} + (\vec{\mathbf{v}} + \vec{\mathbf{w}})$
4. There exists a vector $\vec{\mathbf{0}} \in V$ such that $\vec{\mathbf{u}} + \vec{\mathbf{0}} = \vec{\mathbf{u}}$
5. For all $\vec{\mathbf{u}} \in V$, there is a vector $-\vec{\mathbf{u}} \in V$ such that $\vec{\mathbf{u}} + (-\vec{\mathbf{u}}) = \vec{\mathbf{0}}$
6. $c\vec{\mathbf{u}} \in V$
7. $c(\vec{\mathbf{u}} + \vec{\mathbf{v}}) = c\vec{\mathbf{u}} + c\vec{\mathbf{v}}$
8. $(c + d)\vec{\mathbf{u}} = c\vec{\mathbf{u}} + d\vec{\mathbf{u}}$
9. $c(d\vec{\mathbf{u}}) = (cd)\vec{\mathbf{u}}$
10. $1\vec{\mathbf{u}} = \vec{\mathbf{u}}$

Talk with the people around you for a minute

$H =$ line in the plane through the origin and $\vec{\mathbf{v}} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ is a subspace of $V = \mathbb{R}^2$

(a) True, and I can explain why

(b) True, but I am unsure why

(c) False, and I can explain why

(d) False, but I am unsure why

(e) Errr. . .

Talk with the people around you for a minute

$H =$ the 1$^{\text{st}}$ quadrant in the plane is a subspace of $V = \mathbb{R}^2$

(a) True, and I can explain why

(b) True, but I am unsure why

(c) False, and I can explain why

(d) False, but I am unsure why

(e) Errr. . .

Talk with the people around you for a minute

$H =$ set of points on $y = x^2$ is a subspace of $V = \mathbb{R}^2$

(a) True, and I can explain why

(b) True, but I am unsure why

(c) False, and I can explain why

(d) False, but I am unsure why

(e) Errr. . .

Talk with the people around you for a minute

Let $\vec{\mathbf{v_1}} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ and $\vec{\mathbf{v_2}} = \begin{bmatrix} -2 \\ 1 \\ -5 \end{bmatrix}$. Then $H = \text{Span}\left\{\vec{\mathbf{v_1}}, \vec{\mathbf{v_2}}\right\}$ is a subspace of $V = \mathbb{R}^3$

(a) True, and I can explain why

(b) True, but I am unsure why

(c) False, and I can explain why

(d) False, but I am unsure why

(e) Errr. . .

Talk with the people around you for a minute

$H =$ the 1st and 3rd quadrant in the plane is a subspace of $V = \mathbb{R}^2$

(a) True, and I can explain why

(b) True, but I am unsure why

(c) False, and I can explain why

(d) False, but I am unsure why

(e) Errr. . .

Talk with the people around you for a minute

Let $A = \begin{bmatrix} 1 & 0 & -2 & 3 \\ 0 & 1 & 2 & -1 \end{bmatrix}$

Then $H = \left\{ \vec{\mathbf{x}} \in \mathbb{R}^4 \ \middle|\ A\vec{\mathbf{x}} = \vec{\mathbf{0}} \right\}$ is a subspace of $V = \mathbb{R}^4$

(a) True, and I can explain why

(b) True, but I am unsure why

(c) False, and I can explain why

(d) False, but I am unsure why

(e) Errr. . .

Let $A = \begin{bmatrix} 2 & 6 & 2 & 8 \\ -3 & 1 & -3 & -8 \\ 3 & 4 & 3 & 10 \end{bmatrix}$

1. Fill in the blank: nul(A) is a subspace of $\mathbb{R}$—
2. Is $\vec{\mathbf{x}} = \begin{bmatrix} 2 \\ -1 \\ 3 \\ -1 \end{bmatrix}$ in nul(A)?
3. Find a spanning set of vectors for nul(A)
4. Fill in the blank: col(A) is a subspace of $\mathbb{R}$—
5. Is $\vec{\mathbf{b}} = \begin{bmatrix} 44 \\ -36 \\ 51 \end{bmatrix}$ in col(A)?
6. Find a spanning set of vectors for col(A)