# 2x2 Matrices - Multiplication

Find the product of the following matrices.

First Matrix   Second Matrix

$$\begin{bmatrix} 2 & -9 \\ 4 & -1 \end{bmatrix} \begin{bmatrix} -1 & 9 \\ 6 & 6 \end{bmatrix} = \begin{bmatrix} -56 & -36 \\ -10 & 30 \end{bmatrix}$$

| | | |
|---|---|---|
| Row 1 | Column 1: | $(2 \times -1) + (-9 \times 6) = -56$ |
| Row 1 | Column 2: | $(2 \times 9) + (-9 \times 6) = -36$ |
| Row 2 | Column 1: | $(4 \times -1) + (-1 \times 6) = -10$ |
| Row 2 | Column 2: | $(4 \times 9) + (-1 \times 6) = 30$ |

Matrix Multiplication

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} \end{bmatrix}$$
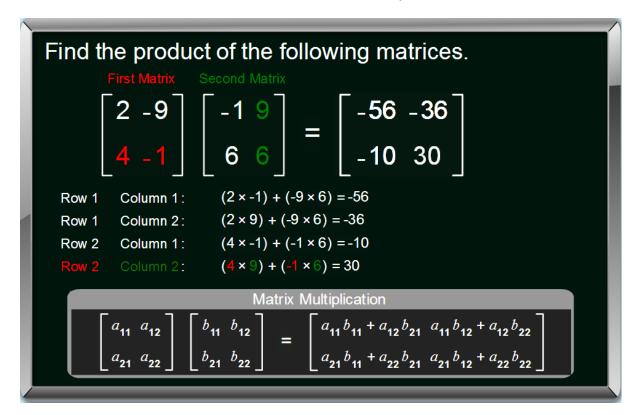
## Description

Students calculate the product of vector with matrix, matrix with vector and matrix with matrix.

## Teaching Hints

Show students that when they multiply a $n \times m$ matrix by a $m \times p$ matrix the result is a $n \times p$ matrix. Show students that when they write the dimensions of the matrices next to each other in the order they appear then the product is only defined if the inner two are equal e.g. $n \times m \leftrightarrow m \times p$ (the matrix on the left has the same number of columns as the matrix on the right has columns.
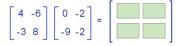
## Activities

Find the product of the vector and matrix.

$$\begin{bmatrix} 7 & 6 \\ -5 & 4 \end{bmatrix} \begin{bmatrix} 7 \\ -8 \end{bmatrix} = \begin{bmatrix} \phantom{0} \\ \phantom{0} \end{bmatrix}$$

Matrix by vector

Find the product of the vector and matrix.

$$\begin{bmatrix} -2 & -3 \end{bmatrix} \begin{bmatrix} -4 & -5 \\ 4 & -6 \end{bmatrix} = \begin{bmatrix} \phantom{0} & \phantom{0} \end{bmatrix}$$

Vector by matrix

Find the product of the following matrices.

$$\begin{bmatrix} 4 & -6 \\ -3 & 8 \end{bmatrix} \begin{bmatrix} 0 & -2 \\ -9 & -2 \end{bmatrix} = \begin{bmatrix} \phantom{0} & \phantom{0} \\ \phantom{0} & \phantom{0} \end{bmatrix}$$

Matrix by matrix