I collaborated with:

Solution
Claim: Any instance of Vertex Cover can be solved using Hitting Set.

Proof. First, we must show a certificate for Hitting Set. Given a set A, and collection of sets $B_1, B_2, ..., B_m$ we can check if H is a hitting set by showing $H \cap B_i \neq \{\}$. We can simply check if for all elements $h \in H$, some element h is in B_i for $0 \leq i \leq m$. If no element h is in a subset B_i then H is not a Hitting Set. This takes time proportional to the size of H and to the size of all subsets B_i.
Let $G = (V, E)$ be a graph. We want to show that we can find a vertex cover for G of size at most k by solving the Hitting Set problem. First, we must transform an instance of vertex cover to an instance of the hitting set problem. We can make every vertex of $G = \{v_1, v_2, ..., v_n\}$ an element of a set $A = \{v_1, v_2, ..., v_n\}$. Vertices u and v are in the same subset of the collection if they are connected by an edge. Thus, we have converted a vertex cover problem to a hitting set problem.
A vertex cover C of G gives us a hitting set for this reduces problem, because vertices in C are incident to every edge. Elements of C are elements of a hitting set because subsets of A are made up of indicent vertices, and elements of C are indicent to every edge. Now, we can find a hitting set H of A of size at most k in polynomial time. This set H contains at least one element from each subset in the collection, so an element h_i is connected to all vertices of subset B_i. This means that the elements of H are incident to all edges of G, because they connect to all vertices of our collection. $\square$