

Here are some homework problems, based upon the filmstrips we watched.

Problem 1. *You have many bricks that are 1 foot by 2 feet by 4 feet. Prove that you cannot completely pack a box with these bricks, if the box is 6 feet by 6 feet by 6 feet.*

(Hint: break up the box into 2 by 2 by 2 cubes. Color these 27 cubes like a 3D checkerboard. Note that there are 14 cubes of one color (say black) and 13 of the other color (say white). Break up each of the 2 by 2 by 2 cubes into 1 by 1 by 1 cubes. Note that there are now 8 more black 1 by 1 by 1 cubes than there are white 1 by 1 by 1 cubes. How does this help?)

Problem 2. *A water lily is growing in a lake. Its root is at the bottom of the lake, and its blossom is above the water level. When its stem is vertical, the blossom is 10 centimeters above the surface of the lake. If you pull the lily to one side, keeping the stem straight, the blossom touches the water at a spot 21 centimeters from where the stem formerly cut the surface. How deep is the water?*

Problem 3. *A small chessboard is 3 squares wide and 4 squares long. Let's say the "top" and "bottom" are 3 squares across, so that the sides are 4 squares long. Place 3 black knights on the top 3 squares, and 3 white knights on the bottom 3 squares. Show how to move all the black knights to the bottom and all the white knights to the top, in just 16 knight moves. (If you can't do it in 16 moves, do it in as few moves as you can.)*

Problem 4. *A pilot flies due south 100 kilometers, then goes east 100 kilometers, then north 100 kilometers and finds out that he's right back where he started from. He did not start at the North Pole. Where on Earth could he possibly have started?*