Introduction

If you've ever had a severe knee injury or read about one, you're likely familiar with an account like the following: "I moved in the wrong way, I heard a pop, and then I felt the pain." The knee, like pretty much all other joints in our body, is held together (in part) by ligaments. These ligaments are strong cords that function to guide normal joint motion. But when a joint, like the knee, is forced to move in an abnormal way, one or more ligaments are stretched beyond their limit, they can tear or snap (the "pop"), resulting in joint instability (because the ligament can no longer function properly) and pain. This example illustrates the basic principle that ligament function, joint motion, and joint injury are all causally connected:

- *If* ligament A functions to limit excess motion in direction X, *then*...
- the motion that can injure ligament A is excess motion in direction X
- and injury of ligament A can cause pain or instability when moving in direction X.

If you want to fully understand knee joint injuries, you need to also understand the functions of the knee ligaments and the motions that these ligaments normally limit.

But how do you evaluate the function of a ligament? In molecular biology, the function of a cellular component (e.g., a protein) is evaluated by "knocking it out." Cells are blocked from producing the protein and the resulting phenotype gives you an indication as to what the function of that protein is. For example, if a cell with a knockout has membrane abnormalities, you have a clue that the protein may help to form the cell membrane. This is the classic "knockout" experiment: an abnormal result gives you a clue about normal function.

In this activity, you'll do a ligament knockout experiment with your knee kit. You'll knock out each of the ligaments of the knee and simulate a range of normal knee motions to discover which motions have become abnormal (the phenotype). Through these simulations, you'll simultaneously learn the function of the ligament, the particular motion(s) that can injure that ligament, and the motion(s) that could cause pain or instability if the ligament is injured. With this understanding, you'll then be able to answer several challenge questions about why some ligaments are more commonly injured than others, why some ligaments are commonly injured together, and why landing from a jump in a particular way can reduce the chances of injuring your knees.

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