Answer Key – Northwestern Crows

1. The biologist Reto Zach observed that the crows use the second flight path, B, most often. One conjecture is that the path permits them to see where the whelk lands even though they lose some of the height of the drop. Some students may think that the crow is throwing the whelk down. The video clip shows that the crows level off. The amount of descent is minimal.

2. Some of the factors that might influence the height at which the birds drop the whelk include the work involved in lifting the whelk, the likelihood the whelk will break, minimizing the chance of other birds stealing the whelk, and better aim at lower heights.

3. The whelk has to be dropped at least once - never dropped, never broken. If the whelk is dropped from a really small height, then a large number of drops may be required.

4. If the whelk is "dropped" from 0 meters, the whelk will never break due to dropping. Similarly, the hard shell of the whelk might withstand any finite number of drops from a small height. So there may be a smallest height at which, for all practical purposes, the whelk does not break. There are physical limitations to how high a crow can fly. Also, at some point, dropping a whelk from a larger height is no longer "beneficial" since the whelk will reach a terminal velocity.

5. Answers will vary. Shelled, whole, blanched peanuts may represent whelks and may be dropped at differing heights to determine the number of drops needed before each peanut breaks into two and the work involved to break it.

6. A sketch of a decreasing graph should include a horizontal asymptote at $N = 1$ and a vertical asymptote at some unknown height $H = H_{min}$ where N is the number of drops and H is the height of the drop. Certainly the whelk must be dropped at least once, accounting for a horizontal asymptote. The fact that a whelk may never break is possible. Repeatedly dropping a whelk 1 mm may never cause breakage. Thus there may be a height at which insufficient force is generated to ever break open the whelk. Worst case scenario is if a whelk is dropped at a 0 height, then an infinite number of (non) drops will not break open the whelk. This suggests a vertical asymptote. The scales are not important.