Name: _____

Read the article below, then answer the questions on the back of this sheet.

From the *Discover* magazine February 1996 issue; published online February 1, 1996
http://discovermagazine.com/1996/feb/whydidthechicken703/?searchterm=dna , accessed 3/28/12

"Why Did the Chicken Lose Its DNA?"

Birds are different from most vertebrates. Aside from the obvious distinctions like wings and feathers, birds have only about half as much DNA per cell as mammals and reptiles. Many biologists had assumed that the diminished bird genome was simply the legacy of some ancient genetic accident, when a huge chunk of DNA was somehow deleted in an ancestral bird. But Austin and Marianne Hughes, a husband-and-wife team of molecular biologists at Penn State, have found evidence that the dearth of DNA in bird cells is no accident. They say it is more likely a crucial adaptation for flight.

The Hughes's compared genetic material from humans and chickens. In both types of bipeds, the Hughes's found, the DNA that actually codes for proteins was about the same length. But in chickens, introns--regions of DNA that don't seem to code for anything--were on average less than half as long as the same regions in humans. The researchers looked at the DNA in many different genes in chickens and humans, and the results were always the same: large portions of introns were occasionally missing in the birds, but their coding DNA was invariably intact.

A genetic accident in some avian ancestor can't explain these results, says Austin Hughes. Chance deletions wouldn't be so widespread or affect only noncoding DNA, he says. He and his wife believe that only one interpretation of their research makes sense. Having less DNA must be adaptive, says Hughes, because it happened many, many times independently, in many different genes.

The Hughes's believe that birds, by streamlining their DNA, have evolved smaller, more energy-efficient cells that better sustain the metabolic demands of flying. With less DNA in a cell, the cell can be smaller. Smaller cells have a higher ratio of surface area to interior than larger cells, so they can absorb oxygen more efficiently and use it to release energy from food. That would make flying--which requires lots of energy--a more manageable endeavor.

Although evidence in the literature suggests that bird cells do indeed tend to be smaller than those of other animals, no formal comparison has yet been made, especially as regards the cells' metabolic efficiency. But other evidence supports the Hughes's' case as well. Bats, Hughes points out, are the only mammals that fly, and they have less DNA in their cells than other mammals. The couple also hopes to study birds that have lost the ability to fly to see if their cells have begun to accumulate junk DNA. (Chickens are essentially flightless, but they've only recently evolved from flying jungle fowl, and their DNA has not had enough time to change significantly.) It would be interesting, says Hughes, to see if an ostrich or a penguin shows a relaxation of the tendency to have less DNA.

Name: _____

Questions

1. What is the meaning of the word "dearth," found in the first paragraph? Use context clues to figure it out.

2. How can having less DNA in cells be a helpful adaptation for birds?

3. What cellular process requires oxygen to release energy from food?

4. One often hears the term "junk DNA" when studying DNA and genetics. What term used in this article is a synonym for junk DNA? What do these terms mean?

5. How can birds have so much less DNA in each cell compared to other animals, yet their cells still function normally?

6. What prediction might you make if you were about to compare the amount of DNA in the cells of spiders and mosquitoes?