

1. What do scientists mean by “undernutrition without malnutrition?”

*Drastically cutting calories without skimping on essential nutrients. A calorie is used to measure heat output of organisms or the energy producing value of food.*

2. What were the results of the tests on rats and monkeys when their caloric intake was reduced by 30 percent?

*In rats, a 30 percent cut in calories stretched the average life span by 30 percent. The rats did not get the ailments of aging — disease, diabetes and cancer — until much later in life. Similarly, monkeys being fed 30 percent less than they would eat on their own showed biological markers of aging, such as blood pressure, “good” cholesterol and triglyceride levels, improved. Also, the blood-borne hormone insulin was better able to help metabolize sugar, suggesting that the monkeys would be less likely to develop diabetes as they age.*

3. What did the experiment restricting the amount of calories monkeys received indicate about their ability to learn tasks?

*Although restricted monkeys are more active, there is no evidence at this point that they learn quicker.*

4. Why might this caloric restriction diet not work on people?

*It is very difficult for people to adhere to such a strict diet. Also, it might be difficult to ensure people received the proper nutrition.*

5. How might this research be applied to people?

*One possibility is to solve the mechanism by which this produces longer life span, and pharmacologically (using drugs) trick the cells.*

6. What effect did the caloric restriction experiments on rats and mice have on tumors? What theory do scientists have for this effect?

*Calorically restricted rats and mice got fewer and/or smaller tumors than animals that could eat all they wanted. Scientists theorize that perhaps there is not enough to feed the disease if you barely get enough to feed the host.*

7. What has the research shown about the effect fat content has on calorically restricted animals?

*Fat content of the diet doesn’t seem to matter if the calorie count is low enough. Tumor counts in calorically restricted animals eating 25 percent dietary fat were similar to those of free-feeding animals that ate 5 percent fat.*

8. How has the research on fat content changed tests done on lab animals?

*Since overeating, rather than the chemicals being tested, might be causing tumors in lab animals, in the future, animals will be eating fewer calories.*

9. Describe the role of free radicals or "reactive oxygen species" in the body.

*Free radicals are busybody chemicals, usually containing oxygen, which rapidly react with other chemicals. Free radicals damage proteins, DNA, and lipids, generally causing mayhem inside cells. The presence of too many free radicals creates a condition called "oxidative stress" in a cell.*

10. What theory do scientists have about oxidative stress and antioxidants?

*The oxidative stress hypothesis offers a general explanation of aging. It predicts that the level of oxidative stress should increase with age (as it does in fruit flies and mammals). It also predicts that increased levels of antioxidants, which cells manufacture to convert free radicals into harmless chemicals like oxygen and water, should reduce oxidative stress and extend the life span.*

11. Describe the experiment to show that reducing oxidative stress extends the life span. What is the role of superoxide dismutase (SOD) and catalase, the prime antioxidant enzymes?

*When transgenic lines of some fruit flies were created that simultaneously over-expressed both antioxidant enzymes, the average life span jumped from 45 to 75 days.*

12. Describe how oxidative stress, the buildup of too many free radicals in cells, may explain the benefits of caloric restriction. What did Richard Weindruch's study of calorically restricted monkeys demonstrate? What was the role of mitochondria in this study?

*Weindruch showed that mitochondria, tiny "factories" inside cells that make adenosine triphosphate (ATP), a chemical that powers a wide range of cellular activities, are a major source of free radicals. The free radicals, in turn, damage the mitochondria, and the damaged mitochondria make more free radicals. Reducing caloric intake should reduce the amount of free radicals. According to the theory, more energy, in the form of more calories, creates more disorder. So in the broadest sense, more disorder equals more destruction and less ability to function — in other words, aging.*

13. What problems might scientists run into when conducting experiments involving animals, such as monkeys, rats, mice, and fruit flies? Why must scientists be careful about drawing conclusions about human aging based on animal studies?

*Animals may be susceptible to diseases that would not affect humans. In addition, the life spans of animals used in many experiments are often quite short; and therefore, scientists do not know the long-term effects of the study.*