LEVEL 11B_REX 5 UNIT 7 QUIZ

A. Choose the best answer for each question.

The Downside of Upright

Our aching backs may be trying to tell us something: It's part of the price we pay for walking on two legs.

[A] We humans are odd creatures: tailless bipeds with curved spines, long limbs, arched feet, agile hands, and enormous brains. Our bodies are a mosaic of features shaped by natural selection over vast periods of time - exquisitely capable yet deeply flawed. We can stand, walk, and run with grace and endurance, but we suffer aching feet and knee injuries; we can twist and torque our spines, and yet most of us are plagued by back trouble at some point in our lives. Scientists have long pondered how our bodies came to be the way they are. Now, using new methods from a variety of disciplines, they are discovering that many of the flaws in our "design" have a common theme: They arise primarily from evolutionary compromises that occurred when our ancestors stood upright - the first step in the long path to becoming human.

Yesterday's Model

[B] Humans come from a long line of ancestors, reptile to mammal to ape, whose skeletons were built to carry their weight on all fours. Our ape ancestors probably evolved around 20 million years ago from small primates that carried themselves horizontally. Over the next several million years, some apes grew larger and began to use their arms to hold overhead branches. Then, six or seven million years ago, our ancestors stood up and began to move about on their hind legs.

[C] It was a radical shift. "Bipedalism is a unique and bizarre form of locomotion," says Craig Stanford, an anthropologist at the University of Southern California. "Of more than 250 species of primates, only one goes around on two legs." Stanford and many other scientists consider bipedalism the key defining feature of being human.

[D] Evolutionary biologists agree that shifts in behavior often drive changes in anatomy. Standing upright launched a series of anatomical alterations. The method of upright walking is so different from walking on all fours that bones from the neck down had to change. To support the body's weight and absorb the forces of upright locomotion, joints in limbs and the spine enlarged, and the foot evolved an arch. The pelvis evolved from the ape's long, thin paddle into a wide, flat saddle shape, which thrust the weight of the trunk down through the legs and allowed for the attachment of large muscles.

Upright Citizens

[E] At his laboratory in the anthropology department at Harvard University, Dan Lieberman uses biomechanical studies to see how we use our body parts in various aspects of movement. These experiments on walking and running illuminate just how astonishing a feat of balance, coordination, and efficiency is upright locomotion. The legs on a walking human body act not unlike inverted pendulums. Using a stiff leg as a point of support, the body swings up and over it in an arc, so that the potential energy gained in the rise roughly equals the kinetic energy generated in the descent. By this trick the body stores and recovers so much of the energy used with each stride that it reduces its own workload by as much as 65 percent.

[F] "Compare this with the chimp," Lieberman says. "Chimps pay a hefty price in energy for being built the way they are. They can't extend their knees and lock their legs straight, as humans can. Instead, they have to use muscle power to support their body weight when they're walking upright, and they waste energy rocking back and forth."

[G] Chimps are our closest living evolutionary relatives and, as such, are well suited to teach us about ourselves. Almost every bone in a chimp's body correlates with a bone in a human body. Whatever skeletal distinctions exist are primarily related to the human pattern of walking upright. Two-legged walking in a chimp is an occasional, transitory behavior. In humans, it is a way of life, one that carries with it several benefits, including freed hands. But upright posture and locomotion come with a number of uniquely human maladies.

Aching Back

[H] Back pain is one of the most common health complaints. That most of us will experience back pain at some point in our lives raises the question of the spine's design.

[I] "The problem is that the vertebral column was originally designed to act as an arch," explains Carol Ward, an anthropologist and anatomist at the University of Missouri in Columbia. "When we became upright, it had to function as a weight-bearing column." To support our head and balance our weight directly over our hip joints and lower limbs, the spine evolved a series of S curves - a deep forward curve, or lordosis, in the lower back, and a backward curve, or kyphosis, in the upper back.

[J] "This system of S curves is energetically efficient and effective for maintaining our balance and for bipedal locomotion," Ward says. "But the lower region of the column suffers from the excessive pressure and oblique force exerted on its curved structure by our upright posture."

[K] Lean back, arching your spine. You're the only mammal in the world capable of this sort of backbend. Feel a cringing tightness in your lower back? That's the vertical joints between your vertebrae pressing against one another as their compressive load increases. The curvature in your lower spine requires that its building blocks take the shape of a wedge, with the thick part in the front and the thin part in the back.

[L] But in the lower back region, where the load is heaviest and the wedging most dramatic, strains such as heavy lifting or hyperextension can cause your lowest vertebrae to slip or squish together. When the vertebrae are pressured in this way, the disks between them may herniate, or bulge out, impinging on spinal nerves and causing pain. Or the pressure may pinch the delicate structures at the back of the vertebrae, causing a fracture called spondylolysis.

[M] Considering the pressures of natural selection, why are such seriously debilitating diseases still prevalent? Latimer believes the answer lies in the importance of lordosis for upright walking: "Selection for bipedality must have been so strong in our early ancestors that a permanent lordosis developed despite the risk it carries for spondylolysis and other back disorders."

Unlikely Feat

[N] And where does the buck finally stop? What finally bears the full weight of our upright body? Two ridiculously tiny platforms. "The human foot has rightfully been called the most characteristic peculiarity in the human body," says Will Harcourt-Smith, a paleontologist at the American Museum of Natural History. "For one thing, it has no thumblike opposable toe. We're the only primate to give up the foot as a grasping organ."

[O] This was a huge sacrifice. The chimp's foot is a brilliantly useful and versatile feature, essential to tree climbing and capable of as much motion and manipulation as its hand. The human foot is designed to do just two things, propel the body forward and absorb the shock of doing so. Bipedality may have freed the hands, but it also yoked the feet.

[P] Harcourt-Smith studies foot bones of early humans with the new technique of geometric morphometrics - measuring objects in three dimensions. In all the fossil feet Harcourt-Smith studies, some type of basic human pattern is clearly present: a big toe aligned with the long axis of the foot, or a well-developed longitudinal arch, or in some cases a humanlike ankle joint - all ingenious adaptations but fraught with potential problems.

[Q] "Because the foot is so specialized in its design," Harcourt-Smith says, "it has a very narrow window for working correctly." In people with a reduced arch, fatigue fractures often develop. In those with a pronounced arch, the ligaments that support the arch sometimes become inflamed. When the carrying angle of the leg forces the big toe out of alignment, bunions may form - more of a problem for women than men because of their wider hips.

What Do We Stand For?

[R] We humans gave up stability and speed. We gave up the foot as a grasping tool. We gained spongy bones and fragile joints and vulnerable spines. Given the trade-offs - the aches and pains, and severe drawbacks associated with bipedalism - why get upright in the first place?

[S] Theories about why we got upright have run the gamut from freeing the arms of our ancestors to carry babies and food to reaching hitherto inaccessible fruits. "But," says Mike Sockol of the University of California, Davis, "one factor had to play a part in every scenario: the amount of energy required to move from point to point. If you can save energy while gathering your food supply, that energy can go into growth and reproduction."

[T] Studies suggest that at the time our ancestors first stood upright, perhaps six to eight million years ago, their food supplies were becoming more widely dispersed. "If our ape ancestors had to roam farther to find adequate food, and doing so on two legs saved energy, then those individuals who moved across the ground more economically gained an advantage."

[U] Scientists are the first to admit that much work needs to be done before we fully understand the origins of bipedalism. But whatever drove human ancestors to get upright in the first place, the habit stuck. They eventually evolved the ability to walk and run long distances. They created and manipulated a diverse array of tools. These were essential steps in evolving a big brain and a human intelligence, one that could make poetry and music and mathematics, develop sophisticated technology, and consider the roots of its own quirky and imperfect upright being.

____ 1. What is the main idea of this article?
   a. Scientists have recently discovered many flaws in our bodies' "design."
   b. Walking on all fours gives chimps many advantages over humans.
   c. Standing upright has both advantages and disadvantages for humans.
   d. The change to an upright posture led to major changes in human behavior.

____ 2. The word *pondered* in paragraph A is closest in meaning to which of the following?
   a. wondered

b. decided
c. confirmed
d. Argued

___ 3. What does the author imply in paragraph C?
a. Walking on two legs is strange.
b. Stanford's theories about bipedalism are unique.
c. There are more types of primates than was once thought.
d. Besides humans, only one type of primate is bipedal.

____ 4. The author states in paragraph D that *shifts in behavior often drive changes in anatomy*. Which of the following is an example of this principle?
a. Bees have learned that flowers of a certain color are richer in pollen and visit those flowers first.
b. When penguins could no longer fly and began to swim, their wings became like the flippers of sea mammals.
c. Dolphins have found that working together to herd fish into shallow water allows them to catch more fish.
d. Horses have legs that are good for running, but can't be used to scratch their backs.

____ 5. Which of the following is NOT one of the changes that took place in human ancestors when they began walking on two feet?
a. Their pelvises grew wider and flatter.
b. Their arms became shorter and their legs longer.
c. Their feet developed an arch.
d. The joints of their limbs and spine grew larger.

____ 6. What does the author say about chimps in paragraph G?
a. It's unusual to see them walk on four legs.
b. Walking upright can cause them pain.
c. Their skeletal structure is identical to humans'.
d. They don't generally walk on two feet.

____ 7. According to the article, most back problems occur because of ____.
a. the inability of humans to fully arch their spine
b. weakness in the design of the upper spine
c. the pressure placed on the lower curve of the spine
d. slippage of the top vertebrae in the spinal column

____ 8. In paragraph T, what does the phrase *doing so* refer to?

a. saving energy by moving less
b. moving on four legs
c. consuming more food
d. traveling a greater distance

____ 9. Which of the following statements is an opinion on chimps, not a fact?
a. Chimps can't extend their knees or lock their legs straight.
b. Chimps are our closest living evolutionary relatives.
c. Chimps are well suited to teach us about ourselves.
d. Almost every bone in a chimp's body correlates with a bone in a human body.

____ 10. Which of the following statements is an opinion on human feet, not a fact?
a. They bear the full weight of our upright body.
b. They are the most characteristic peculiarity in the human body.
c. They do not possess thumblike opposable toes.
d. The ligaments that support the arch sometimes become inflamed.

DIRECTIONS: Complete the sentences. Choose the correct word.

a. assigned
b. compatible
c. crude
d. embedded
e. intricate
f. licensed
g. salvage
h. sensation
i. valid
j. vibrate

____ 11. The archeologists found the fossils ____ in a layer of dried mud.

____ 12. The historians want to ____ the decaying house because of its unique architecture.

____ 13. The embroidery pattern on the silk was ____ and detailed.

____ 14. The topic of butterfly migration was ____ as homework for the biology class.

____ 15. Some people like the ____ of falling because it gives them an adrenaline rush.

____ 16. Given the airline strike, not being able to get a flight home is a(n) ____ concern.

____ 17. He puts his phone on ____ mode when he goes for his classes.

____ 18. I think you should go to a(n) ____ professional rather than relying on home remedies.

____ 19. I can't use the new software because it is not ____ with my old computer.

____ 20. Although the tribes who live in the mountains do beautiful weaving, their pottery is ____ and simple.