Name: _____ Date: _____

# The Bamboo Bargain

Reading level 13 · 1315 words

On paper, the giant panda should not work. Molecular studies have shown that it is a true bear, a member of the family Ursidae, and its gut looks far more like a meat eater's than a plant eater's. It is very bad at breaking down cellulose and lignin, the tough stuff of plant cell walls. Yet roughly 99 percent of what a wild panda eats is bamboo. The result is a body that pushes huge amounts of barely digested plant matter straight through, taking out little energy and little protein on the way. A panda may empty its bowels up to forty times in a day. Biologists have spent decades on a question that sounds simple: how does an animal built for meat make a living on grass?

Even the basic numbers are less settled than a fact sheet suggests. The Smithsonian's National Zoo puts a panda's daily need at 70 to 100 pounds of bamboo, eaten over 10 to 16 hours. National Geographic gives 28 pounds and about 12 hours of every 24. Another summary reports 9 to 14 kilograms of shoots a day, or roughly 20 to 31 pounds. Those estimates differ by more than a factor of three. The honest reading is that no single figure fits every animal, every season and every part of the plant. What they agree on is that feeding fills a large part of each day, and that a panda moves as little as it can while it does. Its day, in other words, is mostly chewing and stillness.

Watch a panda feed and the first thing you notice is its grip. Beside its five digits sits a sixth pad that works like a thumb. It is not a finger at all but a long, enlarged wrist bone called the radial sesamoid, under a thick cushion of skin, and the bear pins bamboo stalks against it to strip them. In a 1978 essay, the scientist Stephen Jay Gould used this odd thumb to argue that poor design is better evidence for evolution than good design. A wrist bone doing a thumb's job was his example. The red panda, which is not a close relative, has a similar false thumb, and it, too, lives mostly on bamboo.

Why would a bear give up meat? One clue is in its genes. Tas1r1 builds the receptor that detects umami, the savory taste of meat, and in the panda it is broken. The loss has been dated to roughly 4.2 million years ago, at about the time its ancestors switched to plants, though the dates on both sides are loose. Fossils show some bamboo eating at least seven million years ago, while a diet of almost nothing else came only about 2 million years ago. It is tempting to say meat simply stopped tasting good, but the evidence is murkier. Horses and cows, strict plant eaters, still carry a working copy of the gene, and every bat examined has lost it or broken it, whatever it eats. The broken gene may be a cause of the switch, a result of it, or a coincidence.

The clearest progress has come from measuring energy. In a study published in Science in

July 2015, a team led by Fuwen Wei of the Chinese Academy of Sciences, with John Speakman of the University of Aberdeen, measured the daily energy use of three wild pandas in Foping Nature Reserve and five at the Beijing Zoo. The animals used only about 38 percent of the energy expected for mammals of their size. That rate is among the lowest reported in any mammal, close to that of sloths. Put another way, a 90-kilogram panda burns less than half the energy of a 90-kilogram person. Over a day, the wild bears covered an average of only about 20 meters an hour.

The same study traced this thrift to several sources at once. Pandas have extremely low levels of thyroid hormones, which help set the pace of metabolism. The likely reason is a mutation in a gene called DUOX2, which helps make those hormones. Their brains, livers and kidneys are small for bears, and smaller organs likely lower the body's energy demands. Their thick fur traps what little heat they make, and the surface of their bodies is much cooler than that of other black and white animals. Wei described the result as a whole set of changes, in body shape, behavior, chemistry and genes, working together. The panda is not lazy in any moral sense; it is built to run on almost nothing.

Running on almost nothing still leaves a problem of nutrition, and here the panda turns out to be a careful shopper. Researchers fitted GPS collars to six pandas in the Qinling Mountains and followed them for six years. The bears climbed from the valleys up the mountains in spring and came back down in autumn. As they went, they switched between the shoots and leaves of two kinds, arrow bamboo and wood bamboo. The summer food was high in protein but very low in calcium, which is needed to make milk and grow bone, and the winter food reversed the balance. As the ecologist David Raubenheimer put it, only by moving with the seasons can pandas get enough of both to breed. A diet that looks dull to us is, to the panda, a calendar.

A 2019 study in Current Biology then turned the whole paradox around. Instead of asking which foods pandas eat, the team used a method called nutritional geometry to ask which mix of protein, fat and carbohydrate they take in and absorb. About 50 percent of a panda's energy comes from protein. That is close to the shares recorded for feral cats, at 52 percent, and wolves, at 54 percent. Panda milk, too, has a nutrient mix like that of other meat eaters. Wei summed it up: by the foods they eat, pandas are plant eaters, but by the nutrients they absorb, they belong with the carnivores. The authors concluded that the evolutionary leap from meat to bamboo was likely smaller than scientists had assumed.

The diet may even explain the famous coat. Scientists long admitted they were not certain why pandas are black and white, a hard question because almost no other mammal looks like one. In 2017, Tim Caro of the University of California, Davis, and his colleagues compared patches of the panda's fur with those of 195 other carnivore species and 39 subspecies of bear. They treated each part of the body as a separate problem. Their answer was that the white face, neck, belly and rump help a panda hide in snow, while the black limbs hide it in

shade. A bamboo diet never lets it store enough fat to sleep through winter, so it must stay active all year, from snowy heights to warmer forests lower down, and it needs camouflage for both. The dark ears and eye patches, they suggested, may serve as signals.

Living on one plant carries its own risk. All the plants of one bamboo species tend to flower at the same time and then die, and many kinds flower only once every 65 or 120 years. So a panda needs at least two kinds of bamboo within reach to avoid starving. Today the wild animals are split among more than 30 small groups in a few mountain ranges of central China, and the loss of their forests remains the largest threat. A national survey released in 2015 counted 1,864 wild pandas, and a later estimate puts the number near 1,900. In 2016 the species was moved from endangered to vulnerable, and nearly 70 reserves have since been joined into one Giant Panda National Park. Whether the bamboo bargain began with a lost taste, a changing landscape, or both is still unresolved. The evidence keeps arriving one collared, chewing bear at a time.

## Questions

**1. What makes the giant panda's diet a paradox?**

A. It eats only meat but lives in a bamboo forest
B. It is a bear with a carnivore's gut that lives almost entirely on bamboo
C. It eats bamboo but cannot hold it

**2. Why does the book say the broken umami gene does not prove why pandas gave up meat?**

A. Horses and cows still have the gene, and bats lost it whatever they eat
B. Pandas can still taste meat perfectly
C. The gene was never studied

**3. What did the 2015 energy study find?**

A. Pandas use more energy than most bears
B. Pandas burn energy as fast as wolves
C. Pandas use only about 38 percent of the energy expected for their size

**4. In this book, what does "thrift" mean when it describes the panda's energy use?**

A. Fast growth
B. Careful saving
C. A kind of store

**5. Why do the Qinling pandas migrate up and down the mountains?**

A. To avoid other pandas
B. To find water
C. To get both protein and calcium from different bamboo at different seasons

**6. How does the bamboo diet connect to the panda's black and white coat?**

A. The panda cannot hibernate, so it needs camouflage for snow and shade all year

B. Bamboo turns the fur white

C. Black fur helps it digest bamboo

## Words to know

cellulose: plant wall material

sesamoid: small embedded bone

receptor: sensing molecule

metabolism: body's energy use

thrift: careful saving

camouflage: hiding by blending

# Answer key: The Bamboo Bargain

1. B. It is a bear with a carnivore's gut that lives almost entirely on bamboo
2. A. Horses and cows still have the gene, and bats lost it whatever they eat
3. C. Pandas use only about 38 percent of the energy expected for their size
4. B. Careful saving
5. C. To get both protein and calcium from different bamboo at different seasons
6. A. The panda cannot hibernate, so it needs camouflage for snow and shade all year