The Fat Paradox

How fat keeps us skinny
The body stores energy two ways:

- **Glycogen**
- **Fat**
Glycogen can be converted to glucose
Fatty acids cannot be converted to glucose
Cells in the brain can burn glucose but not fatty acids.
The brain uses 20% of the body’s energy

- The body relies on a steady blood glucose level (too much or too little are both bad)

Food for the brain  Brain cannot use

Glucose  Fatty acids
Yet most energy is stored as fat

1,600 calories stored
135,000 calories stored

Based on a typical 154-pound man.

Fat stores more calories in less space

Dry weight = 4 calories/gram
Hydrated = 1.33 calories/gram

Fat stores more calories in less space

135,000 calories

- Stored as fat = 33 pounds
- Stored as hydrated glycogen = 223 pounds
Implications for weight loss

• When we restrict calories, glycogen is depleted quickly (1 to a few days)

1,600 calories stored ➞ 2.6 pounds
Implications for weight loss

• When we restrict calories, glycogen is depleted quickly (1 to a few days)

1,600 calories stored

Depleting glycogen alone can result in a rapid 2.6-pound weight loss. This is why dieters often feel successful after the first week.
Implications for weight loss

2.6 pounds of glycogen is very different from 2.6 pounds of fat!

2.6 pounds of glycogen

2.6 pounds of fat
Fat stores more calories in less space

135,000 calories
• Stored as fat = 33 pounds
• Stored as hydrated glycogen = 223 pounds
33 pounds of glycogen vs. fat

20,000 calories
• 10 days

135,000 calories
• 68 days

Fat can keep us alive for much longer

(based on 2,000 calories per day)
**Chemistry**

**OXIDATION**

1. Carbons are separated . . .
2. . . . and more oxygen is added . . .
3. . . . to make carbon dioxide.

**REDUCTION**

1. Hydrogens (and their electrons) are stripped away
2. . . . and combined with oxygen . . .
3. . . . to make water.

Losing Electrons is Oxidation

Gaining Electrons is Reduction

LEO says GER!
• The carbons in fatty acids have more hydrogens (electrons) to lose during oxidation.
• Loss of electrons = more energy transferred.
Implications for evolution

• Fat allows us to carry a large energy reserve
• Storing more energy as fat conveyed a selective advantage: those with more fat reserves were more likely to survive famine and reproduce
• Excess fat storage was good.
Challenges for today

• Even though food is plentiful in the modern world, the body is still hard-wired to store extra energy as fat.

• Excess calories lead to excess fat. Today, obesity and related health problems are common.