Protein Denaturation Affects shape and Function

- **Denaturation**: The process by which proteins uncoil and lose their shape and function when they are exposed to heat, acids, bases, heavy metals, alcohol, and other damaging substances.

- Protein function is lost when a protein is denatured:
  - High fever
  - Blood pH out of normal range
  - During digestion

Stiffening egg whites adds air through the beating action, which denatures some of the proteins within them.
Protein Quality

Methods for estimating protein quality

- **Chemical score**: A method used to estimate a food’s protein quality; it is a comparison of the amount of the limiting amino acid in a food to the amount of the same amino acid in a reference food.

- **Protein digestibility corrected amino acid score (PDCAAS)**: A measurement of protein quality that considers the balance of amino acids as well as the digestibility of the protein in the food. Proteins with higher digestibility are more complete.
  - Animal protein sources, such as meat and dairy products, are highly digestible, as are many soy products; we can absorb more than 90% of these protein sources.
  - Legumes are also highly digestible (about 70% to 80%).
  - Grains and many vegetable proteins are less digestible, with PDCAAS values ranging from 60% to 90%.
Protein Adequacy

- Nitrogen balance determines protein needs
  - **Positive nitrogen balance**: consuming more nitrogen than is excreted
    - Growth
    - Pregnancy
    - Recovery from illness or protein deficiency
  - **Negative nitrogen balance**: excreting more nitrogen than is consumed
    - Starvation or low-energy diets
  - In **nitrogen balance**: intake equals excretion
Protein Adequacy

Nitrogen consumption > Nitrogen excretion

Positive Nitrogen Balance
Needed for periods of growth, pregnancy, recovery from illness, or protein deficiency

Nitrogen consumption < Nitrogen excretion

Negative Nitrogen Balance
Results from starvation, consumption of very-low-energy diets, severe illness, infections, serious burns, or injuries

Nitrogen consumption = Nitrogen excretion

Nitrogen Balance
Found in healthy adults who are not pregnant
Too Much Protein Can Be Harmful

- Kidney disease
  - High protein diets can increase risk of kidney diseases in susceptible people
  - Maximum of 2 g of protein per kilogram body weight each day is safe for healthy people
  - Important to drink more water with higher protein intake
    - Increases urea production
    - Fluid needed to flush excess urea from kidneys
Amino acids

\[ \text{H} \quad \text{H} \quad \text{N} \quad \text{H} \quad \text{H} \quad \text{N} \quad \text{H} \quad \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \quad \text{N} \quad \text{C} \quad \text{N} \quad \text{H} \]

Ammonia

Carbon dioxide

\[ \text{H} \quad \text{N} \quad \text{H} \quad \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \quad \text{N} \quad \text{C} \quad \text{N} \quad \text{H} \]

Urea

Liver

Kidney

Urea transported to the bladder and excreted in the urine
Protein Sources

- Meats
- Dairy products
- Eggs
- Legumes (including soy)
- Whole grains
- Nuts
- "New foods" (quinoa which provides 8 g of protein in a 1-cup serving.)
Kwashiorkor

- Disease resulting from low protein intake

- Kwashiorkor symptoms include:
  - Some weight loss and muscle wasting
  - Retarded growth and development
  - Edema resulting in distention of the belly
  - Fatty degeneration of the liver
  - Loss of appetite, sadness, irritability, apathy
  - Skin problems and hair loss