Unit B: Seed Germination, Growth, and Development

Lesson 1: Identifying Seed Germination Processes and Requirements

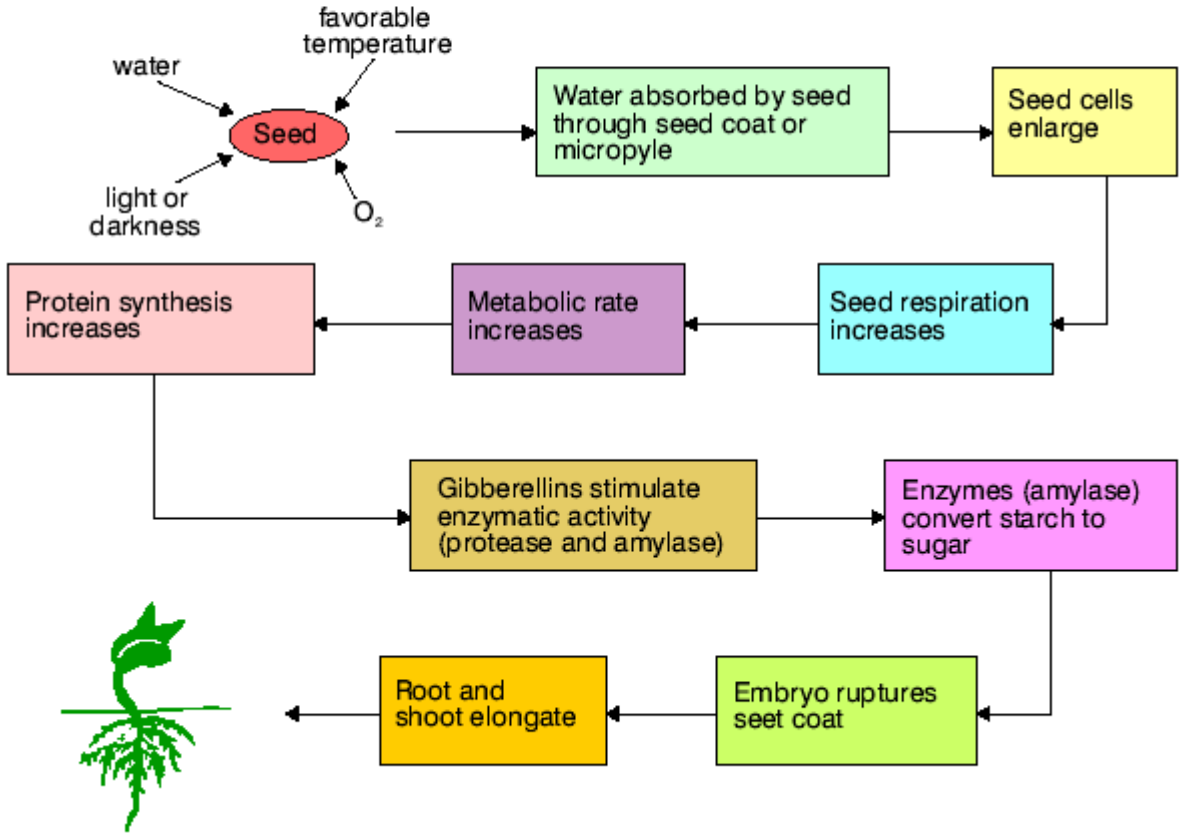
Terms

- Amylase
- Germination
- Phytochrome
- Protease
- Scarification
- Stratification
- Turgid
- Viability
- Vigor

What is the Process of Seed Germination?

- I. **Germination** is the process by which the seed embryo begins growth. A seed is considered to have germinated when the embryonic root emerges from the seed coat. Many important crops are grown from seed. Wheat, rice, cotton, and vegetables are started from seeds. Seed germination is a complex process that begins when conditions are favorable for growth.
  - A. Some plants produce seeds, which germinate immediately once they are released. Others produce seeds that have internal dormancy mechanisms and remain dormant until conditions are favorable before the seed can germinate.

THE GERMINATION PROCESS



Stratification

- ***Stratification*** is a dormancy mechanism that involves temperature. Seeds with this mechanism must experience a period of cold temperature before the seed can germinate.

Scarification

- ***Scarification*** is a dormancy mechanism that involves the breakdown of the seed coat. Some plants have very thick and tough protective seed coats. These seed coats prevent water and oxygen from entering the seed. The seed coat must be broken before germination can begin. The seed coat can be damaged or broken by the acid produced in the animal stomach, soil micro organisms, repeated freezing and thawing, mechanical stress from the grinding in the gizzard of birds, being stepped upon, chewed, etc.

Stages of Germination

- There are three major stages in the germination process.

- Stage 1:
  - Germination begins with the seed's absorption of water. Most dormant seeds have 5–10% moisture content. When conditions are right, water is absorbed very rapidly. Most water is absorbed through the micropyle. As the cells hydrate, they swell and become **turgid** or rigid. The moisture triggers an increase in cellular respiration. Oxygen must be present for cellular respiration.

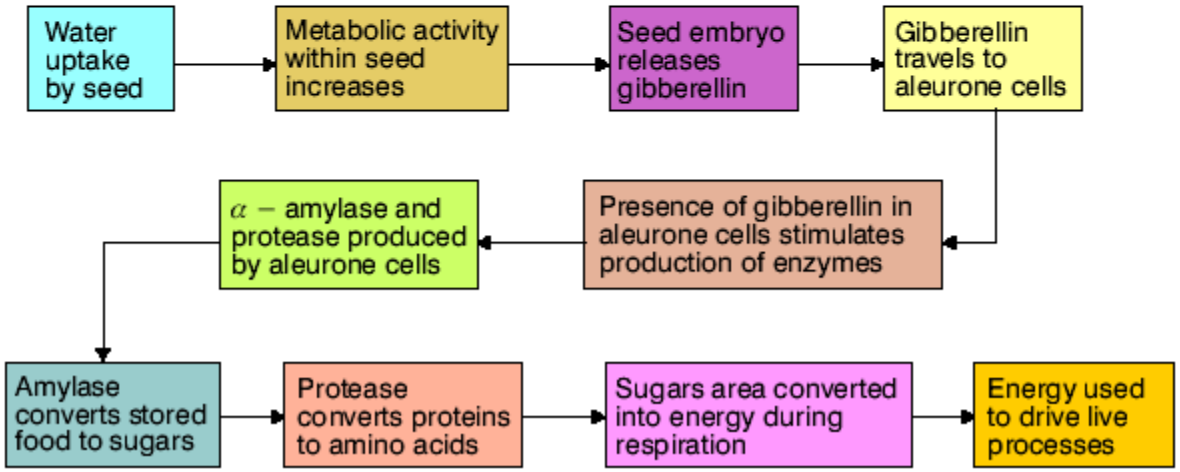
Stages of Germination

- In stage two, metabolic activity surges. Proteins are synthesized. Gibberellins stimulate the production of enzymes. The enzyme **amylase** converts stored starches to sugars. The enzyme **protease** breaks down stored proteins into amino acids. The sugars and amino acids are directed towards cell division, growth, and differentiation sites at the root and shoot meristems or tips.

Stages of Germination

- Metabolic processes increase in the third phase of germination. The swelling of cells causes the seed coat to rupture. The primary root or radicle emerges downward, and the stem grows upwards. The shoot begins manufacturing food through photosynthesis. The roots absorb water and nutrients.

ENZYME ACTIVITY DURING GERMINATION



What Conditions are Required for Seed Germination?

- Germination begins when favorable conditions exist for the survival of the developing plant.
- The conditions for germination include moisture, air, optimal temperatures, and possibly light or darkness.
  - Water triggers germination processes and is necessary as the embryo grows and develops.

- All seeds need oxygen to germinate. Oxygen is required for cellular respiration, a process necessary for converting stored food into energy. Seeds germinate at a wide range of temperatures,ranging from 0°C to 40.6°C. However, the optimum temperature for most seeds lies between 18.3°C and 26.7°C. Temperature influences the speed of metabolic activities. Metabolism is faster when temperatures are warm than when temperatures are cool.

- Seeds of some plants need exposure to light before they will germinate. Seeds of other plants require darkness in order to germinate, and there are those that are not influenced by light or darkness. Seeds that are light sensitive have a photoreceptor pigment, called ***phytochrome***, found in the seed coat. This pigment sends messages to the seed instructing it to initiate or to stop germination.

FAVORABLE TEMPERATURES FOR GERMINATION

Crop	Minimum (°C)	Optimum (°C)
Maize	10	23.9
Rice	15	25
Pea	4.4	23.9
Snap bean	15.6	29.4
Sorghum	10	23.9
Barley	5	24
Squash	15.6	35
Tomato	10	23.9
Wheat	1.7	18.3

Why is Seed Quality Important?

- Seed quality and proper storage of seed are crucial to achieving desired high germination rates. High quality seeds produce healthy seedlings. Seed quality refers to both viability and vigor.
  - **Viability** is the ability of seeds to germinate under optimal conditions.

- **Vigor** is the ability of seeds to germinate under different conditions and still produce healthy plants.

-Seed producers test seeds to determine the percentage of seeds that will germinate. Germination rates from the tests are printed on the seed container label.

- Until the seeds are sold and planted they must be kept in storage. A goal is to maintain seed viability and vigor during the storage period. The best seed storage conditions typically consist of cool temperatures (about 4.4°C) and low humidity (approximately 15%).

Review/Summary

1. What is the process of seed germination?
2. What conditions are required for seed germination?
3. Why is seed quality important?