39.4 - Fertilization and Development
- Sperm swim through the uterus into the Fallopian tubes.
- The egg has a **protective layer** with **binding sites** for sperm.
- Once attached, the sperm releases **enzymes** that break down the protective layer of the egg.
- The sperm nucleus enters the egg, and chromosomes from the sperm and egg are brought together.
39–4 Fertilization and Development

From ovulation to implantation

Fallopian tube
Zygote
2 cells 4 cells
Fertilization
Ovulated secondary oocyte
Ovary
Endometrium
Day 0
Day 1
Day 2
Day 3
Day 4
Inner cell mass
Uterus
Blastocyst implants
Embryo
Muscle layer

Copyright Pearson Prentice Hall
While still in the Fallopian tube, the zygote begins to undergo **mitosis**.

Four days after fertilization, the embryo is a solid ball of about 64 cells (a **morula**).
The **morula** grows and becomes a **hollow** structure with an **inner cavity** called a **blastocyst** which attaches to the uterine wall.

- The embryo secretes enzymes that **digest a path into it**.
- Blastocyst cells **specialize** due to the activation of genes.
- The **inner cell mass** (a cluster of cells) develops within the inner cavity of the blastocyst.
- The embryo will develop from these cells, while the other cells will differentiate into tissues that surround the embryo.
Fertilization and Implantation

1. **Fertilization**
   - Sperm cells
   - Zygote
   - Fertilization
   - Day 0
   - Ovulation

2. **Implantation**
   - 2 cells
   - 4 cells
   - Morula
   - Fallopian tube
   - Blastocyst
   - Blastocyst implants into uterine wall
   - Uterine wall
   - Ovary
   - Day 7
The inner cell mass of the blastocyst gradually sorts itself into two layers, which then give rise to a third layer.
The third layer is produced by a process of cell migration known as **gastrulation**.
The result of gastrulation is the formation of three cell layers – the **ectoderm**, the **mesoderm**, and the **endoderm**.
- The **ectoderm** develops into the skin and nervous system.
- The **endoderm** forms the digestive lining and organs.
- **Mesoderm** cells differentiate into internal tissues and organs.
- **Neurulation** is the development of the nervous system.

- Shortly after gastrulation is complete, a block of mesodermal tissue begins to differentiate into the **notochord**.
As the notochord develops, the neural groove changes shape, producing neural folds.
Gradually, these folds move together to create a neural tube from which the spinal cord and the nervous system develop.
As the embryo develops, membranes (amnion and chorion) form to protect and nourish the embryo.

Fluid-filled amniotic sac cushions and protects the developing embryo.
The chorionic villi and uterine lining form the **placenta**.

The placenta connects the mother and developing embryo.
After eight weeks, the embryo is called a **fetus**.

After three months, most major organs and tissues are formed. The **umbilical cord** also forms.

The umbilical cord connects the fetus to the placenta.

The inner cell mass contains embryonic stem cells, unspecialized cells that can differentiate into nearly any specialized cell type.
4–6 months after fertilization:

- The heart can be heard with a stethoscope.
- Bone replaces cartilage that forms the early skeleton.
- During the last 3 months, fetus doubles mass, heart and lungs completely develop.
The mother’s posterior pituitary gland releases the hormone **oxytocin**.

- These muscles begin rhythmic contractions (**labor**).
- The opening of the cervix expands until it is large enough for the head of the baby to pass through it.
- The amniotic sac breaks.
- Contractions force the baby out through the vagina.
The baby now begins an independent existence. Its systems quickly adapt to life outside the uterus, supplying its own oxygen, excreting waste on its own, and maintaining its own body temperature.
Multiple Births

If two eggs are released during the same cycle and fertilized by two different sperm, fraternal twins result.

A single zygote may split apart to produce two embryos, which are called identical twins.
Early Years

The first two years of life are called infancy. It is a period of rapid growth and development.

Childhood lasts from infancy until puberty.

Adolescence begins with puberty and ends with adulthood.

Puberty produces a growth spurt that will conclude in mid-adolescence.
Adulthood

Development continues during adulthood. Adults reach their highest levels of physical strength and development between the ages of 25 and 35.

Most people begin to show signs of aging in their 30s. Around age 65, most body systems become less efficient, making homeostasis more difficult to maintain.