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Chapter II. Stages of Embryonic Development

I. First Week of Embryonic Development

I. 2. Segmentation (Cleavage)

The **segmentation** (or **cleavage**) phase follows immediately after fertilization. It enables the transition from a **unicellular** state to a **multicellular** state. Segmentation corresponds to the first mitotic divisions of the zygote into daughter cells called **blastomeres**.

In placental mammals, the zygote divides within its **zona pellucida**. Initially, the blastomeres are nearly ovoid and adhere to their neighbors only over a limited surface area. This segmentation is **total** (holoblastic) and roughly **synchronous**, as the different parts of the egg segment at approximately the same rate.

All these divisions are characterized by an **absence of growth**; as a result, throughout the segmentation process, the blastomeres start large and progressively become smaller. The embryo, still surrounded by the zona pellucida, remains the same overall size as the original fertilized egg.

The embryo passes through the **2, 4, 8, 16, and 32-blastomere stages**, reaching a variable number of cells depending on the animal species. These cells remain clustered together, and the embryo takes on the appearance of a small blackberry, called a **morula**.

Although the blastomeres formed at the beginning of segmentation are morphologically similar, biochemical differences likely exist very early on, as a morphological difference becomes apparent at the **morula stage**.

At the **8-cell stage**, cells establish close contact with each other and acquire polarity:

- ✓ **Microvilli**, previously distributed uniformly over the entire surface, become localized in the areas of the surface facing outward.
- ✓ The non-polarized cells, which are large (**macromeres**), form the **embryoblast** (inner cell mass), which gives rise to the embryo proper. Meanwhile, the smaller, polarized outer cells (**micromeres**) form the **trophoblast**, which gives rise to extra-embryonic structures.

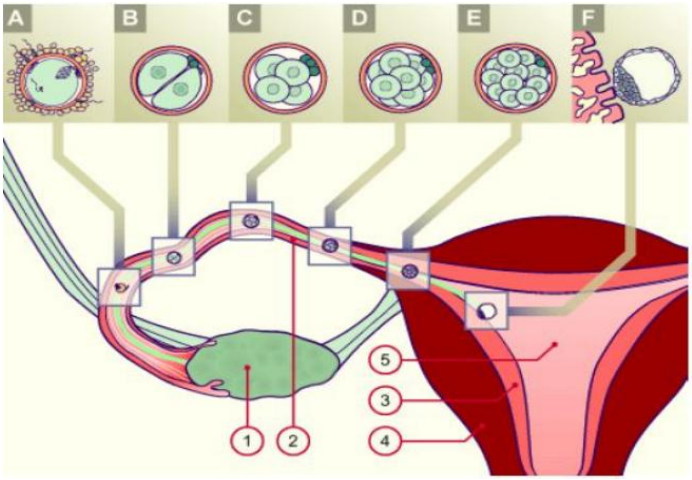
1.3. Tubal Migration

After fertilization, the egg undergoes segmentation while continuing to be transported from the outer third of the Fallopian tube toward the uterine cavity. Thus:

- ✓ **By the 4th day:** The **morula** is located at the utero-tubal junction.
- ✓ **By the 5th and 6th days:** The **blastocyst** is free within the uterine cavity.

This migration is facilitated by:

- ✓ The beating of the **cilia** of the tubal epithelium.
- ✓ Secretions from the cells of the tubal mucosa.
- ✓ **Peristaltic contractions** of the smooth muscle cells in the tubal wall.



Anatomical Structures (1–5)

1. **Vary**
2. **Uterine tube** (or **Fallopian tube** / **Oviduct**)
3. **Endometrium** (Uterine lining)
4. **Myometrium** (Uterine muscle layer)
5. **Uterine cavity**

Developmental Stages (A–F)

A. **Fertilized egg (or Zygote)**
B. **Two-cell stage**
C. **Four-cell stage**
D. **Eight-cell stage**
E. **Morula** (16-cell stage)
F. **Blastocyst**

Figure 1: Diagram of Segmentation and Tubal Migration (in Humans)

1.4. Blastocyst Formation

Intercellular gaps appear, and an influx of fluid from the outside passes through the **zona pellucida** into these gaps within the morula. These fluid-filled spaces coalesce into a single cavity, leading to the separation of two cellular groups (**trophoblast** and **embryoblast**). This cavity is the **blastocoel**, marking the transition from a morula to a **blastocyst**.

The survival of the blastocyst depends on uterine secretions, also known as **uterine milk**. Progesterone plays a key role in maintaining environmental balance, as does the zona pellucida, which enables water retention within the blastocyst despite the presence of more concentrated secretions outside.

The loss of the **zona pellucida** (hatching) appears necessary for implantation to proceed normally. At the blastocyst stage, the embryo ruptures this zona pellucida through increased pressure exerted by the **blastocoel** (physical factor). It is assisted by **enzymes** (chemical factor) secreted by the **trophoblast cells**, which degrade the zona pellucida at the **abembryonic pole** (anti-embryonic pole). This entire process occurs under the influence of uterine secretions and **progesterone**, which control them.

1.5 Pre-implantation Period

Implantation into the uterine mucosa is always preceded by a more or less extended period known as **pre-implantation**, during which the blastocyst remains free within the uterine lumen. The blastocyst feeds on the secretions of the uterine glands (**uterine milk**), which are at their peak activity. The absence of nutrient reserves in the **alecithal egg** of mammals forces the embryo to establish intimate contacts very early on.

This pre-implantation period lasts:

- ✓ **2 days** in humans
- ✓ **15 to 20 days** in bitches (dogs)
- ✓ **30 to 35 days** in cows
- ✓ **40 to 45 days** in mares (horses)