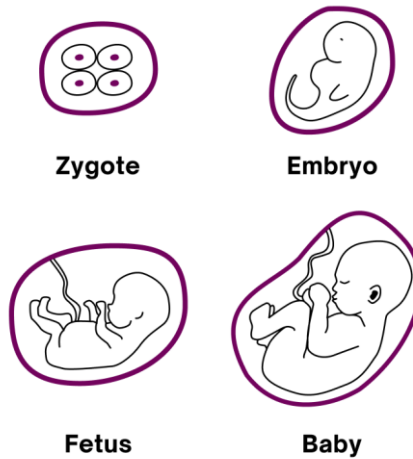




Nutritional Physiology and Metabolic Changes in Pregnancy



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Learning Outcomes:

Explain the key physiological and metabolic adaptations that occur during pregnancy.

Describe how these changes affect nutrient metabolism and requirements.

Identify the critical nutrients needed to support maternal health and fetal growth.

Analyze the effects of inadequate or excessive nutrition during pregnancy on maternal and fetal outcomes.

Apply knowledge of nutritional physiology to assess and plan appropriate dietary strategies for pregnant women.



How Do You Get Pregnant? | Planned Parenthood Video

The First Trimester of Pregnancy

Pregnancy and Metabolism



Introduction to Pregnancy Physiology

Pregnancy physiology refers to the **systemic anatomical, hormonal, and metabolic adaptations** that occur in a woman's body to support **fetal growth, development, and successful childbirth.**

Purpose of Physiological Adaptations

To provide a **nutrient-rich environment** for the developing fetus.

To prepare the maternal body for **delivery and lactation.**

To maintain **homeostasis** despite the increased metabolic and circulatory demands.

Note/ Homeostasis means the body's ability to maintain a stable internal environment — like keeping temperature, blood sugar, and water balance within normal limits — even when the outside world changes.

Phases of Pregnancy

First Trimester (0–13 weeks)

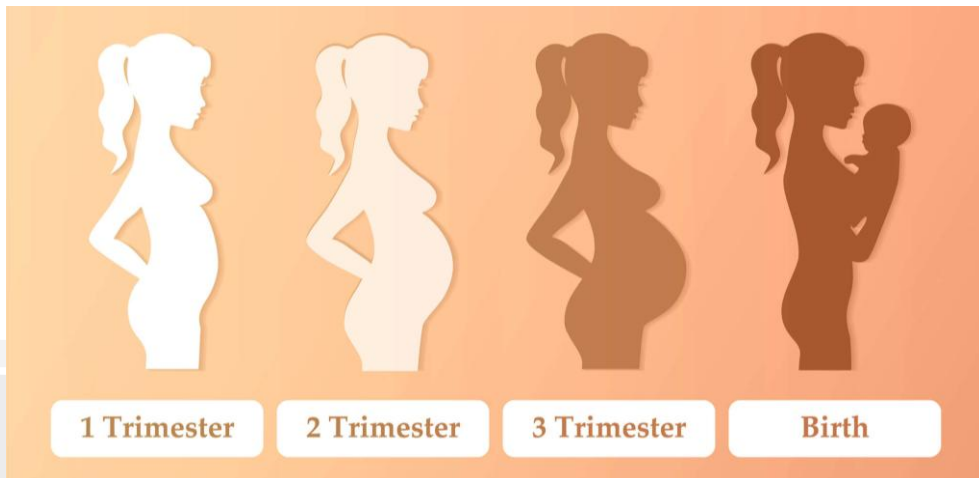
- Organogenesis and placental formation.
- Nausea, vomiting, and fatigue are common due to hormonal surges.

Second Trimester (14–27 weeks)

- Rapid fetal growth and organ maturation.
- Increased blood volume and appetite.

Third Trimester (28–40 weeks)

- Maximal fetal growth.
- Higher maternal energy and nutrient needs.



Major Physiological Systems Involved in Pregnancy

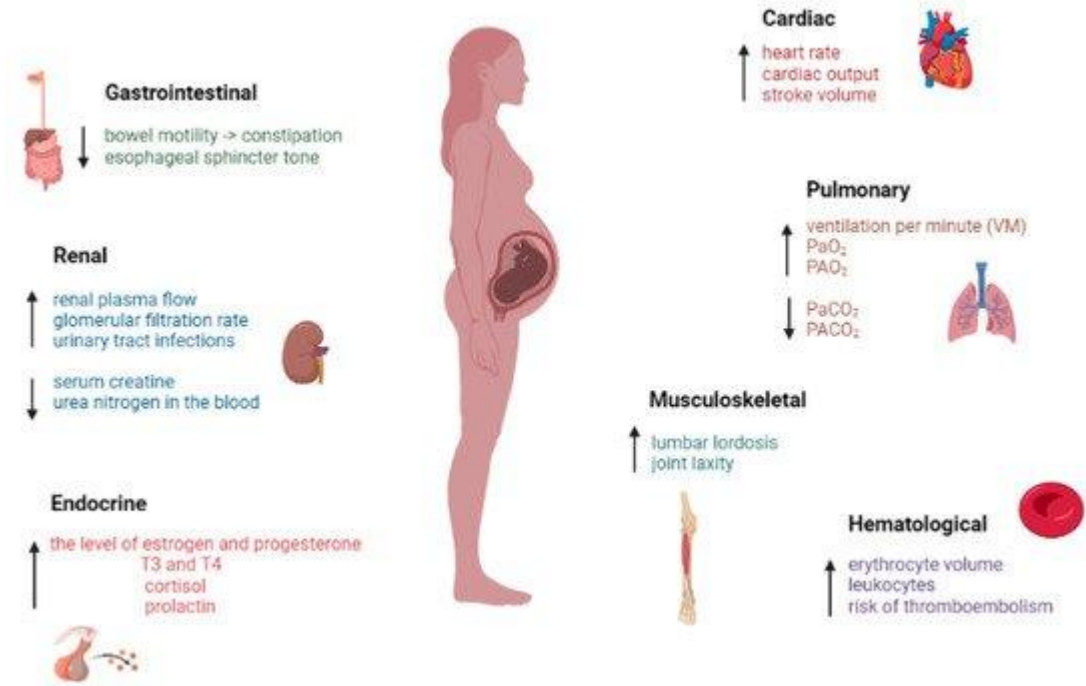
Endocrine System: Hormonal changes regulate metabolism, growth, and nutrient transport.

Cardiovascular System: Adjusts blood flow to meet uteroplacental circulation needs.

Respiratory System: Increases oxygen delivery.

Renal System: Enhances waste removal and maintains fluid balance.

Gastrointestinal System: Improves nutrient absorption but slows motility.





Key Hormonal Changes

Estrogen:
Stimulates uterine growth and blood flow.

Human Chorionic Gonadotropin (hCG): Maintains the corpus luteum in early pregnancy.

Cortisol:
Increases maternal glucose availability.

Progesterone:
Maintains pregnancy and relaxes smooth muscles.

Human Placental Lactogen (hPL): Promotes maternal fat metabolism and insulin resistance.

Placental Role

Acts as the **interface** between mother and fetus.

Produces hormones critical for pregnancy maintenance.

Facilitates **gas exchange, nutrient delivery, and waste removal.**



Nutritional Importance

Adequate and balanced nutrition supports physiological adaptation.

Deficiencies or excesses can disrupt metabolic and hormonal balance, affecting both mother and fetus.

General Terminologies Related to Pregnancy

Conception:

The process when a sperm cell fertilizes an ovum (egg), marking the beginning of pregnancy.

Fertilization:

The union of the sperm and egg to form a single cell (zygote).

Zygote:

The first cell formed after fertilization; it contains genetic material from both parents.

Implantation:

The attachment of the developing zygote (now a blastocyst) to the lining of the uterus, usually about 6–10 days after fertilization.

Embryo:

The developing organism from implantation until the end of the 8th week of pregnancy, during which major organs begin to form.

Fetus:

The developing baby from the 9th week of pregnancy until birth, when growth and organ maturation occur.



Baby (Neonate): The newborn child after birth.

Gestation: The entire period of pregnancy from conception to birth, typically around 40 weeks in humans.

Trimester: One of the three stages of pregnancy, each lasting about three months.

Placenta: The temporary organ that connects the mother and fetus for nutrient, gas, and waste exchange.

Amniotic Fluid: The clear liquid within the amniotic sac that cushions and protects the developing baby.

Amniotic Sac: The fluid-filled membrane that surrounds and protects the fetus during pregnancy.

Umbilical Cord: The cord connecting the fetus to the placenta, containing blood vessels that carry oxygen and nutrients.

Due Date (Estimated Date of Delivery): The predicted date when childbirth is expected, calculated from the first day of the last menstrual period (LMP).

2. Maternal Physiological Changes

Pregnancy is not just “carrying a baby” — it’s a complete physiological transformation.

From conception to birth, a woman’s body coordinates thousands of adjustments to support the developing fetus, sustain maternal health, and prepare for delivery and lactation.

These changes unfold gradually through **three trimesters**, each with distinct metabolic, hormonal, and nutritional demands.

Trimester	1 st trimester				2 nd trimester				3 rd trimester			
Month	0	1	2	3	3	4	5	6	6	7	8	9
Week	0-4	5-8	9-12	13	14-17	18-21	22-25	26-27	28-30	31-34	35-38	39-42



1 Anabolic Phase (Mainly in the 1st & 2nd Trimesters)

“Store and build”
The mother’s body acts like it’s saving for the future — storing nutrients, building tissues, and preparing for the rapid fetal growth coming later.

2 Catabolic Phase (Mainly in the 3rd Trimester)

“Break and deliver”
Now, the baby needs more — and the mother’s body shifts gears, breaking down stored energy to feed the fetus.



Aspect	Anabolic Phase	Catabolic Phase
Timing	1st & 2nd trimesters	3rd trimester
Purpose	Build & store nutrients	Release & supply nutrients
Metabolism	Constructive (storage)	Destructive (breakdown)
Insulin	Sensitive (stores glucose)	Resistant (spares glucose for fetus)
Energy source (for mother)	Glucose	Fatty acids
Fetal growth	Slow-moderate	Rapid

The following Changes based on the Trimester:

Maternal Physiological Changes

Metabolic Adjustments

Nutrient Requirements and Utilization

Fetal Growth and Development

Nutritional Implications and Disorders

Practical Nutrition Considerations

1st Trimester	Month	Weeks
	0	0 - 4
	1	5 - 8
	2	9 - 12
	3	13
2nd Trimester	Month	Weeks
	3	14 - 17
	4	18 - 21
	5	22 - 25
	6	26 - 27
3rd Trimester	Month	Weeks
 <small>@Dr.Funny.Medico</small>	6	28 - 30
	7	31 - 34
	8	35 - 38
	9	39 - 42



1 First Trimester (Weeks 1–13)

Maternal Physiological Changes

Rapid hormonal surge — mainly **hCG, progesterone, and estrogen** — triggers early symptoms (nausea, fatigue, mood swings).

Blood volume begins to increase, but cardiac output and oxygen demand rise only slightly.

The placenta starts developing, establishing the nutrient and oxygen transfer system.

Metabolic Adjustments

The mother's metabolism is still **anabolic**, storing nutrients in preparation for fetal needs.

Mild insulin sensitivity is maintained; glucose utilization slightly increases for the developing embryo.

Nausea and vomiting (morning sickness) can reduce nutrient intake.



Nutrient Requirements and Utilization

Energy: Minimal increase; about +100 kcal/day.

Folate: Needed to prevent neural tube defects — 400–600 µg/day recommended.

Iron: Demand starts to rise as red cell mass expands.

vitamin B6 and ginger reduce or relieve feelings of nausea

Fetal Growth and Development

Foundation stage — all **major organs (organogenesis)** form by week 12.

Fetal heart starts beating; limbs and facial features develop.

Adequate folate, zinc, and vitamin A (in moderation) are key.

Nutritional Implications and Disorders

Poor nutrition or folate deficiency → neural tube defects.

Severe vomiting (hyperemesis gravidarum) → dehydration and electrolyte imbalance.

Practical Nutrition Considerations

Small, frequent meals to combat nausea.

Avoid high-risk foods (raw fish, unpasteurized cheese, processed meats).

Start prenatal supplements early.



2 Second Trimester (Weeks 14–27)

Maternal Physiological Changes

Most women feel better — “honeymoon period” of pregnancy.

Blood volume and cardiac output increase significantly (~30–50%).

Breasts enlarge; uterus expands; skin pigmentation changes.

Metabolic Adjustments

Shift toward **anabolic metabolism** continues — body stores fat, protein, and glycogen.

Insulin sensitivity begins to decrease to ensure glucose availability for the fetus.

Nutrient Requirements and Utilization

Energy: +340 kcal/day.

Protein: +25 g/day to support fetal and uterine growth.

Iron and calcium demands rise sharply.

Vitamin D and **omega-3 fatty acids (DHA)** critical for brain and bone development.



Fetal Growth and Development

Fetus grows rapidly; skeleton begins to ossify.

Nervous system and sensory organs mature.

Placenta fully functional — main nutrient exchange site.

Nutritional Implications and Disorders

Iron deficiency anemia risk increases.

Constipation and heartburn become common due to progesterone's effect on smooth muscles.

Excess weight gain can begin if diet isn't controlled.

Practical Nutrition Considerations

Balanced meals with **iron-rich foods** (meat, beans, leafy greens).

Combine **vitamin C** with iron for better absorption.

Encourage hydration, physical activity, and fiber intake to prevent constipation

3 Third Trimester (Weeks 28–40)

Maternal Physiological Changes

Exponential growth of uterus; pressure on diaphragm → shortness of breath.

Increased heart rate and blood pressure possible.

Edema and **leg cramps** common due to fluid retention.

Metabolic Adjustments

Marked **catabolic phase** — maternal tissues break down fat to supply fetal energy.

Insulin resistance peaks to shunt more glucose to the fetus.

Basal metabolic rate highest of all trimesters.

Nutrient Requirements and Utilization

Energy: +450 kcal/day.

Protein, calcium, magnesium, and omega-3s crucial for fetal brain and bone growth.

Iron: Required for final fetal stores — anemia at this stage increases risk of preterm delivery.

Water: Adequate hydration supports amniotic fluid volume.



Fetal Growth and Development

Final maturation — lungs, brain, and fat stores develop.

Average fetal weight increases from 1 kg to 3–3.5 kg.

Calcium transfer peaks; 80% of fetal calcium is deposited in this trimester.

Nutritional Implications and Disorders

Risk of **gestational diabetes**, **hypertension**, and **preeclampsia** if dietary control is poor.

Edema may worsen with excessive sodium.

Insufficient calcium → maternal bone loss.

Practical Nutrition Considerations

Monitor weight gain closely.

Eat smaller, frequent meals to ease gastric discomfort.

Limit salt; prioritize complex carbs, lean proteins, and calcium-rich foods.

Prepare for **lactation** — increase fluid and continue multivitamin supplementation.




Trimester	Energy ↑	Nutrients	Focus	Common Issues
1st	+100 kcal	Folate, B6, Iron	Organ formation	Nausea, vomiting
2nd	+340 kcal	Protein, Iron, Calcium, DHA	Rapid growth	Constipation, heartburn
3rd	+450 kcal	Iron, Calcium, Omega-3, Magnesium	Brain & fat development	Edema, gestational diabetes



Assignments:

1. Why are vitamin A, liver, and caffeine considered bad during pregnancy?
2. How many kilograms is normal to gain during pregnancy?



How many kilograms is normal to gain during pregnancy?

First trimester: only about 1–2 kg total.

Second & third trimesters: about 0.4 kg/week (if normal weight).

Pre-pregnancy BMI	Category	Recommended Weight Gain (kg)	Average per week (2nd–3rd trimester)
< 18.5	Underweight	12.5 – 18 kg	~0.5 kg/week
18.5 – 24.9	Normal weight	11.5 – 16 kg	~0.4 kg/week
25 – 29.9	Overweight	7 – 11.5 kg	~0.3 kg/week
≥ 30	Obese	5 – 9 kg	~0.2 kg/week



Thank
You