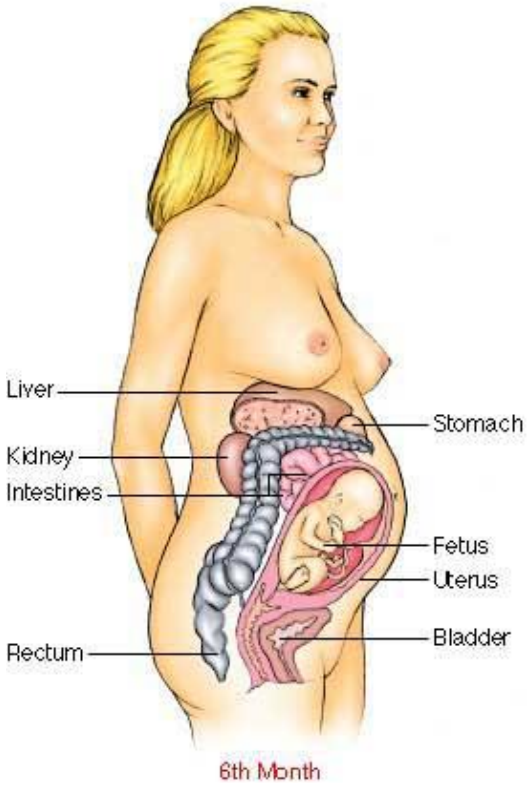
Chapter 15

Life Cycle Nutrition: Pregnancy and Lactation

Nutrition Science and Applications
Dr. Crosier
Presented by: Kellie Henderson & Jennifer Looney

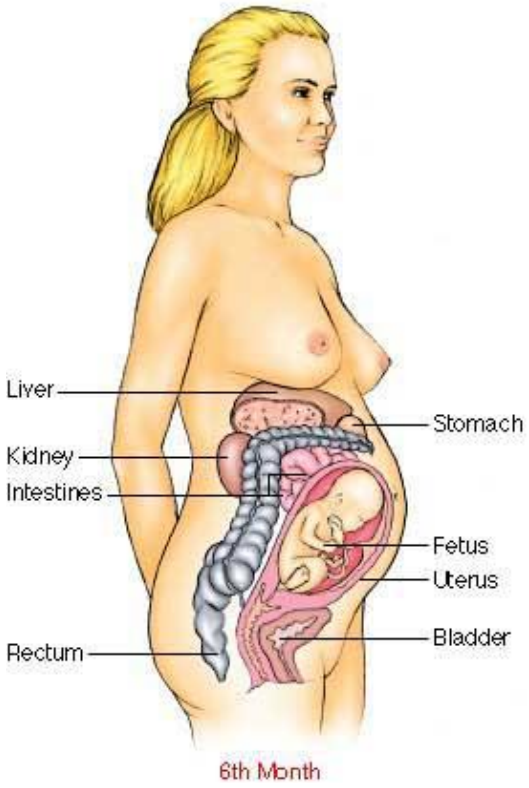
Physiology of Pregnancy



Changes in Circulatory system

- Blood volume expands
- Increased cardiac output
- Blood pressure changes

Physiology of Pregnancy



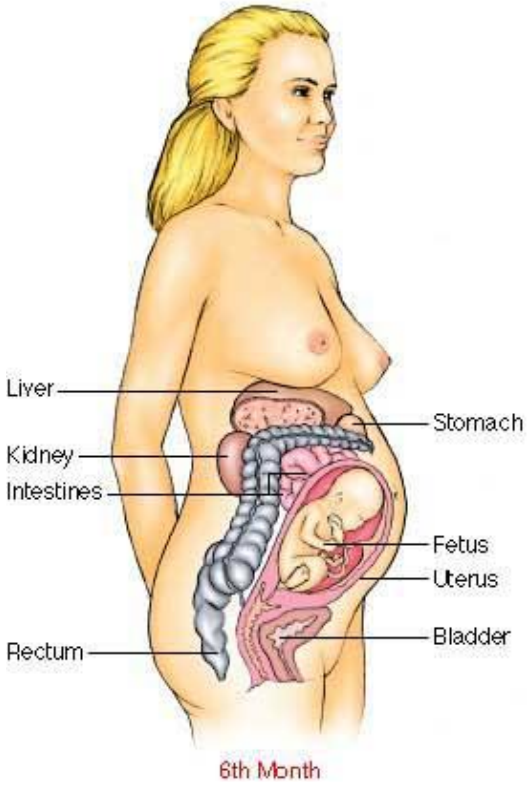
Changes in Respiratory system

- Oxygen requirements increase
- Slight increase in respiratory rate
- Greater "tidal volume"

Gastrointestinal Changes

- Decreased motility in gut
- Constipation
- Esophageal reflux
- Nausea and vomiting

Physiology of Pregnancy



- Kidneys
  - Increased filtration rate
  - Increased risk of UTI
- Basal metabolism
  - Increased BMR
  - Increased body temperature

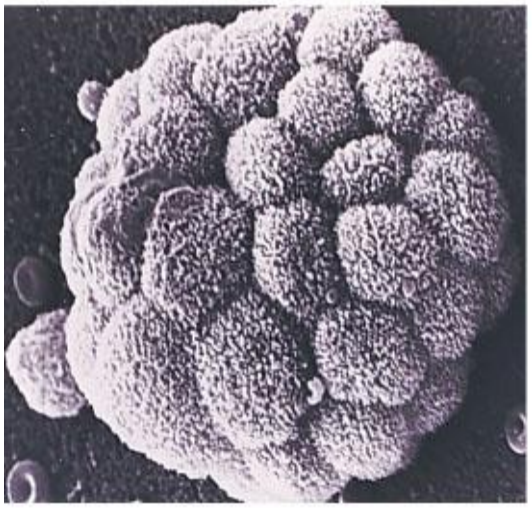
Placental Development

- **Placenta**-fetus receives nutrients and oxygen and returns CO_2 and other waste products.

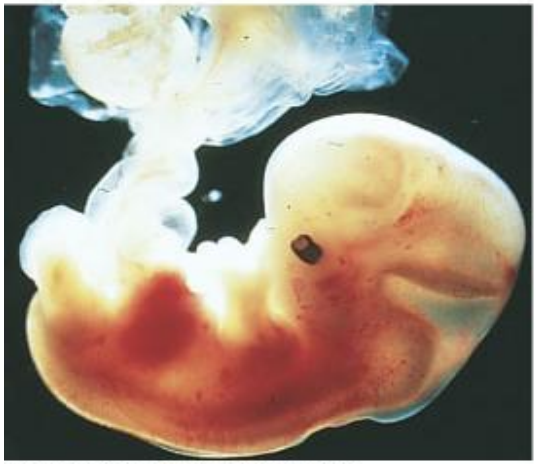
- **Amniotic Sac-**the fluid-filled balloon-like structure that houses the fetus.

- **Umbilical Cord-** a rope-like structure containing fetal blood vessels that extend through the fetus's "belly button" to the placenta.

Fetal Growth and Development



1 A newly fertilized ovum is about the size of a period at the end of this sentence. This **zygote** at less than one week after fertilization is not much bigger and is ready for implantation.



2 After implantation, the placenta develops and begins to provide nourishment to the developing embryo. An **embryo** 5 weeks after fertilization is about ½ inch long.

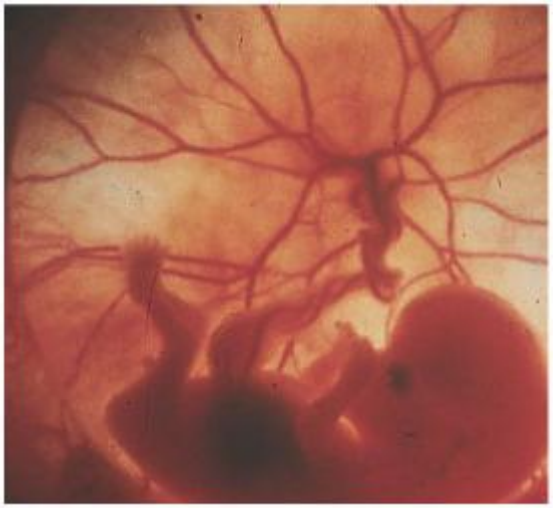
Stage 1: Zygote

- 1st two weeks.
- Implantation-with in two weeks of conception.

Stage 2: Embryo

- 2-8 weeks after conception.
- 1 ¼ in embryo has a complete central nervous system, a beating heart and a digestive system.

Fetal Growth and Development



3 A **fetus** after 11 weeks of development is just over an inch long. Notice the umbilical cord and blood vessels connecting the fetus with the placenta.

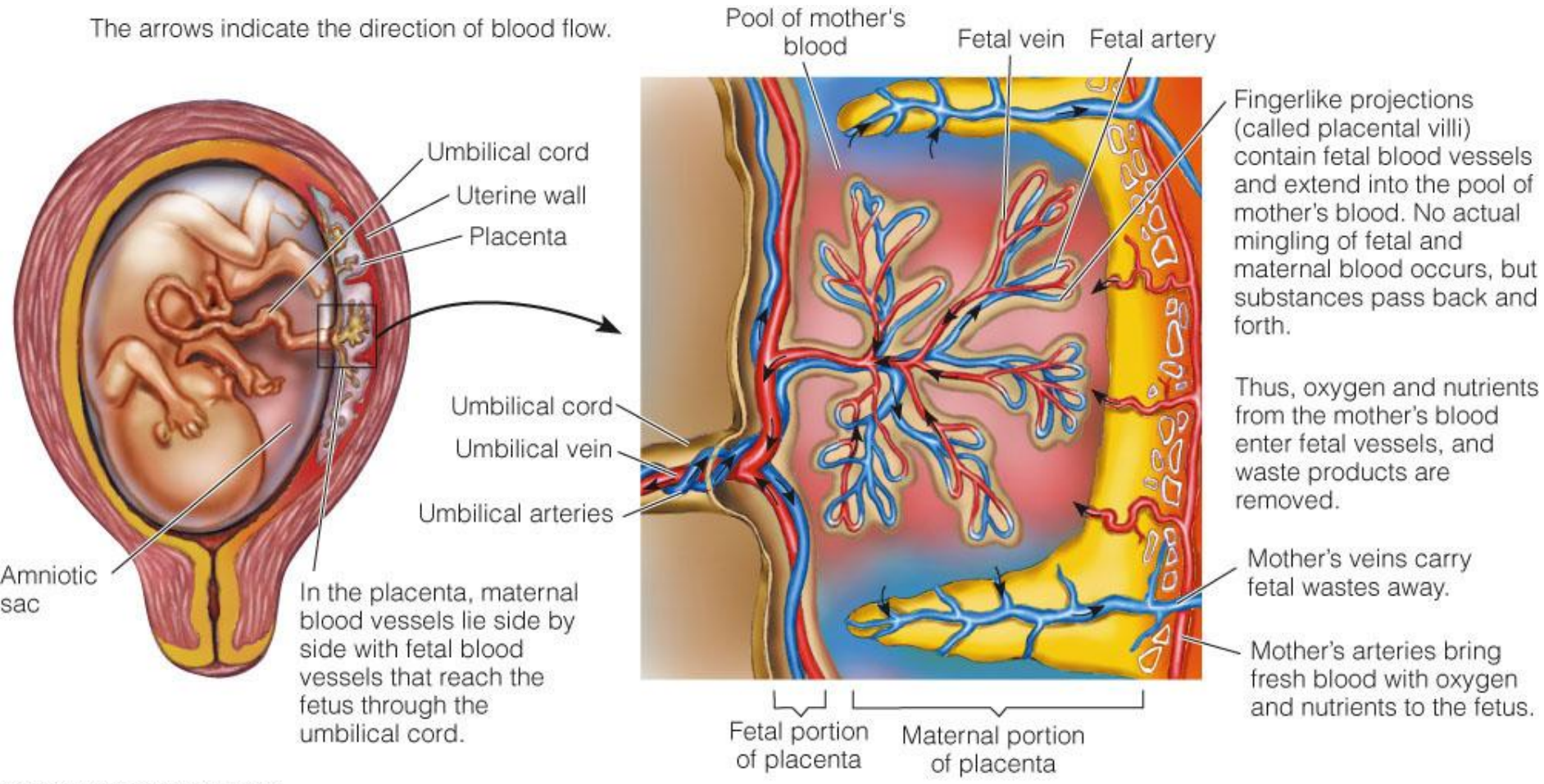
Stage 3: Fetus

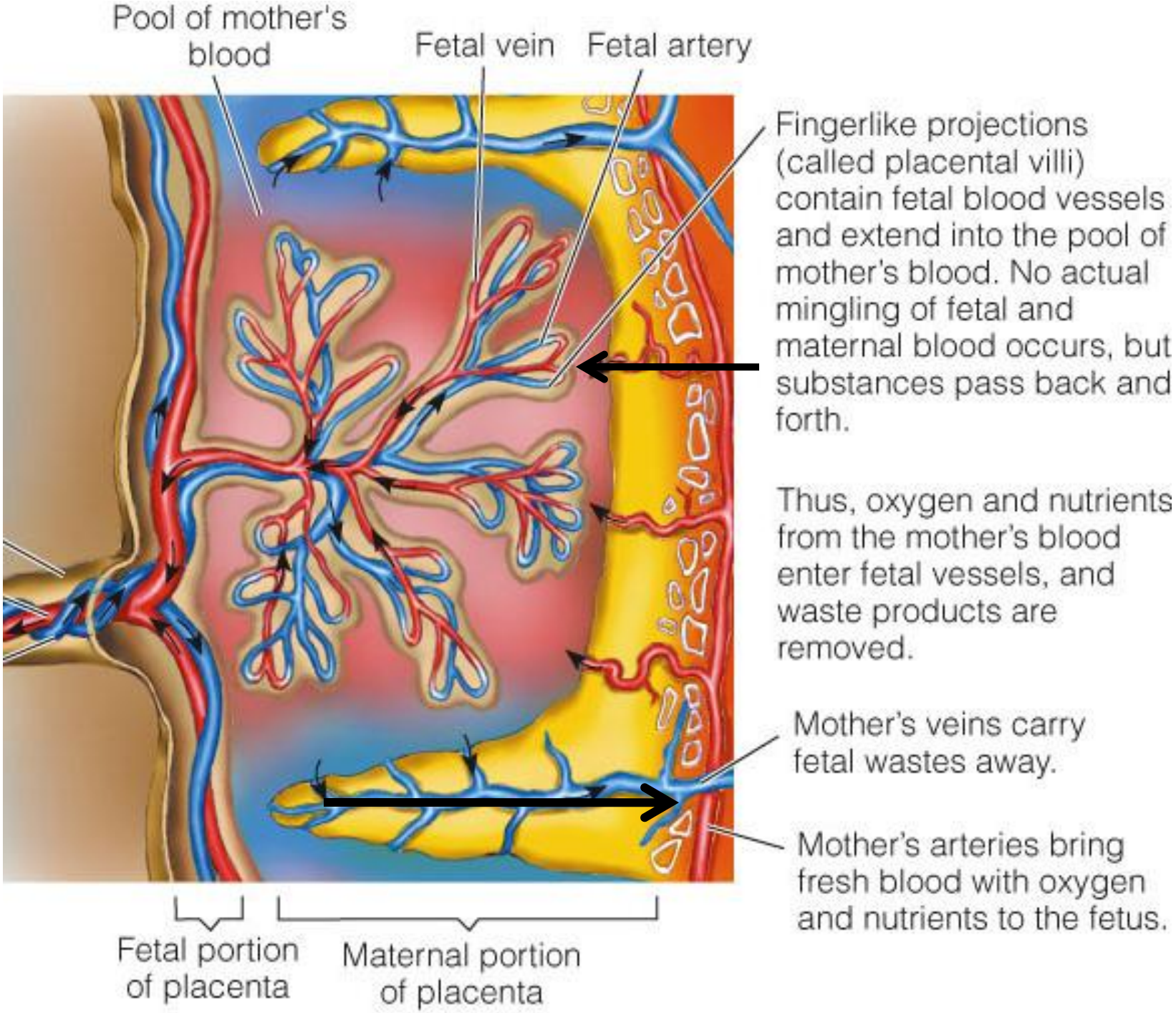
- 8 weeks to term
- Weight increase from less than an ounce to about 7 ½ lbs

4 A **newborn infant** after nine months of development measures close to 20 inches in length. From 8 weeks to term, this infant grew 20 times longer and 50 times heavier.

A successful pregnancy last 38 to 42 weeks and produce a healthy infant weighing between 6 ½ to 9 lbs

Fetal Development




Pool of mother's blood
Fetal vein
Fetal artery
Fingerlike projections (called placental villi) contain fetal blood vessels and extend into the pool of mother's blood. No actual mingling of fetal and maternal blood occurs, but substances pass back and forth.
Thus, oxygen and nutrients from the mother's blood enter fetal vessels, and waste products are removed.
Mother's veins carry fetal wastes away.
Mother's arteries bring fresh blood with oxygen and nutrients to the fetus.
Fetal portion of placenta
Maternal portion of placenta

Maternal weight

- Recommendation: **25-35** pound gain
  - 1 pound/month for 1st 3 months, then 1 pound/week for last 6 months

- If pregravid weight is 10% below desirable or 20% above → higher risk pregnancy

Maternal weight

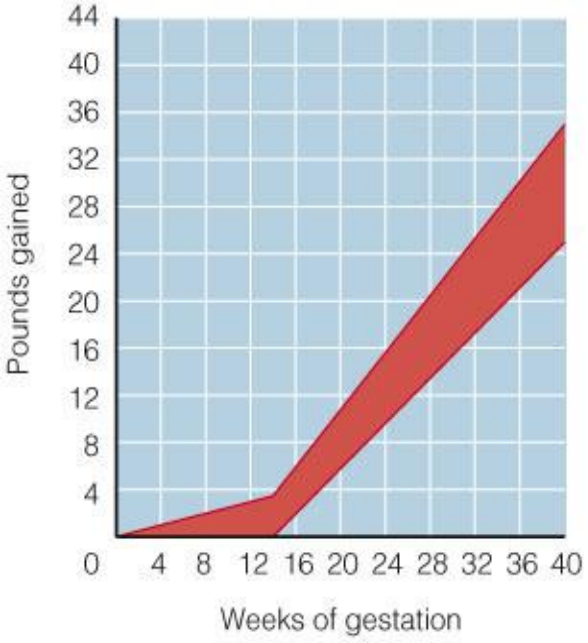
For women with low and moderate BMI, the more weight they gain, the lower their risk of giving birth to a low birthweight infant.

For women with a high BMI, gaining too little or too much weight increases their risk of giving birth to a low birthweight infant

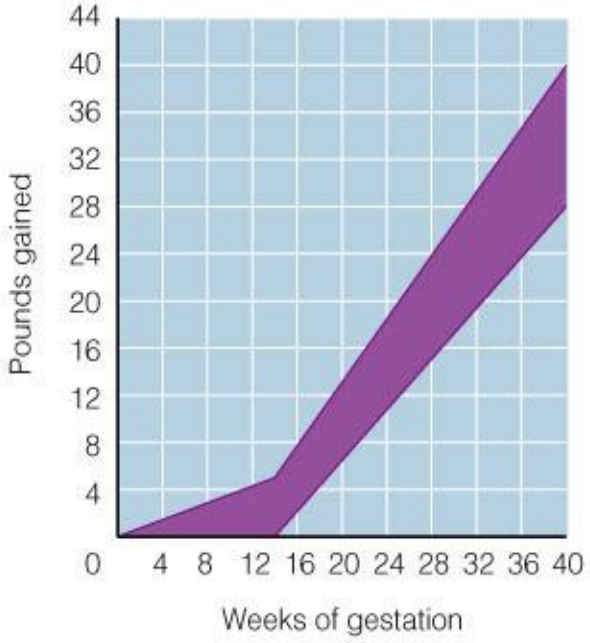
TABLE 15-1 Recommended Weight Gains Based on Prepregnancy Weight

Prepregnancy Weight	Recommended Weight Gain
Underweight (BMI <18.5)	28 to 40 lb (12.5 to 18.0 kg)
Healthy weight (BMI 18.5 to 24.9)	25 to 35 lb (11.5 to 16.0 kg)
Overweight (BMI 25.0 to 29.9)	15 to 25 lb (7.0 to 11.5 kg)
Obese (BMI ≥30)	15 lb minimum (6.8 kg minimum)

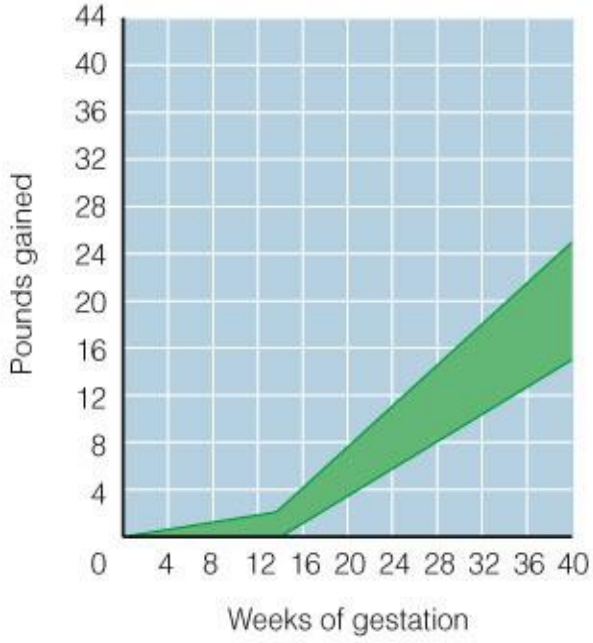
Maternal weight



Normal-weight women should gain about 3½ pounds in the first trimester and just under 1 pound/week thereafter, achieving a total gain of 25 to 35 pounds by term.

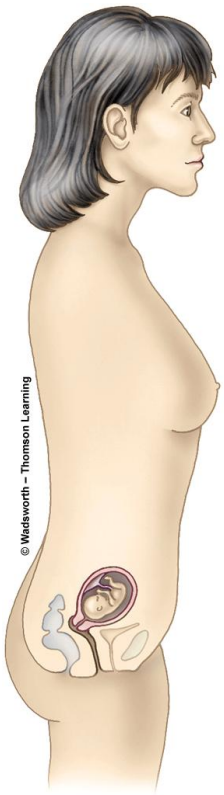


Underweight women should gain about 5 pounds in the first trimester and just over 1 pound/week thereafter, achieving a total gain of 28 to 40 pounds by term.

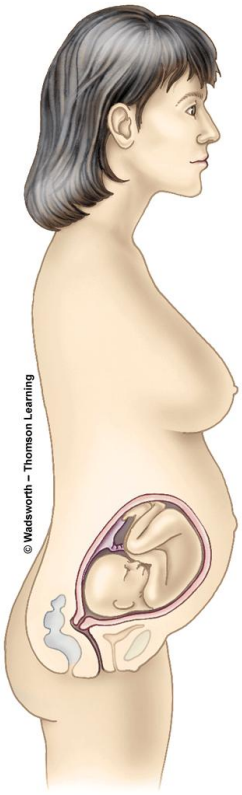


Overweight women should gain about 2 pounds in the first trimester and ⅔ pound/week thereafter, achieving a total gain of 15 to 25 pounds.

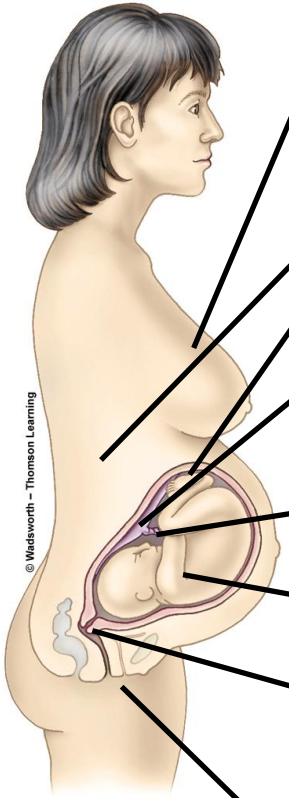
Components of Weight Gain during Pregnancy



1st trimester



2nd trimester

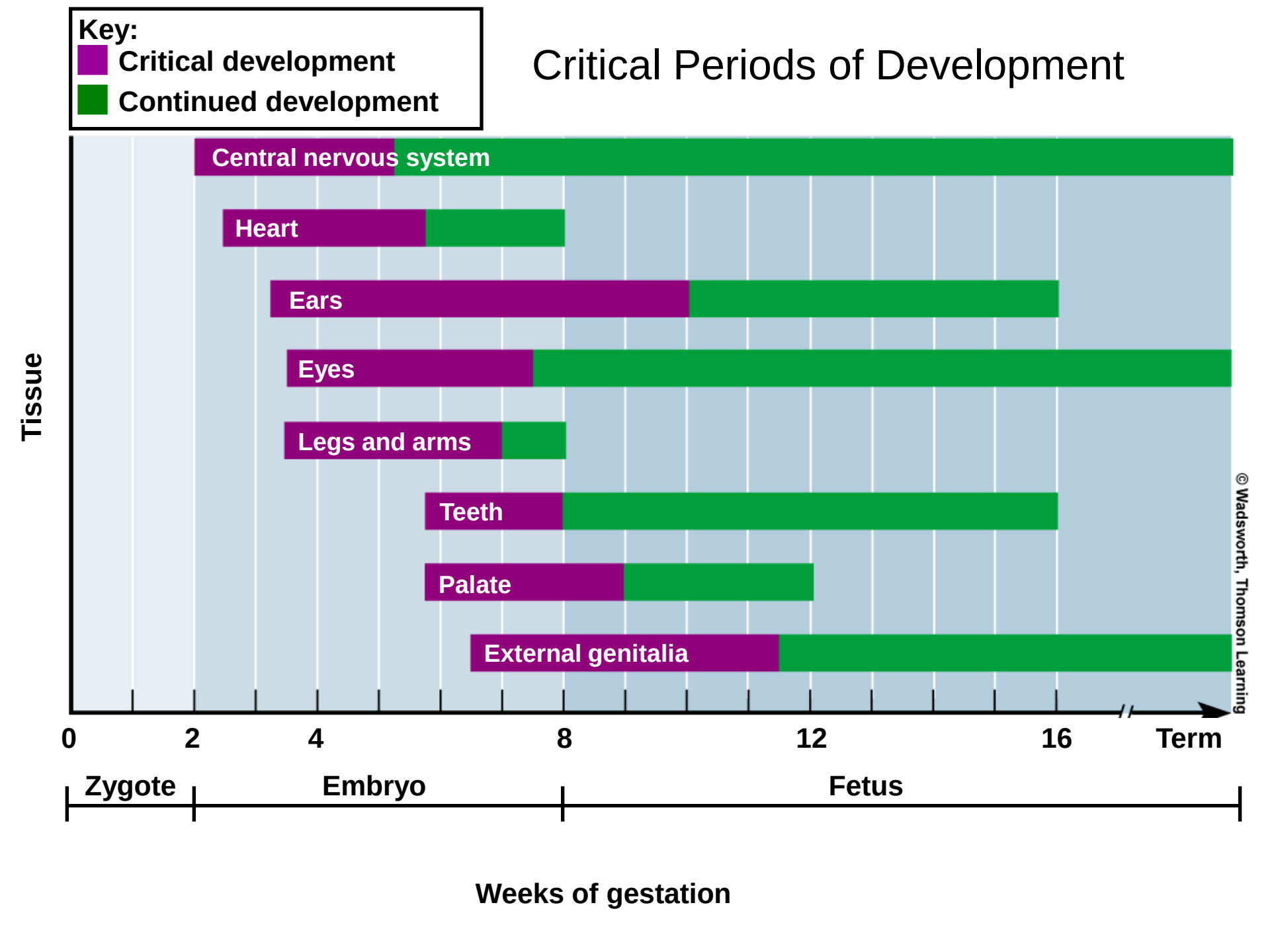


3rd trimester

	Weight gain (lb)
Increase in breast size	2
Increase in mother's fluid volume	4
Placenta	1 1/2
Increase in blood supply to the placenta	4
Amniotic fluid	2
Infant at birth	7 1/2
Increase in size of uterus and supporting muscles	2
Mother's fat stores	7
	30

Critical periods: times of rapid development and cell division

- Critical periods→ finite periods of fetal development; certain events may occur that will have irreversible consequences for later stages; (usually periods of rapid cell division)


Key:
Critical development
Continued development
Critical Periods of Development
Central nervous system
Heart
Ears
Eyes
Legs and arms
Teeth
Palate
External genitalia
Tissue
0
2
4
8
12
16
Term
Zygote
Embryo
Fetus
Weeks of gestation
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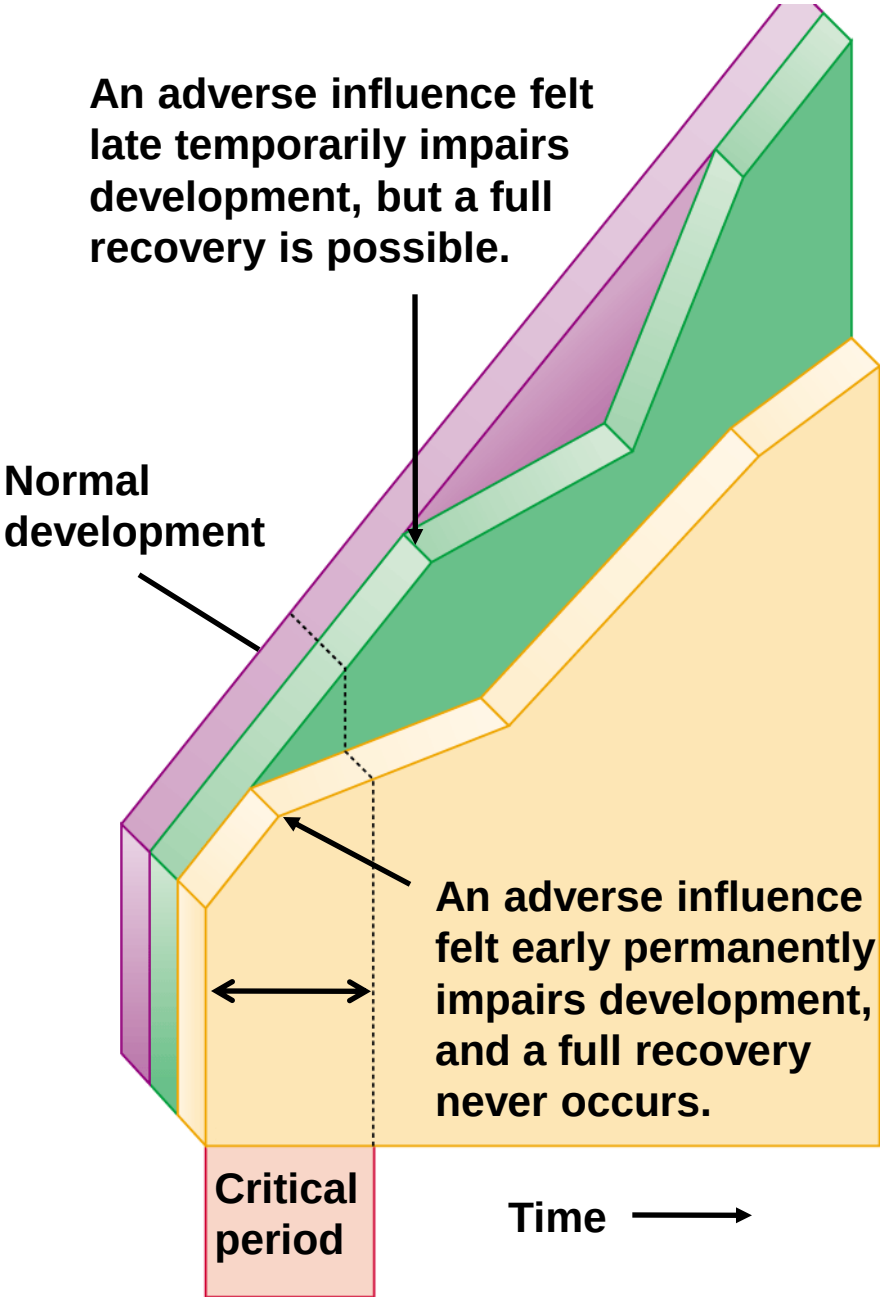
The Concept of Critical Periods



What is a Successful Pregnancy?

- Gestation at least 37 weeks
- Normal Pregnancy 38-44 weeks
- Birth weight greater than 5.5 lb (2.5 kg)
  - Low-birth-weight (LBW) = <5.5 lbs
  - Appropriate for gestational age (AGA) vs. Small for gestational age (SGA)

Key Nutrients During Pregnancy

Calories

- Increase by ~300/day during 2nd trimester
- Increased by ~450 during 3rd trimester

Nutrient dense foods should be chosen to meet higher caloric needs.

- Whole grain breads and cereals
- Legumes
- Dark green vegetables
- Citrus fruits
- Low fat milk and milk products
- Lean meat such as turkey and chicken

Key Nutrients During Pregnancy

Protein

- RDA for pregnant women is +25 g/day (or 1.1 g/kg body weight)

Select protein rich foods:

- Meats
- Low fat milk and milk products
- Legumes
- Whole grains
- Nuts & Seeds

Key Nutrients During Pregnancy

Carbohydrate

- 175 g/day
- Need extra to spare protein
- CHO needed for the brain
- This level will maintain appropriate blood glucose during
- pregnancy
- Glucose is preferred fuel of fetus

Key Nutrients During Pregnancy

Total fat

- Intake should still be ~ 30% of total calories (normal)
- PUFA's very important for growth and development of the fetus
- Since brain is largely made of lipid material, the developing fetus relies on long chain omega 3 and omega 6 fatty acids for growth→ essential fatty acids linoleic and linolenic are important
- Foods high in PUFAs
  - Walnuts & Sunflower seeds
  - Vegetable oils such as soybean oil, corn oil and safflower oil

Key Nutrients During Pregnancy

Most micronutrient needs can be met through a healthy diet

- **Folate**
  - Folate RDA increases from 400 to 600 micrograms/day (prevention of neural tube defects)
  - Supplements, fortified foods and a diet rich in fruits, juices, green vegetables and whole grains

- **B12**
  - 2.6 μg/day
  - Moderate amount of meat, eggs and milk products
  - B-12 supplements are needed if vegan

Both folate and B12 are important for rapid cell proliferation

Key Nutrients During Pregnancy

- **Zinc**
  - RDA 11 to 13 mg
  - Required for DNA and RNA synthesis
  - Supplementation is not advised

- **Iron**
  - Premenopausal women: 18 mg/per day
  - Pregnant women : 27 mg/day
    - Absorption increases threefold (no menses, increased transferrin production)
    - Daily Fe supplement is usually recommended (30-60mg/d)

- **Ca, P, & Mg**
  - needs increase due to role in bone formation
  - However, absorption also increases so dietary changes may not be necessary

NOTE: most of placental transfer of <u>Vitamin E</u> is during last trimester; infant may need supplement if premature.

Nutrient	14-18 yo	19-30 yo	31-50 yo	Pregnancy (<18)
Energy	2200	2200	2200	+340, +452 (2^{nd} 3^{rd} trimester)
Protein	48	46 g	50 g	+25 g 1.1 g/kg/day
Vitamin A	700 RE	700 RE	700 RE	770 RE
Vitamin C	60 mg	90 mg	90 mg	90 mg (80)
Iron	15 mg	18 mg	18 mg	27 mg
Calcium	1300 mg	1000 mg	1000 mg	1000 mg (1300)
Folic Acid	400 mcg	400 mcg	400 mcg	600 mcg
Zinc	8 mcg	8 mg	8 mg	11 mg (13)
Vitamin B_6	1.3 mg	1.3 mg	1.5 mg	1.9 mg

Example of a Prenatal Supplement

Supplement Facts

Serving Size 1 Tablet

Amount Per Tablet	% Daily Value for Pregnant/ Lactating Women
Vitamin A 4000 IU	50%
Vitamin C 100 mg	167%
Vitamin D 400 IU	100%
Vitamin E 11 IU	37%
Thiamin 1.84 mg	108%
Riboflavin 1.7 mg	85%
Niacin 18 mg	90%
Vitamin B6 2.6 mg	104%
Folate 800 mcg	100%
Vitamin B12 4 mcg	50%
Calcium 200 mg	15%
Iron 27 mg	150%
Zinc 25 mg	167%

INGREDIENTS: calcium carbonate, microcrystalline cellulose, dicalcium phosphate, ascorbic acid, ferrous fumarate, zinc oxide, acacia, sucrose ester, niacinamide, modified cellulose gum, di-alpha tocopheryl acetate, hydroxypropyl methylcellulose, hydroxypropyl cellulose, artificial colors (FD&C blue no. 1 lake, FD&C red no. 40 lake, FD&C yellow no. 6 lake, titanium dioxide), polyethylene glycol, starch, pyridoxine hydrochloride, vitamin A acetate, riboflavin, thiamin mononitrate, folic acid, beta carotene, cholecalciferol, maltodextrin, gluten, cyanocobalamin, sodium bisulfite.

DHA DUET

Why take DHA too?

To promote healthy brain and eye development in the fetus

Kimberly June

Can Women Exercise During Pregnancy?

Exercise Guidelines During Pregnancy

DO

Do exercise regularly (at least three times a week).

Do warm up with 5 to 10 minutes of light activity.

Do exercise for 20 to 30 minutes at your target heart rate.

Do cool down with 5 to 10 minutes of slow activity and gentle stretching.

Do drink water before, after, and during exercise.

Do eat enough to support the additional needs of pregnancy plus exercise.

Pregnant women can enjoy the benefits of exercise.

DON'T'S

Don't exercise vigorously after long periods of inactivity.

Don't exercise in hot, humid weather.

Don't exercise when sick with fever.

Don't exercise while lying on your back after the first trimester of pregnancy.

Don't exercise if you experience any pain or discomfort.

Don't participate in activities that may harm the abdomen or involve jerky, bouncy movements.

Regular exercise is recommended

Common Concerns

- Nausea & vomiting
  - Hyperemesis gravidarum
- Constipation and hemorrhoids
- Heartburn
- What recommendations would you make to a client??

Recommendations: Nausea/Vomiting

1. Rise slowly upon waking
2. Keep crackers/toast by the bed
3. Drink plenty of water
4. Drink carbonated beverages
5. Eat small, frequent meals
6. Avoid foods with offensive odors
7. Chew gum or suck on hard candies

Recommendations: Constipation

1. Eat more fiber
2. Do not resist the urge to defecate
3. Drink plenty of fluid
4. Avoid caffeine
5. Exercise regularly

Recommendations: Heart burn

1. Sleep at an elevated angle
2. Don't eat for 3-4 hours before bed
3. Avoid foods that will aggravate your heart burn
4. Avoid caffeine
5. Eat slowly, avoid overeating
6. Drink liquids between meals
7. Sit up while eating
8. Wait an hour after bed before lying down
9. Wait two hours after eating before exercise

Food Cravings and Aversions

- Believed to be caused by hormonal changes, <u>not</u> by a chemical need for any particular food or beverage.

Pica

- Craving to eat soap, clay, dirt, laundry starch, paper, mothballs, coffee grounds

Foods to avoid/limit during pregnancy

- Deli meats and soft cheeses
- Sushi
- Coffee
- Tea
- Fish
- Undercooked meat
- Potato/pasta salad w/ mayonnaise

Mercury containing fish

- **Highest Mercury Fish (avoid eating)**

  Grouper, Marlin, Orange roughy,Tilefish, Swordfish, Shark, Mackerel (king)

- **High Mercury Fish** (eat no more than three 6-oz/servings month)

  Bass saltwater, Croaker, Halibut, Tuna (canned, white albacore) Tuna (fresh bluefin, ahi), Sea trout, Bluefish, Lobster (American/Maine)

Mercury containing fish

- **Low Mercury Fish (eat no more than six 6-oz servings/month)** Carp, Mahi Mahi, Crab (dungeness),Snapper
  Crab (blue), Herring, Crab (snow), Monkfish, Perch (freshwater), Skate, Cod, Tuna (canned, chunk light)

- **Lowest Mercury Fish (enjoy two 6-oz servings/week):** scallops, shrimp, calamari, crab (king), flounder, haddock, salmon, tilapia, sole, clams, oysters, trout (freshwater).

Risks During Pregnancy

- Preexisting hypertension
  - increases risk of low birth weight and can lead to pre-eclampsia
  - monitored regularly; not usually advised to follow sodium restriction

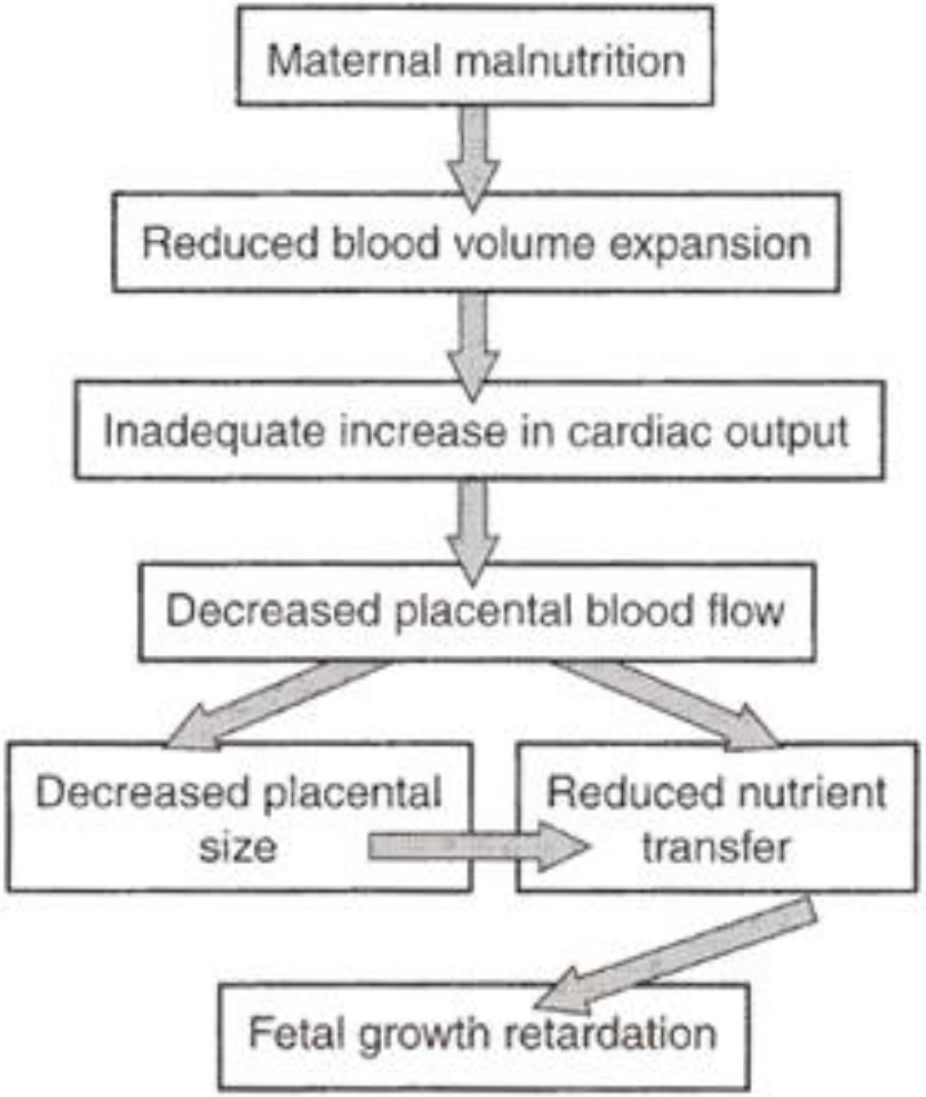
- Preeclampsia is characterized by high BP along with proteinuria and fluid retention (edema)
  - Preeclampsia causes decreased blood flow through the placenta= retards fetal growth
  - could progress to eclampsia (accompanied by convulsions and is more serious)

Signs of Preeclampsia

Warning Signs

- Severe and constant headaches
- Swelling especially of face
- Dizziness
- Blurred vision
- Sudden weight gain (1 lb/day)

Risks During Pregnancy

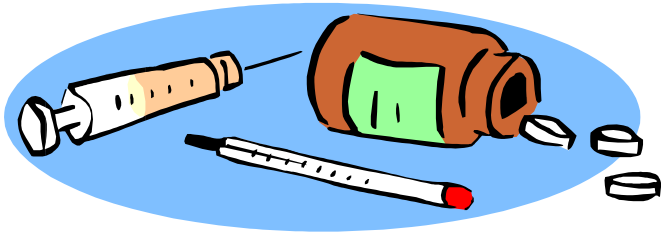


Risks During Pregnancy

- Gestational diabetes: placental hormones may alter insulin function
- Usually detected by an Oral Glucose Tolerance Test (OGTT) at approximately 24-28 weeks gestation
- Regular diabetic meal plan recommended; calories must be adequate (i.e. still consume the additional 300 calories).
- Higher risk of development of type II diabetes after the pregnancy

TERATOGENS

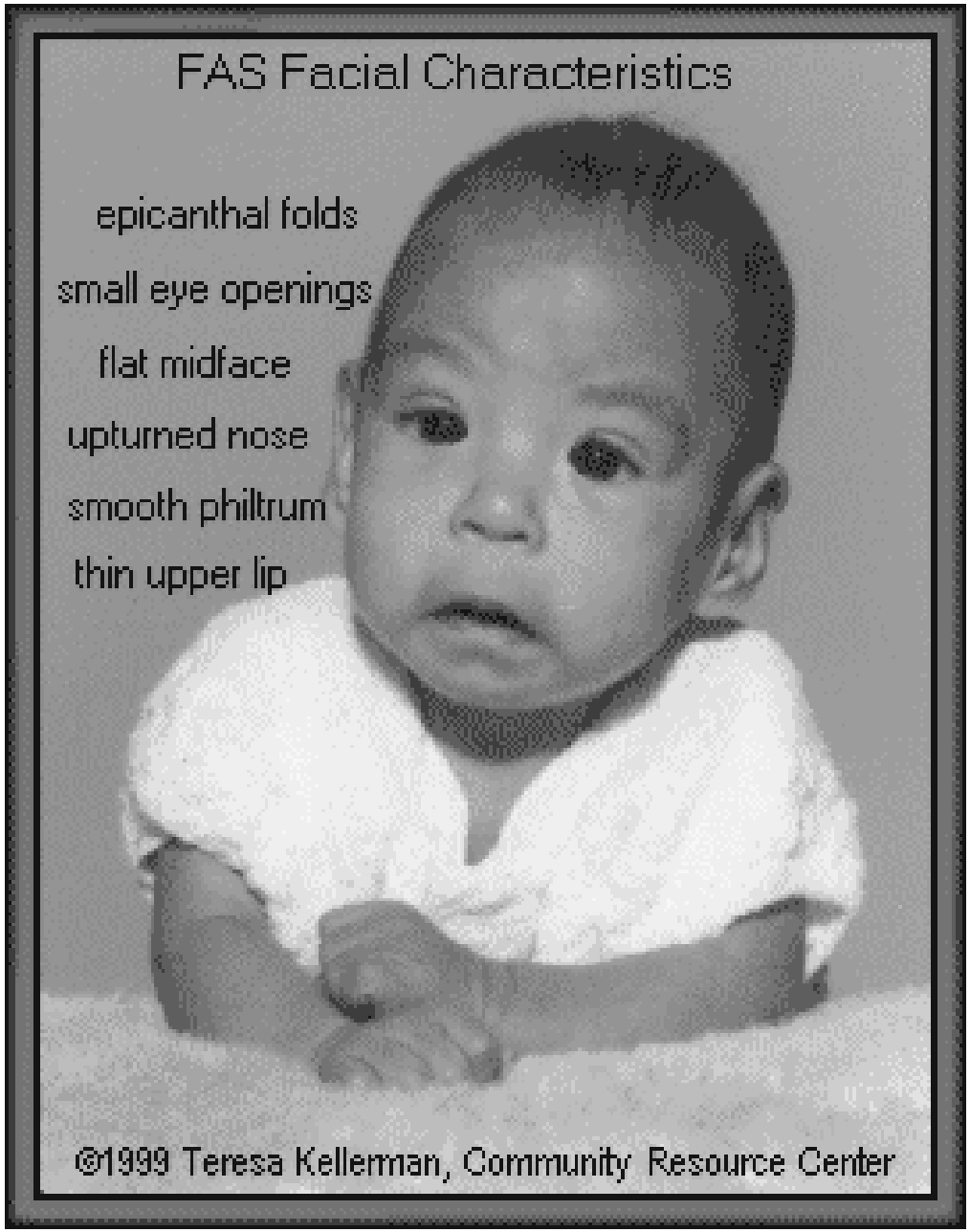
- Caffeine
- Tobacco
- Alcohol
- Illicit drugs
- Medicines (including over-the-counter) should only be used under the direction of a physician.



Children with FAS

Feature	Problem
Head	small
Forehead	Narrow and receding
Nose	Flat and upturned
Jaw	Receding underdeveloped chin
Eyes	Downward slanting, small, drooping, inability to focus
Ears	Uneven in placement, small, poorly formed
Lips	Flat upper lip, missing filtrum

Typical Facial Characteristics of FAS

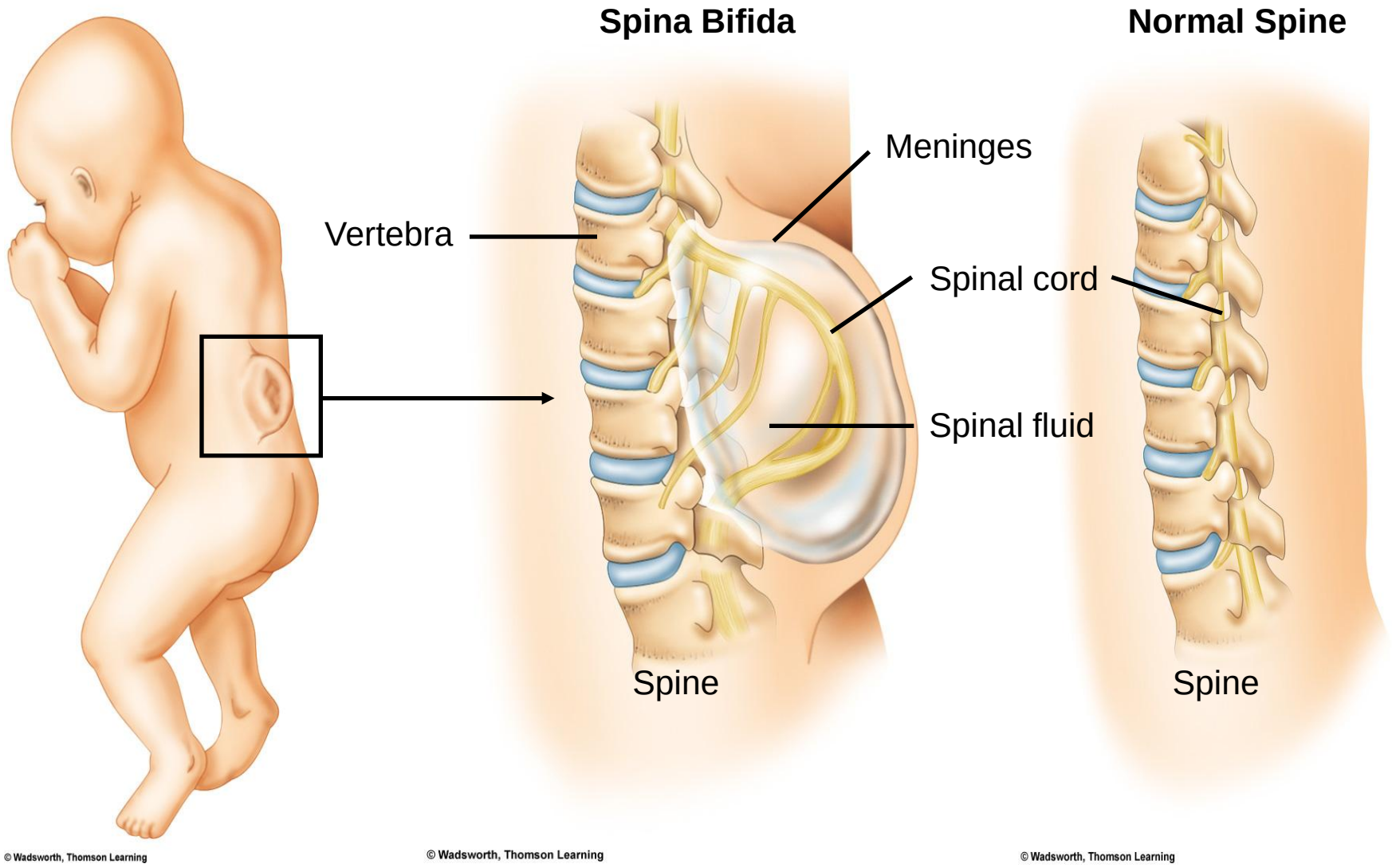


All containers of beer, wine, and liquor have warning labels directing women not to drink alcohol during pregnancy.

Alcohol intake is the primary preventable cause of mental retardation

Other Birth Defects

- Neural tube defects (affect 30 out of 100,000 births)
- Two most common are:
  - **Anecephaly** (upper end of neural tube fails to close – brain is missing or does not develop)
  - **Spina bifida:** incomplete closure of spinal cord; membranes surrounding spinal cord protrude as a sac. Usually results in varying degrees of paralysis


Spina Bifida
Normal Spine
Vertebra
Meninges
Spinal cord
Spinal fluid
Spine
Spine
© Wadsworth, Thomson Learning
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Children with Spina Bifida

Prevention of Spina Bifida

- Adequate folic acid intake in 1st 6 weeks of pregnancy lessens risk of these defects, by as much as 70%.
- Problem? Many women don't know their pregnant yet!
- U.S. fortifies many foods with Folic acid.

Folate containing foods

Whole Food Sources	Serving	Folate (mcg)
Lentils, cooked	1/2 cup	179
Garbanzo beans, cooked	1/2 cup	141
Asparagus, cooked	1/2 cup	134
Spinach, cooked	1/2 cup	131
Beef Liver, cooked	3 ounces	123
Broccoli, cooked	1/2 cup	84
Lima beans, cooked	1/2 cup	78
Beets, cooked	1/2 cup	66
Romaine Lettuce	1/2 cup	49
Navel Orange	1 large	48

Lactation

American Academy of Pediatrics recommendation: exclusive breastfeeding for the first 6 months of life, and a combination of breastfeeding and infant foods until 1 year.

Lactation

- Confers greater nutritional/health benefits than bottle-feeding
  - Rich in all nutrients except vits. D, K & fluoride.
    - Protein in breast milk: lactalbumin
    - Mother or infant may need to take supplements
  - Generally associated with fewer allergies
  - More easily digested
  - Infant acquires mother's immunities (colostrum)
  - Cognitive benefits
  - May protect against obesity later in life
  - Economic benefits
  - Better for bonding

Nutrient Requirements of the mother for Lactation

- Vitamins and minerals
  - Recommendations are increased for:
    - B6, folate, B12, Vit A, Vit C, Vit E
    - Copper, Iodine
    - Most needs will be met through diet
      - B12 supplement may be needed for vegans

Nutrient Requirements of the mother for Lactation

- Energy requirement
  - Extra 500 kcals/day
  - Recommendation is for increased dietary intake of ~300kcal and get the rest from fat stores

- Fluid intake is important to prevent dehydration

TABLE 15-5 Ten Steps to Successful Breastfeeding

To promote breastfeeding, every maternity facility should:

- Develop a written breastfeeding policy that is routinely communicated to all health care staff
- Train all health care staff in the skills necessary to implement the breastfeeding policy
- Inform all pregnant women about the benefits and management of breastfeeding
- Help mothers initiate breastfeeding within ½ hour of birth
- Show mothers how to breastfeed and how to maintain lactation, even if they need to be separated from their infants
- Give newborn infants no food or drink other than breast milk, unless medically indicated
- Practice rooming-in, allowing mothers and infants to remain together 24 hours a day
- Encourage breastfeeding on demand
- Give no artificial nipples or pacifiers to breastfeeding infants[a]
- Foster the establishment of breastfeeding support groups and refer mothers to them at discharge from the facility

[a]Compared with nonusers, infants who use pacifiers breastfeed less frequently and stop breastfeeding at a younger age. C. G. Victora and coauthors, Pacifier use and short breastfeeding duration: Cause, consequence, or coincidence? *Pediatrics* 99 (1997): 445–453.

SOURCE: United Nations Children's Fund and World Health Organization, *Protecting, Promoting and Supporting Breastfeeding: The Special Role of Maternity Services.*

Breastfeeding Video

Lactation consultant helps mom breastfeed her baby.

http://www.youtube.com/watch?v=VkfR9xlQFi4

Formula Costs

FORMULA	AMOUNT	TYPE	COST
Enfamil	6- 23.4 oz cans	Powder	$147.00
Good Start	6-24 oz cans	Powder	$ 89.88
Similac	1 qt six pack	Ready-serve	$34.68
Similac	12 13-oz cans	concentrate	60.00

How do I make a formula bottle?

1. **Powder:** mix 1 scoop with 2 oz water and shake. Water must be boiled or purified. Heating is unnecessary. Left over must be thrown away in 1 hour. If refrigerated good for 24 hours.

2. **Ready Serve:** No preparation needed

3. **Concentrated:** measure out water and concentrate, most will call for equal amounts of formula and water.

Is the baby getting enough milk/formula?

- Weight gain of 4-8 ounces/week
- Has wet diapers
- Has bowel movements 3x/day or 1/5 days

How much formula should my baby eat?

AGE	AMOUNT
0-1 month	1-2 oz every 3-4 hours
1-2 months	2-3 oz every 3-4 hours
3-4 months	3-4 oz every 3-4 hours
Up 1 oz every month thereafter	

At 4-6 months Baby cereal and baby foods will be introduced.
Regular Milk should not be introduced until 1 year

How do I know my babies Hungry?

- Fussiness, crying, flared fingers
- Sucking on hands/fingers
- Timing
- Mouth movements (sucking)
- Rooting
- Increased alertness

How often should my baby eat?

- Formula fed infants need to be fed every 3-4 hours the first month postpartum, including throughout the night
- Breastfed infants need to be fed every 1-2 hours the first month postpartum, including throughout the night

Different kinds of Bottles

- Drop ins
- Solid bottles
- Angled bottles
- Slow, medium, and fast flowing nipples
- Different shapes of nipples

Breast Pump

Instructions

1. Choose a time of day when your breasts are the fullest (in the morning, for most women).
2. Make sure your breast pump equipment is clean and sterilized.
3. Select a quiet, comfortable place for pumping where you won't be interrupted.
4. Wash your hands with soap and water.
5. Place the breast shield over your breast correctly, with the entire areola enclosed.
6. Begin at a low speed, gradually building up to high speed.
7. Collect breast milk in the attached plastic container.
8. Turn the pump off before pulling out your breast.
9. pour breast milk into plastic bags designed for storing milk in the freezer, or simply attach nipple to container and feed infant

Why do mothers Bottle Feed?

- Safe alternative to breast feeding
- Indicated for AIDS/HIV or TB positive mothers
- Indicated for mothers with drug addictions/alcohol abuse
- Women who have had breast surgery who may have difficulty with breastfeeding
- Perceived convenience
- Early return to work
- Lack of support from husband

Resources available to low-income women:

- In Massachusetts:
  - Healthy Start
  - MassHealth
  - WIC
  - Head Start

Healthy Start

What is it?

- Basic medical insurance coverage for prenatal care, delivery, and two months postpartum

To be eligible for Healthy Start, you must:

- Be pregnant
- Be a resident of Massachusetts
- Have little or no health insurance coverage for pregnancy
- Not be eligible for MassHealth (except MassHealth Limited)
- Meet the income guidelines

Healthy Start

Healthy Start Income Limits (200% Federal Poverty Guidelines March 1, 2009)

Family Size	Annual Income (Before Taxes)
2	$29,160
3	$36,624
4	$44,114
5	$51,600
6	$59,064
For every additional child add	$7,488

MassHealth

- MassHealth is a public health insurance program for eligible low and medium-income residents of Massachusetts. MassHealth is the name used in Massachusetts for Medicaid and the Children's Health Insurance Program (CHIP), combined in one program.

W.I.C

- The Special Supplemental Nutrition Program for Women, Infants, and Children.

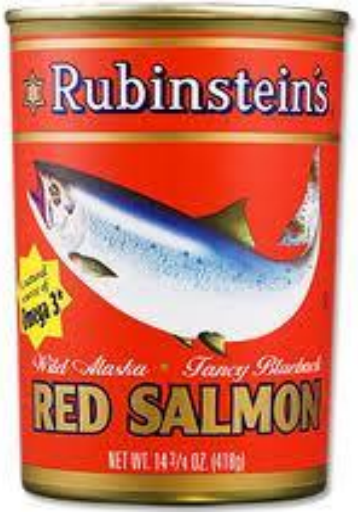
- Food vouchers and nutritional counseling for pregnant and lactating women, infants, and children up to age 5, Screening and referrals to other health, welfare and social services

The W.I.C food package/month for non-breastfeeding mothers

- Eggs
- Peanut Butter
- Dried beans
- Bread, tortillas, or brown rice
- Milk, fat free or 1%
- 16 oz cheese
- Formula and baby food
- Cereals
- $10.00/month for fruits/vegetables

The W.I.C food package/month for breastfeeding mothers

Includes all previously mentioned, but fully breastfeeding receive MORE food per month. Also includes canned tuna, salmon, and sardines.



Head Start

- Provides comprehensive education, health, nutrition, and parent involvement services to low-income children and their families.
- Serve children from birth to three years of age
- Programs are administered locally by non-profit organizations and local education agencies such as school systems.
- Goal: Help children become ready for kindergarten and to provide health care and food support.