Preview Of A Birth
Fetal Development

Stage 1
Fertilization

Stage 2
Zygote
1st Week

Stage 3
Embryo
2-7 Weeks

Stage 4
Fetus
8 Weeks To Birth
Fetal Development

Stage 1
Fertilization

Stage 2
Zygote
1st Week

Stage 3
Embryo
2-7 Weeks

Stage 4
Fetus
8 Weeks To Birth
All the eggs necessary to populate the entire world would fit into a cookie jar.
During sexual intercourse, between 300 million to 600 million sperm are deposited in the vagina. They survive 24 to 48 hours. All the sperm necessary to populate the entire world will fit into a thimble.
Over 2,000 sperm may find and surround the egg but only one will be allowed to enter. The egg releases a substance that prevents other sperm from entering. After the sperm unites with the egg, it is called a zygote.
Fetal Development

Stage 1
Fertilization

Stage 2
Zygote
1st Week

Stage 3
Embryo
2-7 Weeks

Stage 4
Fetus
8 Weeks To Birth
4.5 Days
107 Total Cells
8 Will Become The Embryo
99 Will Become The Supporting Structures, i.e. Placenta, Amniotic Sac And Umbilical Cord
On average, it takes the zygote between 5 to 14 days to travel down the fallopian tube to the uterus. Fallopian tubes are about the size of a hair bristle and 4 inches long. Once the zygote implants itself into the uterus, it becomes known as an embryo.
Fetal Development

Stage 1
Fertilization

Stage 2
Zygote
1st Week

Stage 3
Embryo
2-7 Weeks

Stage 4
Fetus
8 Weeks To Birth
Embryo At 3 Weeks

- Heartbeat At 22 Days
- Leg and Arm Buds Appear At 26 Days
5 Weeks

- Heart Output At 40 Days Is 20% Of An Adult
- 40 Pairs Of Muscles Present
Close-up of a 5 week embryo.
An embryo removed from the fallopian tube in a tubal, or ectopic, pregnancy. The ectopic rate in the USA in 1987 was 16.8 per 1,000 pregnancies, up from 4.5/1000 in 1970. By 2002 it had risen to 19.7/1,000.
On average, it takes the zygote between 5 to 14 days to travel down the fallopian tube to the uterus. Fallopian tubes are about the size of a hair bristle and 4 inches long. Once the zygote implants itself into the uterus, it becomes known as an embryo.
A 7 week embryo is about \( \frac{3}{4} \) of an inch long. You can see the ribs, which at this point are cartilage. Calcification is still several weeks away.
At 7 weeks the embryo only weighs $\frac{1}{30}$ of an ounce.
Back view of 7 week embryo. Notice the development of the spinal cord.
7 Weeks
- ¾ Inch Long
- Nerves & Muscles Work Together For First Time
- At 43 Days Brain Wave Patterns Can Be Recorded
Close-up of 7 week eyes. This is about 40x the actual size. Gluey ridges are beginning to form. The eyes will be sealed shut until the 6th month.
The dark area of the eye is the pigment of the retina as it is forming. At this stage, the nose and all of the facial features are flat.
Front view of 7 week embryo. By this time the fingers and toes become separate entities. At 50 days after conception, all internal organs and external structures are identifiable. Both hemispheres of the brain are clearly seen in this picture.
8 WEEKS

- All Organs Functioning — Stomach, Liver, Kidney, Brain
- Lines in Palms Of Hands
- From This Point Until Age 23 Years — All Future Development Is The Result Of Refinement & Increase In Size
Fetal Development

Stage 1
Fertilization

Stage 2
Zygote
1st Week

Stage 3
Embryo
2-7 Weeks

Stage 4
Fetus
8 Weeks To Birth
Fetus At 2 Months
8 week male fetus.
These are 10 week-old feet.
By 10 weeks, the fetus is highly responsive to touch. Cartilage is calcifying to become bone.
12 week fetus. Note the placenta and umbilical cord.
By this time, the fetus is about 3 inches long and does everything from urinate to hiccups.
Close-up of 12 week fetus.
Notice the development of the muscles.
At 16 weeks, the skin has the texture of the mucus membranes in your mouth. The fetus is now about 6 to 8 inches long.
By this stage the fetal heart circulates 25 quarts of blood through the body per day. The first thin transparent layer of skin begins to replace the protective membrane.
At about 4 months, most mothers can feel their babies kicking.
Here is a 17 week hand. Notice the loose skin.
18 week fetus sucking her thumb.
Notice the development of the blood vessels at 18 weeks.
This is a live shot (fetoscopy) taken with a wide angle lens inside the mother.

The Fetus Is Sensitive To Light From 16 Weeks Gestation
Following are some detailed structures present at this time.

5½ Months
Notice the hair, eyebrows, and eyelids.
At 27 Weeks The Developing Fetus Has Established The Ability To Hear
17 week hand.
Notice the cuticles and toenails.
Footprints are used for identification for newborns in some hospitals.
Photography

Patrick G. Cahill
Lennart Nilsson
Landrum B. Shettles, M.D.

Script

William Warren, M.D.
Robert Metzger, M.D.
Melanie Brooker, RN, BSN
Deborah L. Ellis, RN, MPH
Margo Foley, RN, BSN
<table>
<thead>
<tr>
<th>Score</th>
<th>Color</th>
<th>Heartbeat</th>
<th>Reflex Irritability</th>
<th>Muscle Tone</th>
<th>Respiratory Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Blue, pale</td>
<td>Absent</td>
<td>No response</td>
<td>Flaccid, limp</td>
<td>Absent</td>
</tr>
<tr>
<td>1</td>
<td>Body pink, extremities blue</td>
<td>Slow (below 100)</td>
<td>Grimace</td>
<td>Weak, inactive</td>
<td>Irregular, slow</td>
</tr>
<tr>
<td>2</td>
<td>Entirely pink</td>
<td>Rapid (over 100)</td>
<td>Coughing, sneezing, crying</td>
<td>Strong, active</td>
<td>Good; baby is crying</td>
</tr>
</tbody>
</table>
### Table 4.2 Vulnerability During Prenatal Development

<table>
<thead>
<tr>
<th>Period</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Germinal Period</td>
<td>At least 60 percent of all developing organisms fail to grow or implant properly and thus do not survive the germinal period. Most of these organisms are grossly abnormal.</td>
</tr>
<tr>
<td>The Embryonic Period</td>
<td>About 20 percent of all embryos are aborted spontaneously, most often because of chromosomal abnormalities.</td>
</tr>
<tr>
<td>The Fetal Period</td>
<td>About 5 percent of all fetuses are aborted spontaneously before viability at 22 weeks or are stillborn, defined as born dead after 22 weeks.</td>
</tr>
<tr>
<td>Birth</td>
<td>About 31 percent of all zygotes grow and survive to become living newborn babies.</td>
</tr>
</tbody>
</table>
Age of Viability – the age (around 22 weeks) at which a fetus may survive outside the mother’s uterus if specialized medical care is available.

Fetal weight normally doubles in the last trimester of pregnancy with about 2 pounds gained in the last 3 weeks. Consequently,

- Preterm infant – a baby born 3 or more weeks early
- Small for gestational age (SGA) a baby whose birth weight is significantly lower than expected, given the time since conception.
Preterm Survival Rates

• 22 weeks = 5%
• 23 weeks = 26%
• 24 weeks = 56%
• 25 weeks = 76%
• 32 weeks = >90%
Preterm Statistics

**Survival Rates**

Until Week 28, most surviving babies face brain, lung, intestinal and eye problems.

**4 million**

Babies were born in the U.S. in 2010

**478,790**

of those were born before 37 weeks’ gestation

**462,408**

of them survived at least a year

Sources: Centers for Disease Control and Prevention; March of Dimes; National Perinatal Information Center; American Academy of Pediatrics; National Institutes of Health.

**Levels of Neonatal Care**

**Level I**
- Basic Care
  - Nurseries that cater to healthy, full-term babies. They stabilize preterm infants to transfer them out.

**Level II and III**
- Specialty Care
  - Facilities that can aid sick and premature babies. Level III NICUs may perform some surgeries.

**Level IV**
- Surgical Care
  - NICUs capable of performing complex surgeries like repairing congenital heart defects.
Preterm Complications

Saving Little Lives

Medical advances have improved survivability and long-term health for babies born as early as 22 weeks.

**BRAIN** Blood vessels that are not yet fully developed may bleed into fluid-filled areas of the brain. To reduce swelling and relieve pressure, a tube in the brain can drain excess fluid.

**EYES** Abnormal blood-vessel growth in the eye can lead to blindness. Laser surgery can halt the vessel growth and preserve vision.

**GUT** Intestinal tissue can die without beneficial mucus and bacteria. Intravenous nutrition bypasses the gut until it's stronger.

**LUNGS** Without a protein called surfactant, tiny air sacs may collapse. Artificial surfactant and air-delivery devices can help keep airways open.

**SKIN** With little fat, skin is thin and more transparent. It may also be yellow from jaundice. Incubators help babies who are born without a protective fat layer stay warm.

**LONG-TERM EFFECTS** Babies born too early may face developmental delays later. They may also have lingering vision, hearing, cardiac and respiratory problems as children and adults.
### Birth Defects from Teratogens: Time of Exposure and Effects on Major Organs

<table>
<thead>
<tr>
<th>Germinal Period</th>
<th>Main Embryonic Period (in weeks)</th>
<th>Fetal Period (in weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CNS</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Eye</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>Heart</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>Arm</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Leg</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ear</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ear</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Eye</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Leg</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>CNS</td>
<td></td>
</tr>
</tbody>
</table>

#### Central nervous system
- Neural tube defects (NTDs)
- Mental retardation

#### Heart
- Cleft lip
- Low-set malformed ears and deafness

#### Arms
- Enamel staining
- Cleft palate

#### Legs
- Cataracts, glaucoma

#### Lips
- Masculinization of female genitalia

#### Ears
- Sex organs

#### Eyes
- Teeth

#### Palate
- Source: Adapted from Moore & Persaud, 1998.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Usage</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>3 or more drinks daily, or binge drinking of 5 or more drinks on one occasion early in pregnancy</td>
<td>Causes fetal alcohol syndrome (FAS). Symptoms include a small head, abnormal facial characteristics (wide spacing between the eyes, a flattened nose and a narrow upper lip), unusual eyelids, and missing skin indent between nose and upper lip, overall growth retardation, learning disabilities, and behavior problems (including poor concentration and impaired social skills).</td>
</tr>
<tr>
<td></td>
<td>More than ½ oz. of absolute alcohol a day</td>
<td>Causes fetal alcohol effects (FAE). FAE does not observably affect facial appearance or physical growth, but it affects brain functioning. The first sign is noisy, higher-frequency cries at birth. Later signs, on cognitive tests, include lower IQ (by about 5 points).</td>
</tr>
<tr>
<td></td>
<td>Moderate drinking: less than 1 or 2 servings of beer or wine or 1 mixed drink a few days per week</td>
<td>Probably has no negative effects on prenatal development, although this is controversial.</td>
</tr>
<tr>
<td>Tobacco</td>
<td>Maternal smoking early in pregnancy</td>
<td>Increases risk of abnormalities, including malformations of the limbs and the urinary tract.</td>
</tr>
<tr>
<td></td>
<td>Maternal smoking late in pregnancy</td>
<td>Reduces birthweight and size. Babies born to habitual smokers weigh, on average, about 9 oz. (250 g) less than would otherwise be expected, and they are shorter, both at birth and in the years to come. They may have childhood problems, particularly with respiration, and, in adulthood, increased risk of becoming smokers themselves.</td>
</tr>
<tr>
<td></td>
<td>Paternal smoking</td>
<td>Reduces birthweight by about 2 oz. (45 g) on average.</td>
</tr>
<tr>
<td>Marijuana</td>
<td>Heavy use</td>
<td>Affects the central nervous system, as evidenced by the tendency of affected newborns to emit a high-pitched cry that denotes brain damage.</td>
</tr>
<tr>
<td></td>
<td>Light use</td>
<td>Has no proven long-term effects.</td>
</tr>
<tr>
<td>Heroin</td>
<td></td>
<td>Because of the physiological &quot;highs&quot; and &quot;crashes&quot; of the addiction (such as the reduction of oxygen, irregular heartbeat, and sweating and chills that occur during withdrawal), heroin causes slower fetal growth and premature labor. (See also methadone, below.)</td>
</tr>
<tr>
<td>Methadone</td>
<td>Later in pregnancy</td>
<td>Moderates the effects of heroin withdrawal during pregnancy but is as addictive as heroin. Heavily addicted newborns require regulated drug doses in the first days of life to prevent the pain and convulsions associated with sudden opiate withdrawal.</td>
</tr>
<tr>
<td>Cocaine</td>
<td></td>
<td>Causes overall growth retardation, problems with the placenta, and specific learning problems in the first months of life. Research on long-lasting effects is confounded by the effects of poverty and the ongoing addiction of the mother. The major concern is in language development (Lester et al., 1988).</td>
</tr>
<tr>
<td>Solvents</td>
<td>Especially early in pregnancy</td>
<td>Causes smaller heads, crossed eyes, and other abnormalities.</td>
</tr>
</tbody>
</table>

Overall sources: Larsen, 1998; Lyons & Rittner, 1988
Alcohol (Marteufel, 1966; Nagler et al., 1990; Streisguth, 1977); tobacco (Eskens et al., 1965; Kallen, 1967; Kandel et al., 1968; Li et al., 1990); marijuana (Lester & Drohot, 1989); methadone (Schneider & Hara, 1980); cocaine (including crack) (Hurt et al., 1990); solvents (glue, other inhalants) (Arnold, 1997).
<table>
<thead>
<tr>
<th>Teratogens Diseases</th>
<th>Effects on Child of Exposure</th>
<th>Measures for Preventing Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubella (German measles)</td>
<td>In embryonic period, causes blindness and deafness, in first and second trimesters, causes brain damage</td>
<td>Get immunized before pregnancy</td>
</tr>
<tr>
<td>Toxoplasmosis</td>
<td>Brain damage, loss of vision, mental retardation</td>
<td>Avoid eating undercooked meat and handling cat feces, garden dirt</td>
</tr>
<tr>
<td>Measles, chicken pox, influenza</td>
<td>May impair brain functioning</td>
<td>Get immunized before pregnancy; avoid infected people during pregnancy</td>
</tr>
<tr>
<td>Syphilis</td>
<td>Baby is born with syphilis, which, untreated, leads to brain and bone damage and eventual death</td>
<td>Early prenatal diagnosis and treatment with antibiotics</td>
</tr>
<tr>
<td>AIDS</td>
<td>Baby may catch the virus. If so, illness and death are likely during childhood.</td>
<td>Prenatal drugs and cesarean birth make AIDS transmission rare</td>
</tr>
<tr>
<td>Other sexually transmitted infections, including gonorrhea and chlamydia</td>
<td>Not usually harmful during pregnancy but may cause blindness and infections if transmitted during birth</td>
<td>Early diagnosis and treatment; if necessary, cesarean section, treatment of newborn</td>
</tr>
<tr>
<td>Infections, including infections of urinary tract, gums, and teeth</td>
<td>May cause premature labor, which increases vulnerability to brain damage</td>
<td>Get infection treated, preferably before pregnancy</td>
</tr>
<tr>
<td>Pollutants</td>
<td>May cause spontaneous abortion, preterm labor, and brain damage</td>
<td>Most common substances are harmless in small doses, but pregnant women should still avoid regular and direct exposure, such as drinking well water, eating uncooked fruits or vegetables, using chemical compounds, eating fish from polluted waters</td>
</tr>
<tr>
<td>Radiation</td>
<td>In the embryonic period, may cause abnormally small head (microcephaly) and mental retardation in the fetal period, suspected but not proven to cause brain damage. Exposure to background radiation, as from power plants, is usually too low to have an effect.</td>
<td>Get ultrasounds, not X-rays, during pregnancy; pregnant women who work directly with radiation need special protection or temporary assignment to another job</td>
</tr>
<tr>
<td>Social and Behavioral Factors</td>
<td></td>
<td>Get adequate relaxation, rest, and sleep; reduce hours of employment; get help with housework and child care</td>
</tr>
<tr>
<td>Very high stress</td>
<td>Early in pregnancy, may cause cleft lip or cleft palate, spontaneous abortion, or preterm labor</td>
<td>Consume adequate vitamins and minerals, especially folic acid, iron, and vitamin A; achieve normal weight before getting pregnant, then gain 25-35 lbs (10-15 kg)</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>When severe, may interfere with conception, implantation, normal fetal development, and full-term birth</td>
<td>Get regular, moderate exercise</td>
</tr>
<tr>
<td>Excessive, exhausting exercise</td>
<td>Can affect fetal development when it interferes with pregnant woman’s sleep or digestion</td>
<td></td>
</tr>
<tr>
<td>Teratogens</td>
<td>Effects on Child of Exposure</td>
<td>Measures for Preventing Damage</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lithium</td>
<td>Can cause heart abnormalities</td>
<td>Avoid all medicines, whether prescription or over-the-counter, during pregnancy unless they are approved by a medical professional who knows about the pregnancy and is aware of the most recent research.</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>Can harm the teeth</td>
<td></td>
</tr>
<tr>
<td>Retinoic acid</td>
<td>Can cause limb deformities</td>
<td></td>
</tr>
<tr>
<td>Streptomycin</td>
<td>Can cause deafness</td>
<td></td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>Can harm digestive organs</td>
<td></td>
</tr>
<tr>
<td>Phencobarbital</td>
<td>Can affect brain development</td>
<td></td>
</tr>
<tr>
<td>Thalidomide</td>
<td>Can stop ear and limb formation</td>
<td></td>
</tr>
<tr>
<td>Psychoactive Drugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caffeine</td>
<td>Normal use poses no problem</td>
<td>Avoid excessive use. Drink no more than three cups a day of beverages containing caffeine (coffee, tea, cola drinks, hot chocolate).</td>
</tr>
<tr>
<td>Alcohol</td>
<td>May cause fetal alcohol syndrome (FAS) or fetal alcohol effects (FAE)</td>
<td>Stop or severely limit alcohol consumption during pregnancy; especially dangerous are three or more drinks a day or five or more drinks on one occasion.</td>
</tr>
<tr>
<td>Tobacco</td>
<td>Increases risk of malformations of limbs and urinary tract, and may effect the baby’s lungs</td>
<td>Stop smoking before and during pregnancy.</td>
</tr>
<tr>
<td>Marijuana</td>
<td>Heavy exposure may affect the central nervous system; when smoked, may hinder fetal growth.</td>
<td>Avoid or strictly limit marijuana consumption.</td>
</tr>
<tr>
<td>Heroin</td>
<td>Slows fetal growth and may cause premature labor; newborns with heroin in their bloodstream require medical treatment to prevent the pain and convulsions of withdrawal</td>
<td>Get treated for heroin addiction before becoming pregnant; if already pregnant, gradual withdrawal on methadone is better than continued use of heroin.</td>
</tr>
<tr>
<td>Cocaine</td>
<td>May cause slow fetal growth, premature labor, and learning problems in the first years of life</td>
<td>Stop using cocaine before pregnancy; babies of cocaine-using mothers may need special medical and educational attention in their first years of life.</td>
</tr>
<tr>
<td>Inhalants (glue or aerosol)</td>
<td>May cause abnormally small head, crossed eyes, and other indications of brain damage</td>
<td>Stop sniffing inhalants before becoming pregnant; be aware that serious damage can occur before a woman knows she is pregnant.</td>
</tr>
</tbody>
</table>

Note: This table summarizes some relatively common teratogenic effects. As the text notes clear, many individual factors in each pregnancy affect whether a given teratogen will actually cause damage and what that damage might be. This is a general summary of what is known; new evidence is reported almost daily so some of these generalities will change. Pregnant women or women who want to become pregnant should consult with their physicians.


**Response for Nutritionists** (from page 106) Useful, yes; optimal, no. Some essential vitamins are missing too expensive, and individual needs differ, depending on age, sex, health, genes, and eating habits. The reduction in neural-tube defects is good, but many women don’t eat cereal or take vitamin supplements before becoming pregnant.
The Stages of Pregnancy: First Trimester Emotions

- Emotional state during pregnancy varies according to several factors:
  - Women who desire the pregnancy are less anxious than women who do not.
  - Low income is associated with depression during pregnancy.
  - Women with a supportive partner are less likely to be depressed.
  - In the first trimester, women’s anxieties often center on concerns about miscarriage.
The Stages of Pregnancy: Second Trimester

- Physical problems include constipation and nosebleeds.
- **Edema** (water retention and swelling) in the face, hands, wrist, ankles, and feet may be a problem.
- **Colostrum**, a thin amber or yellow fluid, may come out of the nipples beginning about the 19th week.
The Stages of Pregnancy: Psychological Well Being

- Psychological well-being is greater among women who:
  - have social support
  - have higher incomes
  - experience fewer concurrent stressful life events
The Postpartum Period: Emotions

Postpartum depression is characterized by:

– depressed mood
– insomnia
– tearfulness
– feelings of inadequacy
– fatigue
Causes of Postpartum Depression

- Physical exhaustion, including low levels of estrogen and progesterone
- Feeling overwhelmed with responsibilities of parenthood
- Financial issues associated with giving birth and acquiring all the things that will be needed to care for a baby
- Being estranged from the baby’s father
- Initial feelings of ambivalence toward the baby (“I must be a horrible mother”)
Drs. K & K’s Goofy Idea

• In the 1970s, pediatricians Marshall Klaus & John Kennell popularized the idea that there is a “critical period” or “sensitive period” in the minutes & hours immediately after birth, during which the mother & infant should bond to each other.

• No scientific evidence for the sensitive-period-for-bonding hypothesis.