

***SCIENCE SHEDS LIGHT ON UNBORN HUMAN LIFE***

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**Figure 1: Sixteen weeks from conception**

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It is no secret that abortion is one of the most difficult and polarizing issues facing our country today. Each side argues its case, but it often seems that we are talking past each other and the problem remains as intractable as ever.

As a pro-lifer, I believe we can make the most progress by influencing the views of open-minded people on the pro-choice side. I think the first step is to address the human life issue in a friendly and objective way, free of moralizing, religious overtones and judgmental attitudes. After all, one person won't necessarily agree with the religious views of his neighbor and each may have different value systems and ideas of right and wrong. We all do agree on one thing, however. It is wrong to take a life. Our country has laws against doing this. So, then the question: "Is the unborn child a life"?

To provide an objective framework for talking about the human life issue, I gathered scientific information from many sources that lays out the step-by-step development of the unborn child. In doing so, I was amazed at what science has learned about this awesome process. In particular, I had no idea how much development occurs in the early stages of pregnancy, especially during the first eight weeks when virtually all of the organs and tissues of the body are formed.

I have always been pro-life as a matter of intuition. However, as I gradually built up the scientific data, its cumulative impact reinforced my gut feeling that the unborn child really is a human being from the moment of its conception. I invite others to consider this information. The sources for all the information presented below can be found in the appendices.

### ***The Unborn Child Develops So Rapidly!***

In the following few paragraphs I've highlighted some of the ways the child's body develops, with an emphasis on the early stages of pregnancy – often on a day-by-day basis. The developments I've chosen are only a few of the hundreds of other things that are happening early in pregnancy. I selected them because they captured my imagination. Readers who browse through the appendices will find information about other developments they may find interesting.

But before we begin, a comment might be in order about the moment when it all gets started. A new human being is conceived when a sperm fertilizes an egg. The sperm has 23 chromosomes and so does the egg. But the fertilized egg has 46, half from each parent, and is genetically unique. These 46 chromosomes, which are fixed at conception, establish the child's sex and are a blueprint for how it will develop, both during pregnancy and after birth.

Although the child begins developing immediately after conception, the most visible advances occur during the third to eighth weeks. In fact, key organs are already

developing in the third week – a time when many women are just beginning to wonder if they are pregnant.

Blood vessels start to form very early, about 13-18 days after fertilization. Then, on about the 20<sup>th</sup> day – nearly the end of the third week - the foundation of the brain, the spinal cord, and the entire nervous system is established.

The eyes begin to develop early in the fourth week after conception. During this extremely critical week the esophagus, gallbladder, liver, lungs, pancreas, pharynx, stomach, and trachea also begin to form. And, toward the end of the week, the nose, tongue, and spleen also start to develop.

The heart begins to beat on about the 22<sup>nd</sup> day after conception, circulating blood throughout the child. The arms begin to form on about day 26, followed by the beginnings of the legs on day 28, the same day that the mouth opens for the first time. Also on the 28<sup>th</sup> day, building blocks are present for 40 pairs of muscles that will run from the base of the skull to the bottom of the spinal column.

The kidneys begin to develop early in the fifth week after conception. The jaws and ears are also forming during this week and the face starts to look human.

The intestines are defined at the end of the first month, and the larynx is developing on about the 32<sup>nd</sup> day, the same time that spinal nerves begin to sprout and the palate is forming.

The cerebral cortex, the part of the brain that controls the intellect and motor activity, begins to differentiate on the 33<sup>rd</sup> day after conception, the same day that the forearms and shoulders can be distinguished. The elbows are developing on the 34<sup>th</sup> day, as are both hand and foot plates.

The olfactory nerve, which is related to the sense of smell, is present in the brain on the 35<sup>th</sup> day after conception, the day when the ribs begin to form and lengthen.

Both the upper and lower lips are forming early in the sixth week after conception. Also during the sixth week the eye is obvious, reflecting the fact that retinal pigment is already present. The beginnings of the eyelids and the fingers are also forming during the sixth week, the testes become identifiable at this time and some salivary glands appear. By the sixth to seventh weeks after conception, the heart is contracting forty to eighty times each minute.

The aorta is developing on the 36<sup>th</sup> day after conception, and all the muscle blocks have appeared. The feet and the thighs become distinct on the 37<sup>th</sup> day. Finger rays are visible on the 38<sup>th</sup> day, when the nose is also formed. The urinary bladder is developing on the 39<sup>th</sup> day, and on the 40<sup>th</sup> day, the forehead, nostrils, diaphragm and teeth are beginning to appear.

The penis begins to develop on about the 42<sup>nd</sup> day after conception, the same day that the beginnings of the toes are evident.

Both the eyes and ears are developing rapidly during the seventh week after conception. At this time, the thumbs, neck, heels of the feet and all of the fingers are also present.

Nipples and the first hair follicles appear on the 44<sup>th</sup> day after conception. On the 46<sup>th</sup> day, microscopic examination can identify the child's sex because the ovaries and testes have differentiated.

The cheeks are visible on about the 47<sup>th</sup> day, when the knees are also developing. The vagina forms during the 36<sup>th</sup> to the 49<sup>th</sup> days, while the wrist is developing on about day 48. During the 49<sup>th</sup> to 51<sup>st</sup> days after conception, the arms are longer and bent at the elbows.

Taste buds begin to form during the eighth week after conception. All parts of the limbs are apparent at this time. In addition, the fingers and toes have lengthened and are completely separated.

On the 50<sup>th</sup> day after conception the eyes are heavily pigmented and the nose looks stubby. The ankles are present on the 54<sup>th</sup> day and the major blood vessels of the body take on their final scheme.

On the 56<sup>th</sup> day, the fingers of both hands are usually found close to the nose, the muscles of the stomach, esophagus, and intestines begin to proliferate, and the face appears quite human. All parts of the arms and legs are well developed, including the toes. The primary teeth are at the cap stage.

By the end of the eighth week the overwhelming majority (several thousand) of the body's organs, structures and systems have already begun to develop. Few, if any, new structures begin to form after this time. During the remainder of the pregnancy, development consists mainly of growth and maturation of the parts of the body that are already present.

Key changes that do occur past the eighth week, however, include the appearance of hair follicles on the eyebrows, eyelids, upper lip and chin at the end of the second month. In addition, fingernails and toenails begin to develop about the tenth week after conception and scattered rudiments of hair also form at this time. External genitalia start to appear at the end of this week which will indicate to the naked eye whether the child is a boy or a girl.

During the fourth month, fine palm lines have formed that can be used to permanently identify the child. Finger, palm and footprints are never duplicated among individuals.

### ***Better and Better Early Diagnosis and Treatment***

Physicians can now measure how the unborn child is growing and what its state of health is with a remarkable degree of accuracy. Doctors can operate on the child using advanced surgical techniques that don't leave a scar.

Ultrasonic imaging is standard practice for measuring a child's progress during most stages of pregnancy. However, an emerging technology called embryoscopy is very promising for use early in pregnancy. Through it, physicians can directly visualize the child during the first trimester, paving the way to improved early prenatal diagnosis and treatment. Taking advantage of high-resolution fiberoptic endoscopy, embryoscopic testing can be done as early as three weeks after conception. The face can be visualized as early as four weeks. Numerous diagnoses have already been done, but these just scratch the surface of the technology's amazing potential.

### ***The Unborn Child Moves Just Like Any Other Baby!***

The way the child moves before birth is similar to the way a newborn baby moves. Prenatal movement patterns are easily recognizable to persons familiar with the kinds of movements made by pre-term and full-term infants. It's amazing that the pattern of yawns and stretches seen in the first trimester remains the same throughout life. The child is engaged in all kinds of movements as early as the sixth week after conception. At this time, periods of inactivity typically last no more than about 260 seconds. See if you can identify with the movements that I've highlighted below.

Hiccups first occur during the sixth week after conception. In a study of twelve children all of them were hiccupping by the eighth week, with a median frequency of about 50 hiccups per hour.

Startles first occur from 6 to 7 \_ weeks after conception. During the seventh week, they were observed in twelve of twelve children studied, with a median rate of 42 startles per hour.

Isolated arm movements begin about 7 \_ to 8 \_ weeks after conception, with isolated leg movements starting after the first 7 \_ to 10 \_ weeks of life. Backward head movements first occur from 7 \_ to 10 \_ weeks.

Rotations of the head also begin from the middle of the seventh week after conception to the middle of the tenth week. During the eleventh week, these movements were present in twelve of twelve children studied, with a median frequency of five rotations per hour. In a separate study, the median frequency was 63 rotations per hour during the eighteenth week.

Breathing movements begin during the eighth week after conception. A single, large displacement of the diaphragm can seem like a sigh. During the ninth week, ten of twelve children examined were making breathing movements, with a median frequency of about 30 breaths each hour. During the eleventh week all twelve children were breathing, and the movements doubled to about 60 per hour. By the seventeenth week, the median breathing rate was 208 times per hour.

The child's breathing movements are related to the mother's eating pattern. In a study of ten children twenty to twenty two weeks after conception, the frequency of their breathing movements was much higher during the second hour after their mother's breakfast or lunch than during the third hour. Breathing movements occurred most often just after the mother's meal at noon.

Stretches first occur during the eighth week after conception. From the twelfth week onward, stretching an arm is frequently accompanied by extending the fingers.

Jaw openings and forward head movements begin during the 8 \_ to 12 \_ weeks after conception. During the tenth week, ten of twelve children examined opened their jaws, with a median frequency of about 18 movements per hour. By the twelfth week, all twelve children were opening their jaws, and the median frequency had increased to 30 times per hour.

In a separate study of ten children during the twentieth to twenty second weeks after conception, the median number of jaw openings increased from 51 per hour in the early morning to 97 per hour in the early afternoon.

Hand-to-face contacts first occur 8 to 10 \_ weeks after conception. The hand touches the face slowly and the fingers often open and close. The child also sometimes inserts fingers into its mouth.

During the tenth week after conception, hand-to-face contacts were seen in all twelve of twelve children examined, with a median frequency of about 25 contacts each hour. In a different study of nine children, the median number of hand-to-face contacts was 95 per hour eighteen weeks after conception.

Tongue movements begin during the ninth week after conception. Yawning starts from the middle of the ninth week to the middle of the thirteenth week. Finger movements first occur during the tenth week after conception when opening and closing of one or more fingers can be seen.

Sucking and swallowing begin from the middle of the tenth week after conception to the middle of the twelfth week.

By the thirteenth week, the child can accomplish a complete change of position, usually with a backwards somersault.

Slow eye movements first occur during the fourteenth week after conception and rapid eye movements begin during the twenty-first week. In an examination of nine children, the median number of eye movements during the eighteenth week after conception was 25 per hour, increasing to 101 per hour during the thirty fourth week. “Blink-startle” responses have been seen during the twenty second and twenty third weeks.

During the twentieth to twenty second weeks after conception, the daily pattern of the child’s heart rate follows changes in the mother’s heart rate. The child’s heart rate decreases overnight.

### ***What the Unborn Child Senses***

In addition to its rapid physical development in the womb, which includes, as we have seen, an impressive repertoire of movement patterns, the child’s senses also start to emerge during the prenatal period. As noted previously, the olfactory nerve, which is integral to the sense of smell, is present on the 35<sup>th</sup> day after conception. The foundation of the sense of smell is established on the 39<sup>th</sup> day when nerve fibers in the brain connect with the olfactory lobe.

At eight weeks after conception, local stimuli can induce partial closing of the fingers, opening of the mouth, and squinting. And during the eleventh week, if the region around the mouth is stimulated, the child will open its mouth and suck a finger.

The child can respond to sounds from the tenth to fourteenth weeks after conception. Changes in its heart rate, eye blinks and movements have occurred after sounds.

Taste buds begin to form during the eighth week after conception. An unborn child actually has more taste buds than a newborn and probably has a sense of taste.

The reflexes between the taste buds and facial muscles are in place by the twenty sixth to twenty eighth weeks after conception. A facial response was evoked at this time when a bitter-tasting substance was given to a child.

Unborn children may have a sweet tooth. In one case, a child swallowed more amniotic fluid when it was sweetened. In another, the child responded to the addition of a bad-tasting substance to the amniotic fluid by reducing its sucking movements.

We can’t, of course, ask an unborn child if it experiences pain. However, research suggests that the answer would likely be that it does.

From the fifth week after conception onward, pain pathways are running from sensory receptors in the skin to those in the brain. These nerve endings are at least as dense in the skin of a newborn as in an adult. Such receptors appear around the mouth during the fifth week after conception and are present in the face, palms, and soles of the feet by the ninth week, spreading to the trunk, arms and legs by the thirteenth weeks and to all areas of the skin by the eighteenth week.



The development of the neocortex, the largest part of the brain, begins six weeks after conception and a full complement of nerve cells is present by the eighteenth week. At this time the pieces are in place to complete the pain circuitry. The evidence thus indicates that the child has developed sufficiently to sense pain late in gestation.

In a study of women undergoing amniocentesis during the third trimester, the sudden burst of body movements that the child made during the procedure may reflect a response to pain. These movements occurred when the needle either struck the child or the child moved against the needle. In another study, the child's heart rate increased in response to scalp blood sampling, a procedure that is likely to be painful.

### ***Learning in the Womb***

Several studies suggest that children can learn while they are still in the womb. For example, newborns prefer the sound of their own mother's voice. In one experiment, they learned to change their pattern of sucking in order to activate a recording of their mother's voice instead of that of another woman. The preference appears to have been acquired before birth.

In another case, newborns preferred the sound of their mother's voice when it was adjusted to resemble what they might have heard in the womb.

In an even more amazing study, newborns stopped crying and responded to songs played on shows that their mothers watched while they were pregnant.

Prenatal learning seems to extend to the sense of taste as well. Mothers who maintained the same diet before and after they gave birth were more successful in breastfeeding than mothers who changed to a less spicy diet. This may reflect the child's preference for food the mother ate while she was pregnant because the mother's milk contains clues about her diet.

### ***What Has Science Shown Us?***

In my view, over the last two decades science has built up an overwhelming body of information that leads us to just one conclusion: **The unborn child must be a human life.** The child quickly develops all the organs and systems that a newborn has. It moves like a newborn. It has senses. It can learn. If it is not a human, what is it?

Perhaps it was information like this that led some doctors to consider the unborn child to be their patient. As noted in Williams Obstetrics (20<sup>th</sup> edition, p 151, 1997), **“The status of the unborn child has been elevated to that of a patient, who, in large measure, can be given the same meticulous care that obstetricians provide pregnant women”**. This view is consistent with that expressed by William J. Larsen, Ph.D. in Essentials of Human Embryology, p 317, (1998), **“The extreme speed with which both our understanding of human biology and our clinical practices are advancing affect a new category of patient: the unborn fetus.”** In further support of this view, Jan G. Nijhuis,

M.D., Ph.D, editor of Fetal Behaviour: Developmental and Perinatal Aspects, p xix, (1992), considers **human life to include the time from conception to birth.**

It's not my intention to make this a cold scientific presentation, although impartial science is certainly at the bottom of it. I hope the scientific approach lends it credibility. However, the human life issue transcends science in that it deals with our children, and it impinges on our humanity, our deepest emotions, and our consciences. I therefore hope the information presented here also triggers an emotional response that goes beyond just rational scientific evaluation.

May the images of the day-by-day development of innocent unborn children inspire enough love in our hearts to nourish and protect their growth until birth. And may we then cherish these new individuals, providing the kind of supportive environment that will see them into a happy adulthood.

To any women who change their mind about having an abortion after considering this information, I am sure your decision will lead to an increase in joy and fulfillment that may not be apparent to you today. The pro-life community stands ready with material and emotional support to help you in your courageous decision.

And help is also available to those who may be in pain from an abortion that has already taken place. You can contact the National Office of Post-Abortion Reconciliation and Healing, which provides assistance on a confidential and non-denominational basis. Their telephone number is 1 800 5 WE CARE, and their website address is [www.marquette.edu/rachel/](http://www.marquette.edu/rachel/).

### ***About the Author***

I am a Senior Vice President at the Daiwa Institute of Research America Inc., an affiliate of Daiwa Securities Co., Ltd., the second largest brokerage and investment banking firm in Japan, and one of the largest worldwide. I analyze the U.S. health care market and make investment recommendations on pharmaceutical, biotechnology and medical device companies.

Prior to joining Daiwa, I was an executive at the biotechnology company, Life Technologies, and at SmithKline Beckman Corporation, a major global supplier of pharmaceuticals and diagnostic products and services. Early in my career at SKB, I was a scientist in the organic chemistry section of the Company's pharmaceutical research and development department.

I have a B.S. in chemistry from Villanova University and studied chemistry at the graduate level at Western Reserve University on a National Defense Education Act Fellowship. I have also completed the Graduate Management Program at the Wharton School of the University of Pennsylvania.

My wife Cathy and I live in the suburban Philadelphia area. Our son is a college junior, attending school in New England.

### ***Use of this Study***

Although this study is copyrighted, all or part of it can be used without my permission or attribution for educating people about the development of unborn human life. The report is free, although in some cases it might be necessary to charge only for the cost of hard copy distribution. I did not undertake it to make a profit. I encourage pro-life speakers, counselors, and writers to abstract parts of the report as background information as they see fit. I particularly encourage pro-choice people to carefully consider this information with an open mind.

I hope the material contributes to a respectful discourse about abortion. I encourage readers to copy and distribute it as hard copy or distribute it via e-mail to persons and organizations that are interested in the human life issue.

I hope Science Sheds Light on Unborn Human Life contributes to an emerging national consensus that the unborn child is indeed a human being, and deserves to be loved, protected, and cherished.

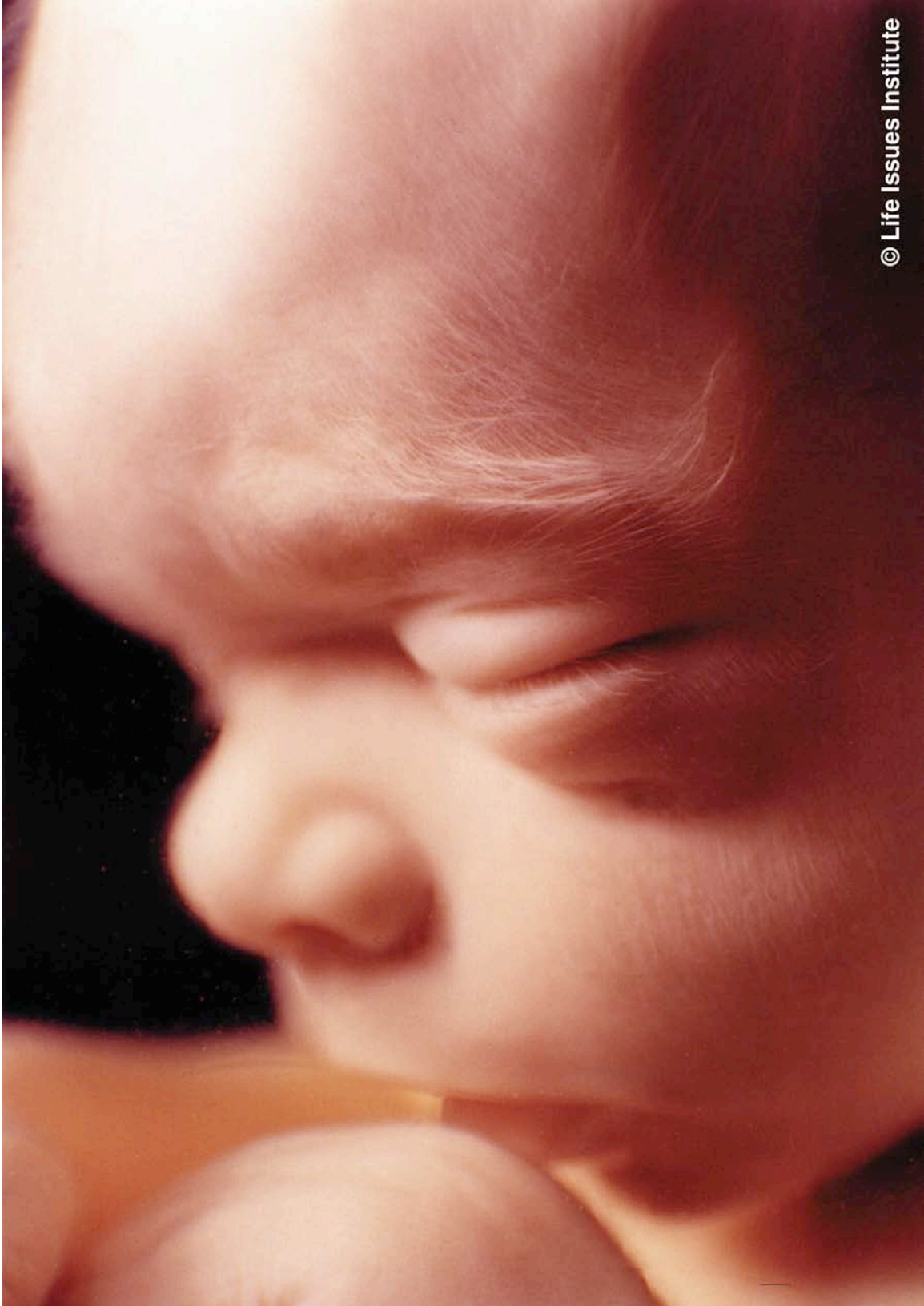
### ***Illustrations***

Figure 1-Page and Figure 2-Page 12 are photographs of an unborn child, respectively, sixteen weeks and twenty weeks from conception . They are provided with the gracious permission of Life Issues Institute, J.C. Willke, M.D., President. Further information about LII, including information about an additional 17 compelling pictures of an unborn child, can be obtained at LII's website, [www.lifeissues.org](http://www.lifeissues.org), or by telephoning 513 729 3600.

The pictures were taken under the direction of Professor Andrzej Skawina of Collegium Medicum Jagiellonian University, Krakow, Poland and Antoni Marsinek, MD of the Czerwiakowski Gynecological and Obstetrics Hospital, Krakow, Poland.

### ***Dedication***

To my dear wife Cathy, and in memory of my parents, Len and Madeline Cogan, and in memory of Edward Blaney. Pro-life stalwarts, all. And also to our son, John, that he and the next generation of pro-lifers may continue the struggle to protect unborn human life.



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**Figure 2: Twenty weeks from conception**

## ***APPENDICES***

### **SELECTED STEPS IN THE DEVELOPMENT OF THE UNBORN CHILD**

The appendices are easy to use. Appendix 1 lists the chronological development of the unborn child from the moment of conception onward, including information on how the parts of the body unfold as well as on how the child breathes, moves, learns, and develops the senses of hearing, smell and taste. Much of the data refers to the first eight weeks (the embryonic period) when the vast majority of parts of the body first appear. After this time, development consists mostly of the growth and maturation of these organs, systems and structures. The embryonic period has been studied by scientists in much greater detail than the fetal period, which begins on the 57<sup>th</sup> day of pregnancy and continues until birth. When possible, I have added information regarding developmental milestones during the fetal period. The data are organized on a week-by-week basis, with day-by-day development noted when available.

Appendix 2 rearranges some of the data from Appendix 1, listing development of the parts of the body in alphabetical order. A general category, “Prenatal Development”, focuses primarily on broad changes that occur during the 3<sup>rd</sup> to the 8<sup>th</sup> weeks. Appendix 2 also includes important definitions and information on measuring methods

Appendix 3 rearranges the rest of the information from Appendix 1, focusing on the ways that the child moves in the womb and when these movement patterns begin, with the entries arranged in alphabetical order. This appendix also highlights information about prenatal learning and the development of the senses, including data on how the child might experience pain. It also contains information describing certain physiological functions such as breathing, swallowing, and squinting.

#### **Interpreting the Appendices**

Some of the information in the appendices may seem repetitive. For example, there are three separate entries in Appendix 2 saying that the eye begins to develop on day 28 after fertilization. However, since these entries come from two different sources (Moore and Sadler), the accuracy of the observation is enhanced. The development of the eye in the same time period is further confirmed by Larsen’s assertion that the eyes begin their development early in the 4<sup>th</sup> week. When multiple sources confirm a finding, it is more reliable. Multiple sources are included so that readers can form their own judgment about the information.

Sometimes the sources differ and the best we can say in these cases is that the part of the body in question begins to develop over a range of time instead of on a given day. Of course, no two persons develop at exactly the same rate anyway, so that even the most highly confirmed data would not necessarily apply to an individual case.

The data presented here are not intended to be an exhaustive layout of the day-by-day development of the unborn child. Some parts of the body were not covered in the sources

cited. Other information was not included in order to keep the report to a reasonable length. As a caveat, it should not be assumed that a part of the body appears **for the first time** on a given day unless the text says so. In all cases, however, a part of the body is present on the day indicated.

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The information used in this book was obtained from the scientific and medical textbooks and journal articles listed below. Next to each source is the shorthand way it is referred to in the appendices.

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## APPENDIX 3

### MOVEMENT AND LEARNING PATTERNS OF THE UNBORN CHILD AND THE DEVELOPMENT OF THE SENSES

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## APPENDIX 1

### THE CHRONOLOGICAL DEVELOPMENT OF THE UNBORN CHILD

	<u>TIMING</u>	<u>SOURCE</u>
<b><u>AT CONCEPTION</u></b>		
An embryo, or a new human, comes into existence when a zygote is produced at fertilization by the combination of a sperm with an ovum.	At conception	Moore, p.2
The sperm has 23 chromosomes and so does the ovum, but the zygote has 46 chromosomes. Although half of its chromosomes come from each parent, the zygote is genetically different than either of them, and is, in fact, genetically unique.	At fertilization	Moore, p 37
The sex of the embryo is determined genetically.	At fertilization	Sadler, p 319
Genetic sex is established.	At fertilization	Williams, p 180
The embryo's chromosomal sex is determined.	At fertilization	Moore, p 37
The difference between a male and a female is determined genetically at the time of conception.	At conception	Rugh, p 7
<b><u>FIRST WEEK</u></b>		
The beginnings of the various organs and systems are established, especially in the third week when certain key organs start to develop.	1 <sup>st</sup> – 3 <sup>rd</sup> weeks of development	O'Rahilly, p 23
<b><u>THIRD WEEK</u></b>		
The central nervous system appears.	Beginning of 3 <sup>rd</sup> week	Sadler, p 411
Embryonic blood vessels begin developing.	3 <sup>rd</sup> week after fertilization	Moore, p 76
Blood vessels appear.	3 <sup>rd</sup> week after fertilization	Williams, p 161

Somites, which will develop into the 33 pairs of vertebrae in the spinal column, are growing.	3 <sup>rd</sup> week after conception	Rugh, p 35
The vascular system appears.	Middle of the 3 <sup>rd</sup> week	Sadler, p 208
Blood cells are developing.	End of 3 <sup>rd</sup> week after fertilization	Moore, p 76
Blood cells and blood vessels are differentiated.	End of the 3 <sup>rd</sup> week of development	Sadler, p 77
Embryoscopy can directly visualize the embryo/fetus during the first trimester, paving the way to improved early prenatal diagnosis and treatment. Utilizing high-resolution fiberoptic endoscopy, testing can be done as early as 3 weeks after conception. The face can be visualized as early as 4 weeks. Numerous diagnoses have already been done but these just scratch the surface of the technology's potential.	3 <sup>rd</sup> – 4 <sup>th</sup> weeks after conception	Reece, pages p 775, 777, & 778
Although the embryo begins developing immediately after conception, the most visible advances occur during the third to eighth weeks.	3 <sup>rd</sup> – 8 <sup>th</sup> weeks after fertilization	Moore, p 2
The most important features of the body's future form are determined at this time because of the many organs that are formed during this period.	3 <sup>rd</sup> – 8 <sup>th</sup> weeks	Sadler, p 108
Most major organs and organ systems are formed during the embryonic period. The mother may not be aware of her pregnancy during this critical period, especially in the third and fourth weeks when the embryo is quite vulnerable.	During 3 <sup>rd</sup> – 8 <sup>th</sup> weeks	Sadler, p 106 & p 107
The organs and systems of the body are formed.	From late in the 3 <sup>rd</sup> week through the 8 <sup>th</sup> week	Larsen, p 319
Blood and blood vessels begin to develop.	Days 13-15 after fertilization	England, p 110



The embryo begins to form blood cells.	Day 17 after conception	Rugh, p 17
The first blood vessels form.	Day 18 of development	Larsen, p 123
The embryo begins to form a heart.	Day 18 after conception	Rugh, p 17
The nervous system begins to form.	Day 18 after conception	Rugh, p 33
The brain's divisions – the forebrain, the midbrain, and the hindbrain – are demarcated.	Day 19	Larsen, p 275
The central nervous system begins to form.	Day 19 after fertilization	Sadler, front pages
The foundation of the brain, spinal cord and entire nervous system is established. The eyes also begin to be formed.	Day 20 after conception	Rugh, p 33
The thyroid gland starts to develop.	Day 20 after fertilization	Moore, p 5
Liver cells begin to draw together.	Day 21 after conception	Rugh, p 42

#### **FOURTH WEEK**

The eyes begin to develop.	Early in the 4 <sup>th</sup> week	Larsen, p 252
The development of the eye is first evident.	Beginning of the 4 <sup>th</sup> week after fertilization	Moore, p 492
The facial primordia begin to appear.	Early in 4 <sup>th</sup> week after fertilization	Moore, p 236
The cardiovascular system has formed.	4 <sup>th</sup> week after fertilization	Williams, p 161
The esophagus is developing.	4 <sup>th</sup> week of development	Sadler, p 274

The gallbladder is developing.	4 <sup>th</sup> week of development	Sadler, p 274
The heart begins to pump.	4 <sup>th</sup> week of development	Sadler, p 77
The liver is developing.	4 <sup>th</sup> week of development	Sadler, p 274
The liver bud sprouts.	4 <sup>th</sup> week	Larsen, p 157
The lung bud develops.	4 <sup>th</sup> week after fertilization	Moore, p 262
Heart activity can be measured with transvaginal ultrasonic scanning.	4 <sup>th</sup> week after fertilization	Williams, p 1027
The pancreas is developing.	4 <sup>th</sup> week of development	Sadler, p 274
The pharynx is developing.	4 <sup>th</sup> week	Sadler, p 274
The stomach appears.	4 <sup>th</sup> week of development	Sadler, p 276
The trachea is developing.	During the 4 <sup>th</sup> week	Sadler, p 274
The thyroid gland primordium first appears.	Late in 4 <sup>th</sup> week of development	Larsen, p 249
The anlage (i.e. the earliest discernible indication) of the central nervous system is present.	End of 4 <sup>th</sup> week of development	Larsen, p 52
Limb buds become visible.	End of 4 <sup>th</sup> week of development	Sadler, 7 <sup>th</sup> edition, p 154
Nasal placodes – the primordia of the nose and the nasal cavities – have developed.	End of 4 <sup>th</sup> week after fertilization	Moore, p 239
The beginnings of many of the organ systems, including the cardiovascular system, are established.	End of 4 <sup>th</sup> week after fertilization	Moore, p 91

The development of the tongue begins.	Late in 4 <sup>th</sup> week of development	Larsen, p 247
The first sign of the tongue's development appears, the median tongue bud.	End of 4 <sup>th</sup> week after fertilization	Moore, p 233
The lung bud appears.	Approximately 4 <sup>th</sup> week of development	Sadler, p 260
The tongue appears.	Approximately 4 <sup>th</sup> week	Sadler, p 362
Facial development mostly occurs.	4 <sup>th</sup> -8 <sup>th</sup> weeks after fertilization	Moore, p 236
Tooth buds form from dental lamina.	4 <sup>th</sup> – 8 <sup>th</sup> weeks of development	Larsen, p 304
The first sign of the developing internal ear occurs.	Approximately day 22	Sadler, p 382
The developing eye appears.	Day 22	Sadler, p 394
The heart begins to pump.	Day 22 after fertilization	Larsen, p xi
The heart begins to beat.	Day 22 after fertilization	Moore, p 5; Larsen, p 104
The heart begins to beat.	Day 22 after fertilization	England, p 104
The lung bud is present.	Day 22	Sadler, p 210
The lung bud appears.	Days 22-24	Larsen, p 82
The primordia of the ears are present.	Day 23 after fertilization	Moore, p 5
The primordia of the eyes are present.	Day 23 after fertilization	Moore, p 5
The heart starts to beat.	Day 24 after fertilization	Rugh, p 17

Blood begins to circulate throughout the embryo.	Day 24	Larsen, p 104
Upper limb buds appear.	Day 24 of development	Larsen, p 209
Otic placodes appear.	Days 24-25	Sadler, p 110
The liver bud is present.	Approximately day 25	Sadler, p 281
The stomach is developing.	Approximately day 25	Sadler, p 281
Upper limb buds appear.	Day 26 after fertilization	Larsen, p xi
The forebrain is developing.	Day 26 after fertilization	Moore, p 95
The otic pit, a sign of the first development of the internal ear, is present.	Day 26 after fertilization	Moore, p 95
Upper limb buds are present.	Day 26 after fertilization	Moore, p 5
The dorsal pancreatic bud begins to grow.	Day 26	Larsen, p 158
Arm buds are present.	Day 26 +/- 1 of development	Williams, p 153
Upper limb buds appear.	Days 26-27 of development	Sadler, p 110
The lung bud branches into left and right bronchial buds.	Days 26-28	Larsen, p 82
Lung buds may be seen.	Day 27 after conception	Rugh, p 43
The gallbladder appears.	Days 27-30 after conception	Rugh, p 42
Liver cells can be recognized as the liver.	Days 27-30 after conception	Rugh, p 42

The embryo grows in length from 5 millimeters to approximately 16 to 17 millimeters.	Day 27 to day 37 of development	Sadler, p 220
The ear placode is present.	Day 28 after fertilization	Sadler, front pages
The lens placode is present.	Day 28	Sadler, p 90
The lens placode (the primordium of the lens) is present.	Day 28 after fertilization	Moore, p 92
The eye anlage is present.	Day 28 after fertilization	Sadler, front pages
Upper limb buds are present.	Day 28 after fertilization	Moore, p 92
Arm buds are present.	Day 28 after fertilization	Sadler, front pages
The separation of the heart into a primordial atrium and ventricle can be seen.	Day 28 after fertilization	Moore, p 95
Lower limb buds appear.	Day 28 of development	Larsen, p 209
The mouth opens for the first time.	Day 28 after conception	Rugh, p 42
Building blocks are present for 40 pairs of muscles, which are located from the base of the skull to the bottom of the spinal column.	Day 28 after conception	Rugh, p 35
The spleen appears.	Day 28 after fertilization	Larsen, p xi
The spinal cord is developing.	About day 28 after fertilization	Moore, p 97
The stomach is forming.	About day 28 after fertilization	Moore, p 97
Leg buds are present.	Day 28 +/- 1 after fertilization	Williams, p 153

Lower limb buds appear.	Days 28-30 after fertilization	Moore, p 91
Hindlimb buds appear.	Days 28-30 of development	Sadler, p 110

**FIFTH WEEK**

The esophagus is developing.	Early in the 5 <sup>th</sup> week of development	Larsen, p 249
The kidneys begin to develop.	Early in 5 <sup>th</sup> week after fertilization	England, p 153
The trachea is developing.	Early in the 5 <sup>th</sup> week of development	Larsen, p 249
The forelimbs and hindlimbs appear as paddle-shaped buds.	Beginning of 5 <sup>th</sup> week	Sadler, p 106
The face begins to look human.	5 <sup>th</sup> week after conception	Rugh, p 45
Pain pathways run from sensory receptors in the skin to those in the brain. Nerve endings that sense pain are at least as dense in the skin of a newborn as in an adult. Such receptors appear around the mouth in the 5 <sup>th</sup> week after conception, and are present in the face, the palms, and the soles of the feet by the 9 <sup>th</sup> week, spreading to the trunk, arms, and legs by the 13 <sup>th</sup> week, and to all areas of the skin by the 18 <sup>th</sup> week. The development of the neocortex, the largest part of the brain, begins at 6 weeks after conception, and by 18 weeks a full complement of nerve cells is present. The evidence thus suggests that by late in gestation the fetus has developed sufficiently to sense pain.	from 5 <sup>th</sup> week after conception	Anand and Hickey, p 1322 & p 1326
The jaws are forming.	5 <sup>th</sup> week after conception	Rugh, p 45
The permanent kidneys appear.	5 <sup>th</sup> week	Sadler, p 305
The pharynx is present.	5 <sup>th</sup> week after fertilization	Rugh, p 45

Liver ducts are forming.	5 <sup>th</sup> week after conception	Rugh, p 46
The pituitary gland is developing.	5 <sup>th</sup> week after fertilization	Williams, p 178; Rugh, p 45
The spleen is forming.	5 <sup>th</sup> week after conception	Rugh, p 46
The spleen is formed.	5 <sup>th</sup> week	Larsen, p 159
The trachea is developing.	5 <sup>th</sup> week after fertilization	Moore, p 262
The thyroid is developing.	Late in 5 <sup>th</sup> week	Larsen, p 249
The tongue is developing.	Late in 5 <sup>th</sup> week	Larsen, p 249
The penis and scrotum form.	5 <sup>th</sup> – 6 <sup>th</sup> weeks	Larsen, p 175
Limb development takes place.	5 <sup>th</sup> – 8 <sup>th</sup> weeks of development	Larsen, p 209
Leg buds are present.	Day 29 after fertilization	Sadler, front pages
The three primary parts of the brain are present.	Day 30 after conception	Rugh, p 41
The ears have started to form.	Day 30 after conception	Rugh, p 41
The eyes have started to form.	Day 30 after conception	Rugh, p 41
The lens pits and optic cups are forming.	Day 30 after fertilization	Moore, p 5
The face is developing.	Day 30 after fertilization	Sadler, front pages
The gallbladder is developing.	Day 30 of development	Larsen, p 155
Nasal placodes are present.	Day 30 after fertilization	Sadler, front pages

The nasal pits, which are the primordia of the nostrils and the nasal cavities, are forming.	Day 30 after fertilization	Moore, p 5 & p 239
The nasal organs have begun forming.	Day 30 after conception	Rugh, p 41
The stomach is forming.	Day 30	Larsen, p 157
The trachea is developing.	Approximately day 30 after fertilization	Rugh, p 43
The intestines are defined.	End of 1 <sup>st</sup> month after conception	Rugh, p 43
The pancreas is defined.	End of 1 <sup>st</sup> month after conception	Rugh, p 43
The liver bud is present.	End of 1 <sup>st</sup> month	Sadler, p 271
The thyroid gland, which plays a critical role in metabolism, begins developing.	End of month 1 after conception	Rugh, p 42
The nervous, muscular, vascular, digestive, and skeletal systems are in an incipient state.	End of 1 <sup>st</sup> month after conception	Rugh, p 35,
The ears are forming.	During the 2 <sup>nd</sup> month	Sadler, p 106
The face is unmistakably human.	2 <sup>nd</sup> month after conception	Rugh, p 54
The nose is forming.	During the 2 <sup>nd</sup> month	Sadler, p 106
The skeleton is developing.	2 <sup>nd</sup> month after conception	Rugh, p 52
The face is forming.	During 2 <sup>nd</sup> month	Sadler, p 106
The limbs are forming.	2 <sup>nd</sup> month	Sadler, p 106



Great changes occur in appearance because of the emergence of a disproportionately large head and the formation of the limbs, face, ears, nose, and eyes.	During the 2 <sup>nd</sup> month	Sadler, p 106
The esophagus (the food tube leading to the stomach) begins to form.	Day 31 after conception	Rugh, p 43
Leg buds begin to form.	Day 31 after conception	Rugh, p 43
The primitive mouth is forming.	Day 31 after fertilization	Moore, p 5
Muscles appear in the pelvic region.	Day 31 after conception	Rugh, p 43
The stomach begins to form.	Day 31 after conception	Rugh, p 43
The nasal pits are visible.	Days 31-32 after fertilization	Moore, p 91
Forelimbs are paddle-shaped.	Days 31-35 of development	Sadler, p 110
The nasal pits are formed.	Days 31-35 of development	Sadler, p 110
Coronary vessels appear.	Day 32 after fertilization	Larsen, p xi
The primary intestinal loop forms.	Day 32 after fertilization	Larsen, p xi
The ventral pancreatic bud is present.	Day 32	Larsen, p 157
Spinal nerves begin to sprout.	Day 32 after fertilization	Larsen, p xi
The primary intestinal loop is forming.	Approximately day 32	Sadler, p 281
The larynx is developing.	Approximately day 32	Sadler, p 281

The palate is developing.	About day 32 after fertilization	Moore, p 98
The pharynx is developing.	About day 32 after fertilization	Moore, p 98
The cerebral cortex, the part of the brain that controls the intellect and motor activity, begins to differentiate.	Day 33 after conception	Rugh, p 44
Melanin first appears in the cells of the developing pigment retina.	Day 33	Larsen, p 257
The forearm region can be distinguished.	Day 33 of development	Larsen, p 209
Hand plates are present.	Day 33 after fertilization	Moore, p 5
Hand plates are developing.	Day 33 after fertilization	Larsen, p xii
The shoulder region can be distinguished.	Day 33 of development	Larsen, p 209
Hand plates are formed and digital rays are present.	Days 33-36 after fertilization	Moore, p 91
The cerebral vesicles are distinct.	Day 34 after fertilization	Moore, p 5
The elbows are developing.	Day 34 after fertilization	Sadler, front pages
Foot plates are developing.	Day 34 after fertilization	Moore, p 5; Sadler, front pages
Hand plates are developing.	Day 34 after fertilization	Sadler, front pages
Echocardiography can detect heart movements.	About day 34 after fertilization	Williams, p 30

The ribs begin to form and lengthen.	Day 35 of development	Larsen, p 48
The olfactory lobe, which is related to the sense of smell, is present in the brain.	Day 35 after conception	Rugh, p 44
The nasal pits deepen to form the nasal cavity.	Days 35-42	Larsen, p 230
The external ears are developing.	Days 35-49	Larsen, p 261

### **SIXTH WEEK**

The upper and lower lips are forming.	Early in 6 <sup>th</sup> week after fertilization	Moore, p 523
The tongue is developing.	Early in 6 <sup>th</sup> week after fertilization	Moore, p 533
The eye is obvious, reflecting the fact that the retinal pigment has formed.	6 <sup>th</sup> week after fertilization	Moore, p 94
The upper and lower eyelid primordia appear.	6 <sup>th</sup> week of development	Larsen, p 259
The primordia of the fingers, called digital rays, start to develop.	6 <sup>th</sup> week after fertilization	Moore, p 94
Hiccups first occur.	6 <sup>th</sup> week after conception	Roodenburg, p 32
The ends of the limb buds become flattened to form foot plates.	6 <sup>th</sup> week of development	Sadler, p 172
The oral cavity is developing.	6 <sup>th</sup> week	Sadler, p 376
Spontaneous movements, such as twitching of the trunk and limbs, have been reported.	6 <sup>th</sup> week after fertilization	Moore, p 94
The pelvis is developing.	6 <sup>th</sup> week	Sadler, p 308
Movement of the muscles is being controlled by the nervous system.	6 <sup>th</sup> week after conception	Rugh, p 34
It is believed that the majority of women do not realize they are pregnant during the first six weeks after conception.	6 <sup>th</sup> week after conception	Rugh, p 54

In a study of 12 fetuses, the longest median period of inactivity was 260 seconds.	6 <sup>th</sup> week after conception	de Vries (1985), p 102
The testes become identifiable.	6 <sup>th</sup> week	O’Rahilly, p 210
The ureter is developing.	6 <sup>th</sup> week	Sadler, p 308
Some salivary glands appear.	About 6 <sup>th</sup> week after fertilization	Moore, p 236
General movements first occur.	6 <sup>th</sup> – 7 <sup>th</sup> weeks after conception	Roodenburg, p 31
The heart is contracting at a rate of 40 to 80 beats per minute, as measured with an electrocardiogram.	6 <sup>th</sup> – 7 <sup>th</sup> weeks after conception	Rugh, p 53
The salivary glands begin to develop.	6 <sup>th</sup> -7 <sup>th</sup> weeks after fertilization	England, p 90
The uterus forms.	6 <sup>th</sup> – 7 <sup>th</sup> weeks	Larsen, p 175
The vagina forms.	6 <sup>th</sup> – 7 <sup>th</sup> weeks	Larsen, p 175
Startles first occur.	6 – 7 _ weeks after conception	Nijhuis/de Vries, p 5
General movements first occur.	6 _ - 7 _ weeks after conception	Nijhuis/de Vries, p 5
The fetus normally moves spontaneously.	6 <sup>th</sup> –8 <sup>th</sup> weeks after conception	de Vries (1982), p 318
Hiccups first occur.	6 _ - 8 _ weeks after conception	Nijhuis/de Vries, p 5
The aorta is developing.	Day 36 of development	Larsen, p 156
Ear swelling is present.	Day 36 after fertilization	Sadler, front pages
The oral and nasal cavities are confluent.	Day 36 after fertilization	Moore, p 5

All of the muscle blocks have appeared.	Day 36 after conception	Rugh, p 46
The pancreas is developing.	Approximately day 36	Sadler, p 281
The thyroid is developing.	Approximately day 36	Sadler, p 281
Digital rays are present in the foot plates.	Days 36-42 of development	Sadler, p 110
Digital rays are present in the hand plates.	Days 36-42 of development	Sadler, p 110
The feet have become distinct.	Day 37 of development	Larsen, p 209
Foot plates are formed on the lower limb buds.	Day 37 after fertilization	Larsen, p xii
The legs have become distinct.	Day 37 of development	Larsen, p 209
The thigh has become distinct.	Day 37 of development	Larsen, p 209
Pigment can be seen in the retina.	Days 37-40 after fertilization	Moore, p 91
The eye muscles begin to form.	Day 38 after conception	Rugh, p 47
Finger rays are visible.	Day 38 of development	Larsen, p 209
Finger rays are developing.	Day 38 after fertilization	Sadler, front pages
The upper and lower jaws begin to fuse in the midline of the face.	Day 38 after conception	Rugh, p 47
The nose is formed.	Day 38 after fertilization	Moore, p 5

It is probable that the heartbeat of the embryo is similar to an adult's heartbeat.	Week 5 _ after Rugh, p 53 conception	
The urinary bladder is developing.	Day 39 after fertilization	Sadler, front pages
The pancreas is developing.	Day 39 after fertilization	Sadler, front pages
The liver is developing.	Day 39 after fertilization	Sadler, front pages
The foundation of the sense of smell is established when nerve fibers connect with the olfactory lobe in the brain.	Day 39 after conception	Rugh, p 47
The eyelids are developing.	Day 40 after fertilization	Moore, p 238
The eyes become pigmented.	Day 40 after conception	Rugh, p 47
The diaphragm forms.	Day 40 after conception	Rugh, p 47
The forehead is developing.	Day 40 after fertilization	Moore, p 238
The jaws are well-formed.	Day 40 after conception	Rugh, p 47
The lower jaw is developing.	Day 40 after fertilization	Moore, p 238
The kidneys are forming.	Day 40 of development	Larsen, p 156
The nostrils are developing.	Day 40 after fertilization	Moore, p 238
The teeth begin to form.	Day 40 after conception	Rugh, p 47
Digital rays are clearly visible in the hand plates.	Days 41-43 after fertilization	Moore, p 91

The rudiments of the fingers become evident.	Day 42 after conception	Rugh, p 47
The earliest reflexes begin.	Day 42 after conception	Rugh, p 47
The penis begins to form.	Day 42 after conception	Rugh, p 47
The rudiments of the toes become evident.	Day 42 after conception	Rugh, p 47
The eye is obvious.	About day 42 after fertilization	Moore, p 99
The pigmented eye is developing.	About 42 days after fertilization	Moore, p 99
<b><u>SEVENTH WEEK</u></b>		
The eyes are developing rapidly.	7 <sup>th</sup> week after conception	Rugh, p 52
The ears are developing rapidly.	7 <sup>th</sup> week after conception	Rugh, p 52
Thumbs and fingers with pads are present.	7 <sup>th</sup> week after conception	Rugh, p 44
All the fingers are present.	7 <sup>th</sup> week after conception	Rugh, p 52
The jaws, ribs, and vertebrae are changing from cartilage to bone.	7 <sup>th</sup> week after conception	Rugh, p 52
The fetal heart is functionally complete and normal.	7 <sup>th</sup> week after conception	Rugh, p 53
The heels are developing.	7 <sup>th</sup> week after conception	Rugh, p 44
Bronchi begin to form in the right and left lung.	7 <sup>th</sup> week after fertilization	Moore, p 262

The first indication of limb musculature is observed.	7 <sup>th</sup> week of development	Sadler, 7 <sup>th</sup> ed., p 168
A distinct neck connects the head with the body.	7 <sup>th</sup> week after conception	Rugh, p 51
The nasal chamber is developing.	7 <sup>th</sup> week	Sadler, p 376
The primary palate is developing.	7 <sup>th</sup> week	Sadler, p 376
The anorectal canal is developing.	7 <sup>th</sup> week	Sadler, p 316
The gonads acquire male or female characteristics.	7 <sup>th</sup> week of development	Sadler, p 319
Neck and trunk muscles start contracting spontaneously.	7 <sup>th</sup> week after fertilization	England, p 206
Startles first occur.	7 <sup>th</sup> week after conception	Roodenburg, p 33
Startles were observed in 12 of 12 fetuses studied, with a median number of about 42 per hour.	7 <sup>th</sup> week after conception	de Vries (1985), p 104
Isolated arm movements first occur.	About 7 _ to 8 _ weeks after conception	de Vries (1982), p 311
Isolated leg movements first occur.	About 7 _ - 10 _ weeks after conception	de Vries (1982), p 311
Backwards head movements first occur.	7 _ - 10 _ weeks after conception	Nijhuis/de Vries, p 5
Head rotations first occur.	7 _ - 10 _ weeks after conception	Nijhuis/de Vries, p 5
Ossification of the bones of the upper limbs has begun.	End of the 7 <sup>th</sup> week after fertilization	Moore, p 96
The toes are well-formed.	7 <sup>th</sup> – 8 <sup>th</sup> weeks	Sadler, p 108



The fingers are developing.	Day 43 after fertilization	Sadler, front pages
Toe rays are developing.	Day 43 after fertilization	Sadler, front pages
The eyelids are formed.	Days 43-49 of development	Sadler, p 110
Pigmentation of the retina can be seen.	Days 43-49 of development	Sadler, p 110
Digital foot rays are separating.	Days 43-49	Sadler, p 110
Digital rays are separating.	Days 43-49 of development	Sadler, p 110
The upper lip is forming.	Days 43-49 of development	Sadler, p 110
The elbows appear.	Day 44 after fertilization	Larsen, p xii
The palate is forming.	Day 44 after conception	Rugh, p 50
Nipples are formed.	Days 43-49 of development	Sadler, p 110
The eyelids form in the face.	Day 44 after fertilization	Larsen, p xii
The nerve cells of the retina form.	Day 44 after conception	Rugh, p 50
The first hair follicles appear.	Day 44 after fertilization	Larsen, p xii
Nipples appear.	Day 44 after fertilization	Larsen, p xii
Toe rays appear.	Day 44 after fertilization	Larsen, p xii

The elbow region is visible.	Days 44-46 after fertilization	Moore, p 91
Digital rays can be seen clearly in the foot plates.	Days 44-46 after fertilization	Moore, p 91
Notches are present between the digital rays in the hand.	Days 44-46 after fertilization	Moore, p 91
Nipples are visible.	Days 44-46 after fertilization	Moore, p 91
The nasal passages open to the outside.	Day 46 after conception	Rugh, p 51
Microscopic examination can identify the embryo's sex because the ovaries and testes have differentiated.	Day 46 after conception	Rugh, p 51
The bridge of the nose is visible.	Days 47-48 after fertilization	England, p 78
The cheek is visible.	Days 47-48 after fertilization	England, p 83
The knees are developing.	Days 47-48 after fertilization	England, p 180
The nerve connections from the retina to the brain are established.	Day 48 after conception	Rugh, p 51
The face becomes fuller and starts to look human.	Day 48 after conception	Rugh, p 51
The stomach is a scale model of what it will be at the time of birth.	Day 48 after conception	Rugh, p 52
The toes are developing.	Day 48 after fertilization	Sadler, front pages
The tongue forms from the floor of the mouth.	Day 48 after conception	Rugh, p 51
The liver is developing.	About 48 days after fertilization	Moore, p 99

The wrist is developing.	About day 48 after fertilization	Moore, p 99
Upper limbs are longer and bent at the elbows.	Days 49-51 after fertilization	Moore, p 91
Notches appear between the digital rays in the feet	Days 49-51 after fertilization	Moore, p 91
The upper limbs are longer and bent at the elbows.	Days 49-51 after fertilization	Moore, p 91
The rudiment of the face is created.	Days 49 – 63	Larsen, p 230

### **EIGHTH WEEK**

The adrenal glands are developing.	8 <sup>th</sup> week after conception	Rugh, p 53
By using Doppler or real-time ultrasonic measurements, the brain can be visualized.	8 <sup>th</sup> week after fertilization	Williams, p 30
The chin is visible.	8 <sup>th</sup> week after fertilization	England, p 81
Ossification begins in the lower limbs, and is first recognizable in the femur.	8 <sup>th</sup> week after fertilization	Moore, p 97
The feet are well-formed and distinctly human.	8 <sup>th</sup> week after conception	Rugh, p 53
Local stimuli may induce partial closing of the fingers.	8 <sup>th</sup> week after fertilization	Williams, p 169
The hands are well-formed and distinctly human.	8 <sup>th</sup> week after conception	Rugh, p 53
Hiccups were observed in 12 of 12 fetuses studied, with a median frequency of about 50 hiccups per hour.	8 <sup>th</sup> week after conception	de Vries (1985), p 108
The permanent kidneys are forming.	8 <sup>th</sup> week after conception	Rugh, p 54
The lungs have lobes and many-branched bronchioles.	8 <sup>th</sup> week after Conception	Rugh, p 53

Purposeful limb movements first occur.	8 <sup>th</sup> week after fertilization	Moore, p 97
Local stimuli may evoke opening the mouth.	8 <sup>th</sup> week after fertilization	Williams, p 169
If the fetus is removed from the uterus, spontaneous movements may be observed.	8 <sup>th</sup> week after fertilization	Williams, p 169
The beginnings of all essential structures are present.	8 <sup>th</sup> week after fertilization	Williams, p 154
Local stimuli may evoke squinting.	8 <sup>th</sup> week after fertilization	Williams, p 169
Taste buds begin to form.	8 <sup>th</sup> week after conception	Rugh, p 53
The ovary is present.	8 <sup>th</sup> week after fertilization	England, p 167
Breathing movements are first seen.	8 <sup>th</sup> week after conception	Roodenburg, p 32
A single, large displacement of the diaphragm is sometimes similar to a sigh.	8 <sup>th</sup> week after conception	Nijhuis/de Vries, p 6
Insertion of the fingers into the mouth has been observed.	8 <sup>th</sup> week after conception.	Nijhuis/de Vries, p 7
Stretches first occur.	8 <sup>th</sup> week after conception	Roodenburg, p 33
Dental buds are present.	8 <sup>th</sup> week	Sadler, 7 <sup>th</sup> edition, p 341
Jaw openings first occur.	8 _ - 10 _ weeks after conception	Nijhuis/de Vries, p 5
Forward head movements first occur.	8 _ - 12 _ weeks after conception	Nijhuis/de Vries, p 5
Stretches first occur.	8 _ - 13 _ weeks after conception	Nijhuis/de Vries, p 5

The auricles of the external ear start to take on their final shape.	End of 8 <sup>th</sup> week after fertilization	Moore, p 100
The eyelids are closing.	End of 8 <sup>th</sup> week after fertilization	Moore, p 99-100
By the end of the 8 <sup>th</sup> week after conception, the face clearly looks human.	End of 8 <sup>th</sup> week after fertilization	Moore, p 239
All areas of the limbs are apparent. In addition, the digits have lengthened and are completely separated.	End of week 8 after fertilization	Moore, p 97
The neck region is established.	End of 8 <sup>th</sup> week after fertilization	Moore, p 99
The neck is developed.	End of 8 <sup>th</sup> week after fertilization	England, p 96
The term embryo refers to the developing human being during the first eight weeks after conception. At the end of this period, all major structures have started to form.	End of 8 <sup>th</sup> week after fertilization	Moore, p 3
The embryonic period concludes at the end of the 8 <sup>th</sup> week after fertilization and the fetal period begins. Few, if any, new structures are formed after this time. Development during the fetal period involves growth and maturation of structures that are already present.	End of 8 <sup>th</sup> week after fertilization	Williams, p 153
The embryonic period consists of the first eight weeks after the last ovulation. During this time, the overwhelming majority (several thousand) of the named human structures appear, and the embryo is about 30 millimeters in length.	End of 8 <sup>th</sup> week	O’Rahilly, p 55
Scientists have examined the embryonic period in far greater detail than the fetal period, which begins in the ninth week and continues until birth. Few new features appear during the fetal period. Instead, the structures that are already present continue to develop.	End of 8 <sup>th</sup> week	O’Rahilly, p 55

The initial formation and development of nearly all of the organs is complete and the organs can be identified in a grossly recognizable state.	End of 8 <sup>th</sup> week of pregnancy	Carlson, p 407
The head is disproportionately large compared with the rest of the body.	End of 8 <sup>th</sup> week of pregnancy	Carlson, p 407
The embryo has human characteristics. The neck area is established and the eyelids are obvious and are closing. The auricles of the external ears begin to take their final shape.	End of 8 <sup>th</sup> week after fertilization	Moore, p 99
The face is unmistakably human.	2 <sup>nd</sup> month after conception	Rugh, p 54
Breathing movements are first seen.	8-9 _ weeks after conception	Nijhuis/de Vries, p 5
Hand-to-face contacts first occur.	8-10 _ weeks after conception	Nijhuis/de Vries, p 5
The hand touches the face slowly and the fingers often open and close.	8-10 _ weeks after conception	de Vries (1982), p 309 & p 311
Limb movements first occur during the 8 <sup>th</sup> week. By the 14 <sup>th</sup> week, they become coordinated.	8 <sup>th</sup> –14 <sup>th</sup> weeks after fertilization	Moore, p 112
External examination can reveal whether the embryo is male or female.	Day 50 after conception	Rugh, p 7
The face is more human-like.	Days 50-56 after fertilization	Sadler, p 110
The fingers are free.	Days 50-56	Sadler, p 110
The limbs are long and bent at the elbows and knees.	Days 50-56 of development	Sadler, p 110
The toes are free.	Days 50-56	Sadler, p 110
The hand plates are slightly flexed at the wrists.	Day 52 of development	Larsen, p 209

The upper limbs are slightly bent at the elbows.	Day 52 of development	Larsen, p 209
The eye is heavily pigmented.	About 52 days after fertilization	Moore, p 100
The fingers are separated.	About day 52 after fertilization	Moore, p 100
The nose is stubby.	About day 52 after fertilization	Moore, p 100
The toes are beginning to separate.	About day 52 after fertilization	Moore, p 100
The fingers are free and longer.	Days 52-53 after fertilization	Moore, p 91
The auricle, or external ear, is visible.	Day 54 after fertilization	England, p 92
The ankles are present.	Day 54 after fertilization	England, p 181
The toes are free and longer.	Days 54-55 after fertilization	Moore, p 91
The major blood vessels of the body take on their final scheme.	Day 56 after conception	Rugh, p 53
The face appears to be quite human.	Day 56 after conception	Rugh, p 53
The fingers of both hands are usually found close to the nose.	Day 56 after conception	Rugh, p 53
Digit separation in the hand is complete.	Day 56	Sadler, p 175
All regions of the arms and legs are well-developed, including the toes.	Day 56 of development	Larsen, p 213
Muscular layers of the stomach, esophagus, and intestines begin to proliferate.	Day 56 after conception	Rugh, p 53

The primary teeth are at the cap stage.	Day 56 after Fertilization	Larsen, p xii
The embryo has a distinct human appearance.	About day 56 after fertilization	Moore, p 100
The mouth is present.	About day 56 after fertilization	Moore, p 100
The lower jaw is developing.	About day 56 after fertilization	Moore, p 100
The shoulders are developing.	About day 56 after fertilization	Moore, p 100
The toes are separated.	About day 56 after fertilization	Moore, p 100

**57<sup>TH</sup> DAY**

The fetal period begins on day 57 after fertilization and ends at birth. The tissues and organs that were formed during the embryonic period continue to grow during the fetal period, but the changes aren't as pronounced. Ultrasonic measurements are used to measure embryonic growth.	Day 57	Moore, p 3
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**NINTH WEEK**

Hair follicles first appear on the eyebrows, eyelids, upper lip, and chin.	End of 2 <sup>nd</sup> month	Larsen, p 309
The legs are short and the thighs are relatively small.	Beginning of the 9 <sup>th</sup> week after fertilization	Moore, p 111
Breathing movements have been detected.	9 <sup>th</sup> week after fertilization	Boddy, p 4
Breathing movements were observed in 10 of 12 fetuses studied, with a median frequency of about 30 movements per hour.	9 <sup>th</sup> week after conception	de Vries (1985), p 106
The eyes are closing or closed.	9 <sup>th</sup> week after fertilization	Moore, p 109; Williams, p 155



The small intestine undergoes peristalsis.	9 <sup>th</sup> week after fertilization	Williams, p 169
The upper and lower lips are forming.	9 <sup>th</sup> week	Sadler, p 376
Red blood cells are formed primarily in the liver.	9 <sup>th</sup> week after fertilization	Moore, p 112
The face is broad, the eyes are widely separated, the ears are low-set, and the eyelids are fused.	9 <sup>th</sup> week after fertilization	Moore, p 110
The anus is present.	9 <sup>th</sup> week after fertilization	England, p 146
The buttocks are present.	9 <sup>th</sup> week after fertilization	England, p 146
Tongue movements first occur.	9 <sup>th</sup> week after conception	Nijhuis/de Vries, p 5
Yawning has been observed.	9 <sup>th</sup> week after conception	de Vries (1985), p 116
Hair begins to develop.	9 <sup>th</sup> – 12 <sup>th</sup> weeks after fertilization	Moore, p 517
Yawning first occurs.	9 _ - 13 _ weeks after conception	Nijhuis/de Vries, p 5

**TENTH WEEK**

The eyelids are closed.	10 <sup>th</sup> week after fertilization	Moore, p 238
The intestines are developing in the abdomen.	10 <sup>th</sup> week after fertilization	Moore, p 109; Williams, p 155
The fingernails are present.	10 <sup>th</sup> week after fertilization	England, p 173
Stretching an arm is frequently accompanied by extending the fingers.	From 10 <sup>th</sup> week after conception	de Vries (1982), p 307
Finger movements first occur.	10 <sup>th</sup> week after conception	Nijhuis/de Vries, p 5

Opening and closing one or more fingers can be seen.	10 <sup>th</sup> week after conception	Nijhuis/de Vries, p 6
Hand-to-face contacts were observed in 12 of 12 fetuses studied with a median frequency of about 25 contacts per hour.	10 <sup>th</sup> week after conception	de Vries (1985), p 113
Jaw openings were observed in 10 of 12 fetuses studied with a median rate of about 18 per hour.	10 <sup>th</sup> week after conception	de Vries (1985), p 114
The most common movement patterns have emerged.	10 <sup>th</sup> week after conception	de Vries (1988), p 87
Fingernails begin to develop at the end of the digits.	About 10 <sup>th</sup> week after fertilization	Moore, p 519
Fingernail anlagen first appear.	About 10 <sup>th</sup> week	Larsen, p 311
The tooth buds for permanent teeth begin to appear.	About 10 <sup>th</sup> week after fertilization	Moore, p 523
Toenails begin to develop at the tips of the digits.	About 10 <sup>th</sup> week after fertilization	Moore, p 519
Sucking first occurs.	10 _ - 12 _ weeks after conception	Nijhuis/de Vries, p 5
Swallowing first occurs.	10 _ - 12 _ weeks after conception	Nijhuis/de Vries, p 5
Fingernails are present.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
The fingers are differentiated.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
Scattered rudiments of hair appear.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
External genitalia are starting to indicate whether the fetus will be male or female.	End of 10 <sup>th</sup> week after fertilization	Williams p 154
The toes are differentiated.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154

Toenails are forming.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
The prostate and seminal vesicles develop in males.	10 <sup>th</sup> – 13 <sup>th</sup> weeks	Larsen, p 175
The fetus responds to sound.	10 <sup>th</sup> – 14 <sup>th</sup> weeks after conception	Nijhuis/Hep- per, p 133

### **ELEVENTH WEEK**

If the region near the mouth is stimulated, the fetus will open its mouth and such a finger.	11 <sup>th</sup> week after fertilization	England, p 206
Breathing movements were observed in 12 of 12 fetuses studied, with a median frequency of about 60 movements per hour.	11 <sup>th</sup> week after conception	de Vries (1985), p 106
Head rotations were observed in 12 of 12 fetuses studied, with a median rate of about 5 rotations per hour.	11 <sup>th</sup> week after conception	de Vries (1985), p 113
Taste buds are developing.	11 <sup>th</sup> – 13 <sup>th</sup> weeks after fertilization	Moore, p 234

### **TWELFTH WEEK**

The face has all the human characteristics.	12 <sup>th</sup> week	Sadler, p 116
Movements begin, but are usually not felt by the mother.	12 <sup>th</sup> week after fertilization	Sadler, p 116
Jaw openings were observed in 12 of 12 fetuses studied with a median rate of about 30 per hour.	12 <sup>th</sup> week after conception	de Vries (1985), p 114
The neck is well-defined.	12 <sup>th</sup> week after fertilization	Moore, p 109; Williams, p 155
The sex can be established by ultrasonic measurement of the external genitalia.	12 <sup>th</sup> week after fertilization	Sadler, p 113
The sex can be determined from external examination.	12 <sup>th</sup> week after fertilization	Moore, p 109

The fetus responds to stimulation of the skin.	12 <sup>th</sup> week after fertilization	England, p 206
Red blood cells are forming in the spleen.	End of 12 <sup>th</sup> week after fertilization	Moore, p 112
Primary ossification centers appear in the skeleton, especially in the skull and long bones.	End of 12 <sup>th</sup> week after fertilization	Moore, p 110, Sadler, p 113
Hair grows on the eyebrows and the upper lip.	End of 12 <sup>th</sup> week after fertilization	Moore, p 517
Stroking the lips causes the fetus to suck and stroking the eyelids results in a reflex response.	End of 12 <sup>th</sup> week after fertilization	Moore, 4 <sup>th</sup> edition, p 91
The sex is clearly distinguishable.	End of 12 <sup>th</sup> week after fertilization	Williams, p 154
The upper limbs have almost reached their final relative lengths and are a bit better developed than the lower limbs.	End of the 12 <sup>th</sup> week after fertilization	Moore, p 111
Respiration is evident.	12 <sup>th</sup> – 14 <sup>th</sup> weeks after fertilization	Williams, p 169
Swallowing is evident.	12 <sup>th</sup> – 14 <sup>th</sup> weeks after fertilization	Williams, p 169
Palm creases appear.	3 <sup>rd</sup> month	Rugh, p 217
The spinal cord extends the entire length of the embryo.	3 <sup>rd</sup> month of development	Sadler, p 422
Taste buds are evident.	3 <sup>rd</sup> lunar month	Williams, p 169
The first hairs appear in the region of the eyebrows and upper lip.	End of 3 <sup>rd</sup> month	Sadler, p 407
Reflex activity can be evoked in aborted fetuses, indicating muscular activity.	End of 3 <sup>rd</sup> month after fertilization	Sadler, p 114
The penile urethra is forming.	End of 3 <sup>rd</sup> month	Sadler, 7 <sup>th</sup> edition p 298

### **THIRTEENTH WEEK**

Respiratory movements can transport amniotic fluid in and out of the respiratory tract	Beginning of the 4 <sup>th</sup> month	Williams, p 177
Eyebrows are present.	13 <sup>th</sup> week after fertilization	England, p 209
The fetus can accomplish a complete change in position, usually with a backwards somersault.	By 13 <sup>th</sup> week after conception	de Vries (1982), p 301 & p 309

### **FOURTEENTH WEEK**

Slow eye movements occur.	14 <sup>th</sup> week after fertilization	Moore, p 112
Scalp hair patterning is determined.	14 <sup>th</sup> week after fertilization	Moore, p 112
The lower limbs are well-developed.	14 <sup>th</sup> week after fertilization	Williams, p 155; Moore, p 109
Toenails are present.	14 <sup>th</sup> week after fertilization	England, p 173
Slow eye movements first occur.	14 <sup>th</sup> week after conception	Nijhuis/de Vries, p 5; Birnholz, p 679
Eye movements are first seen.	About 14 <sup>th</sup> week conception	Inoue, p 172
The nail anlagen form on the toes.	About 14 <sup>th</sup> week	Larsen, p 311
Eye movements are first seen.	14 <sup>th</sup> – 16 <sup>th</sup> weeks after conception	Roodenburg, p 33
The first day that movement is noticed by the pregnant woman is called “quickenings”.	14 <sup>th</sup> – 18 <sup>th</sup> weeks after fertilization	Williams, p 23

## **SIXTEENTH WEEK**

Bones are clearly visible in ultrasound images.	Beginning of the 16 <sup>th</sup> week after fertilization	Moore, p 112
The ears stand out from the head.	16 <sup>th</sup> week after fertilization	Williams, p 155; Moore, p 109
The ovaries are differentiated.	16 <sup>th</sup> week after fertilization	Moore, p 112 & p 113
The appearance is human. The eyes face anteriorly. The ears have almost reached their final position on the sides of the head.	16 <sup>th</sup> week after fertilization	Moore, p 113
Fine palm lines have formed, which can be used to permanently identify the fetus. Finger, palm, and footprints are never duplicated among individuals.	4 <sup>th</sup> month	Rugh, p 217

## **SEVENTEENTH WEEK**

The median breathing movement rate was 208 per hour in 12 fetuses studied.	17 <sup>th</sup> week after conception	de Vries (1985), p 105
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## **EIGHTEENTH WEEK**

Signs of life (i.e. quickening) are felt by the mother.	18 <sup>th</sup> week after fertilization	Moore, p 109
The uterus is formed.	18 <sup>th</sup> week after fertilization	Moore, p 113
Canalization of the vagina has begun.	18 <sup>th</sup> week after fertilization	Moore, p 113
In nine fetuses studied, there were a median of 57 general movements per hour, which were present during 24% of the observation time.	18 <sup>th</sup> week after conception	Roodenburg, p 23
In a study of 9 fetuses, the median number of hand-to-face contacts was 95 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 33

In a study of 9 fetuses, the median number of head rotations was 63 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 33
Jaw movements include isolated jaw movements, sucking, swallowing, yawning, and tongue movements. In 9 fetuses studied, the median frequency of any kind of jaw movements was 142 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 28 & p 29
In a study of 9 fetuses, the median number of stretches were 6 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 28
Some scalp hair is visible.	End of 18 <sup>th</sup> week after fertilization	Williams, p 154
The rate of breathing movements was much higher during the second hour after the mother's breakfast or lunch than during the third hour.	20 <sup>th</sup> –22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
Breathing movements occurred most often right after the mother's meal at noon.	20 <sup>th</sup> –22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
The frequency of breathing movements changes during the day. In a study of 10 fetuses, such movements increased from a median of 2% of the observation time in the morning to 13% in the afternoon, and then fell to 11% in the evening.	20 <sup>th</sup> –22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
The fetal heart rate decreases overnight.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 341
The daily pattern of changes in the fetal heart rate follows the changes in the maternal heart rate.	20 <sup>th</sup> –22 <sup>nd</sup> weeks after conception	de Vries (1987), p 345 & p 346
The frequency of hiccupping changes during the day. In a study of 10 fetuses, the median number of hiccups during 8 AM to 10 AM was 28 per hour, decreasing to 12 per hour during 1 PM to 3 PM.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 338
The frequency of jaw openings changes during day. In a study of 10 fetuses, the median rate was 51 per hour during 8 AM to 10 AM, increasing to 97 per hour during 1 PM to 3 PM.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 338

In a study of 10 fetuses, the majority of movements occurred more frequently in the afternoon and evening than in the morning.	20 <sup>th</sup> –22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
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In 9 fetuses studied, the median number of eye movements at 18 weeks after conception were 25 per hour, increasing to 101 per hour at 34 weeks.	18 <sup>th</sup> - 34 <sup>th</sup> weeks after conception	Roodenburg, p 28
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**TWENTIETH WEEK**

Eyebrows are visible.	20 <sup>th</sup> week after fertilization	Moore, p 113
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Head and body hair is visible.	20 <sup>th</sup> week after fertilization	Williams, p 155
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The testes have begun to descend.	20 <sup>th</sup> week after fertilization	Moore, p 113
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The fetus is viable.	20 <sup>th</sup> week after fertilization	Moore, p 3
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Hair becomes easily recognizable.	About week 20 after fertilization	Moore, p 517
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Sweat glands are developing.	About 20 weeks after fertilization	Moore, p 517
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Sweat glands first appear.	About 20 weeks	Larsen, p 311
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Eyebrows are visible.	By the 5 <sup>th</sup> month after fertilization	Sadler, p 114
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Head hair is visible.	By the 5 <sup>th</sup> month after fertilization	Sadler, p 114
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Movement is usually recognized by the mother.	During the 5 <sup>th</sup> month after fertilization	Sadler, p 114
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**TWENTY FIRST WEEK**

Rapid eye movements begin.	21 <sup>st</sup> week after fertilization	Moore, p 114
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Rapid eye movements first occur.	21 <sup>st</sup> week after conception	Nijhuis/de Vries, 5; Birnholz, p 679
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**TWENTY SECOND WEEK**

A significant increase in fetal breathing occurred after giving glucose to the mother.	22 <sup>nd</sup> week after conception	Nijhuis/Visser, p 19
A fetus born at this time will attempt to breathe.	22 <sup>nd</sup> week after fertilization	Williams, p 154
Eyebrows are usually recognizable.	End of 22 <sup>nd</sup> week after fertilization	Williams, p 154
Eyelashes are usually recognizable.	End of 22 <sup>nd</sup> week after fertilization	Williams, p 154
“Blink-startle” responses have been reported.	22 <sup>nd</sup> -23 <sup>rd</sup> weeks after fertilization	Moore, p 114
“Blink-startle” responses to vibroacoustic stimulation have been observed.	22 <sup>nd</sup> & 23 <sup>rd</sup> weeks after conception	Birnholz & Benacerraf, p 516
The fetus apparently hears some sounds <u>in utero</u> .	22 <sup>nd</sup> – 24 <sup>th</sup> weeks after fertilization	Williams, p 169
A premature fetus born at this time may survive if given intensive care.	22 <sup>nd</sup> – 25 <sup>th</sup> weeks after fertilization	Moore, p 114
The skin of the fetus is reddish and has a wrinkled appearance.	During the 6 <sup>th</sup> month after fertilization	Sadler, p 114

**TWENTY SIXTH WEEK**

Eyelashes are present.	26 <sup>th</sup> week after fertilization	Moore, p 109
The eyes are open.	26 <sup>th</sup> week after fertilization	Moore, p 114
A facial response occurs when the fetus is given bitter-tasting substances. Reflexes between the taste buds and facial muscles are in place.	26 <sup>th</sup> – 28 <sup>th</sup> weeks after fertilization	Moore, p 234

The lungs are capable of breathing air. The central nervous system can direct rhythmic breathing and control body temperature.

26<sup>th</sup> – 29<sup>th</sup> weeks  
after fertilization

Moore, p 114

**AT BIRTH**

The tooth buds for the second and third permanent molars are developing.

At birth

Moore, p 523

## APPENDIX 2

### THE DEVELOPMENT OF THE UNBORN CHILD'S BODY

	<u>TIMING</u>	<u>SOURCE</u>
<b>ADRENAL GLANDS</b>		
The adrenal glands are developing.	8 <sup>th</sup> week after conception	Rugh, p 53
<b>AGE</b>		
Age is calculated from the first day of the last normal menstrual period (LNMP). This is the menstrual, or gestational, age. The actual age is calculated from the time of fertilization, about two weeks after the LNMP. Two weeks must be subtracted from the gestational age to arrive at the actual age of the developing human.	Nap	Moore, p 2
Ultrasonic tests can determine the size and probable age.	Nap	Moore, p 109
Menstrual, or gestational, age, is the length of time from the first day of the last menstrual period, a time that precedes conception by about two weeks.	Nap	Williams, p 151
<b>ANKLES</b>		
The ankles are present.	Day 54 after fertilization	England, p 181
<b>ANUS</b>		
The anus is present.	9 <sup>th</sup> week after fertilization	England, p 146
<b>ARMS</b>		
Upper limb buds appear.	Day 26 after fertilization	Larsen, p xi

Arm buds are present.	Day 26 +/- 1 of development	Williams, p 153
Upper limb buds are present.	Day 28 after fertilization	Moore, p 92
Arm buds are present.	Day 28 after fertilization	Sadler, front pages
Upper limbs are longer and bent at the elbows.	Days 49-51 after fertilization	Moore, p 91

## **BLADDER**

The urinary bladder is developing.	Day 39 after fertilization	Sadler, front pages
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## **BLOOD**

Blood and blood vessels begin to develop.	Days 13-15 after fertilization	England, p 110
The embryo begins to form blood cells.	Day 17 after conception	Rugh, p 17
The first blood vessels form.	Day 18 of development	Larsen, p 123
The mother's blood may be type O and that of fetus may be type A.	Nap	Rugh, p 217
Blood cells are developing.	End of 3 <sup>rd</sup> week after fertilization	Moore, p 76
Embryonic blood vessels begin to develop.	3 <sup>rd</sup> week after fertilization	Moore, p 76
Blood vessels appear.	3 <sup>rd</sup> week after fertilization	Williams, p 161
Blood cells and blood vessels are differentiated.	End of the 3 <sup>rd</sup> week of development	Sadler, p 77

The vascular system appears.	Middle of the 3 <sup>rd</sup> week	Sadler, p 208
The cardiovascular system has formed.	4 <sup>th</sup> week after fertilization	Williams, p 161
The aorta is developing.	Day 36 of development	Larsen, p 156
The major blood vessels of the body take on their final scheme.	Day 56 after conception	Rugh, p 53
Red blood cells are forming in the spleen.	End of 12 <sup>th</sup> week after fertilization	Moore, p 112

## **BONES**

The jaws, ribs, and vertebrae are changing from cartilage to bone.	7 <sup>th</sup> week after conception	Rugh, p 52
Ossification of the bones of the upper limbs has begun.	End of the 7 <sup>th</sup> week after fertilization	Moore, p 96
Ossification begins in the lower limbs, and is first recognizable in the femur.	8 <sup>th</sup> week after fertilization	Moore, p 97
The skeleton is developing.	2 <sup>nd</sup> month after conception	Rugh, p 52
Primary ossification centers appear in the, skelton, especially in the skull and long bones.	End of the 12 <sup>th</sup> week after fertilization	Moore, p 110, Sadler, p 113
Bones are clearly visible in ultrasound images.	Beginning of the 16 <sup>th</sup> week after fertilization	Moore, p 112

## **BRAIN**

The brain's divisions – the forebrain, the midbrain, and the hindbrain – are demarcated.	Day 19	Larsen, p 275
The forebrain is developing.	Day 26 after fertilization	Moore, p 95

The three primary parts of the brain are present.	Day 30 after conception	Rugh, p 41
The cerebral cortex, the part of the brain that controls the intellect and motor activity, begins to differentiate.	Day 33 after conception	Rugh, p 44
The cerebral vesicles are distinct.	Day 34 after fertilization	Moore, p 5
By using Doppler or real-time ultrasonic measurements, the brain can be visualized.	8 <sup>th</sup> week after fertilization	Williams, p 30

## **BREATHING**

Breathing movements have been detected.	9 <sup>th</sup> week after fertilization	Boddy, p 4
A fetus born at this time will attempt to breathe.	22 <sup>nd</sup> week after fertilization	Williams, p 154
The lungs are capable of breathing air. The central nervous system can direct rhythmic breathing and control body temperature.	26 <sup>th</sup> – 29 <sup>th</sup> weeks after fertilization	Moore, p 114

## **BRIDGE OF THE NOSE**

The bridge of the nose is visible.	Days 47-48 after fertilization	England, p 78
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## **BUTTOCKS**

The buttocks are present.	9 <sup>th</sup> week after fertilization	England, p 146
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## **CENTRAL NERVOUS SYSTEM**

The central nervous system begins to form.	Day 19 after fertilization	Sadler, front pages
The central nervous system appears.	Beginning of 3 <sup>rd</sup> week	Sadler, p 411
The anlage (i.e. the earliest discernible indication) of the central nervous system is present.	End of 4 <sup>th</sup> week of development	Larsen, p 52

## **CHEEK**

The cheek is visible.	Days 47-48 after fertilization	England, p 83
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## **CHIN**

The chin is visible.	8 <sup>th</sup> week after fertilization	England, p 81
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## **DIAPHRAGM**

The diaphragm forms.	Day 40 after conception	Rugh, p 47
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## **EARS**

The first indication of the developing internal ear can be found.	Approximately day 22	Sadler, p 382
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The primordia of the ears are present.	Day 23 after fertilization	Moore, p 5
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Otic placodes appear.	Days 24-25	Sadler, p 110
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The otic pit, a sign of the first development of the internal ear, is present.	Day 26 after fertilization	Moore, p 95
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The ear placode is present.	Day 28 after fertilization	Sadler, front pages
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The ears have started to form.	Day 30 after conception	Rugh, p 41
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The external ears are developing.	Days 35-49	Larsen, p 261
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Ear swelling is present.	Day 36 after fertilization	Sadler, front pages
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The ears are forming.	During the 2 <sup>nd</sup> month	Sadler, p 106
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The ears are developing rapidly.	7 <sup>th</sup> week after conception	Rugh, p 52
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The auricle, or external ear, is visible.	Day 54 after fertilization	England, p 92
The auricles of the external ear start to take on their final shape.	End of 8 <sup>th</sup> week after fertilization	Moore, p 100
The ears stand out from the head.	16 <sup>th</sup> week after fertilization	Williams, p 155; Moore, p 109

## **ELBOWS**

The elbows are developing.	Day 34 after fertilization	Sadler, front pages
The elbow region is visible.	Days 44-46 after fertilization	Moore, p 91
The elbows appear.	Day 44 after fertilization	Larsen, p xii

## **ESOPHAGUS**

The esophagus (the food tube leading to the stomach) begins to form.	Day 31 after conception	Rugh, p 43
The esophagus is developing.	4 <sup>th</sup> week of development	Sadler, p 274
The esophagus is developing.	Early in the 5 <sup>th</sup> week of development	Larsen, p 249

## **EYES**

The developing eye appears.	Day 22	Sadler, p 394
The primordia of the eyes are present.	Day 23 after fertilization	Moore, p 5
The lens placode is present.	Day 28	Sadler, p 90
The lens placode (the primordium of the lens) is present.	Day 28 after fertilization	Moore, p 92
The eye anlage is present.	Day 28 after fertilization	Sadler, front pages



The eyes begin their development.	Early in the 4 <sup>th</sup> week	Larsen, p 252
The development of the eye is first evident.	Beginning of the 4 <sup>th</sup> week after fertilization	Moore, p 492
The lens pits and optic cups are forming.	Day 30 after fertilization	Moore, p 5
Melanin first appears in the cells of the developing pigment retina.	Day 33	Larsen, p 257
Pigment can be seen in the retina.	Days 37-40 after fertilization	Moore, p 91
The eye muscles being to form.	Day 38 after conception	Rugh, p 47
The eyes become pigmented.	Day 40 after conception	Rugh, p 47
The eye is obvious, reflecting the fact that the retinal pigment has formed.	6 <sup>th</sup> week after fertilization	Moore, p 94
The eye is obvious.	About day 42 after fertilization	Moore, p 99
The pigmented eye is developing.	About 42 days after fertilization	Moore, p 99
The nerve cells of the retina form.	Day 44 after conception	Rugh, p 50
Pigmentation of the retina can be seen.	Days 43-49 of development	Sadler, p 110
The eyes are developing rapidly.	7 <sup>th</sup> week after conception	Rugh, p 52
The nerve connections from the retina to the brain are established.	Day 48 after conception	Rugh, p 51
The eye is heavily pigmented.	About 52 days after fertilization	Moore, p 100

The eyes are closing or closed.	9 <sup>th</sup> week after fertilization	Moore, p 109; Williams, p 155
Slow eye movements occur.	14 <sup>th</sup> week after fertilization	Moore, p 112
Rapid eye movements begin.	21 <sup>st</sup> week after fertilization	Moore, p 114
“Blink-startle” responses have been reported.	22 <sup>nd</sup> -23 <sup>rd</sup> weeks after fertilization	Moore, p 114
The eyes are open.	26 <sup>th</sup> week after fertilization	Moore, p 114

## **EYEBROWS**

Eyebrows are present.	13 <sup>th</sup> week after fertilization	England, p 209
Eyebrows are visible.	20 <sup>th</sup> week after fertilization	Moore, p 113
Eyebrows are visible.	By the 5 <sup>th</sup> month after fertilization	Sadler, p 114
Eyebrows are usually recognizable.	End of 22 <sup>nd</sup> week after fertilization	Williams, p 154

## **EYELASHES**

Eyelashes are usually recognizable.	End of 22 <sup>nd</sup> week after fertilization	Williams, p 154
Eyelashes are present.	26 <sup>th</sup> week after fertilization	Moore, p 109

## **EYELIDS**

The upper and lower eyelid primordia appear.	6 <sup>th</sup> week of development	Larsen, p 259
The eyelids are developing.	Day 40 after fertilization	Moore, p 238

The eyelids are formed.	Days 43-49 of development	Sadler, p 110
The eyelids form in the face.	Day 44 after fertilization	Larsen, p xii
The eyelids are closing.	End of 8 <sup>th</sup> week after fertilization	Moore, p 99-100
The eyelids are closed.	10 <sup>th</sup> week after fertilization	Moore, p 238

## **FACE**

The facial primordia begin to appear.	Early in 4 <sup>th</sup> week after fertilization	Moore, p 236
The face is developing.	Day 30 after fertilization	Sadler, front pages
The face is forming.	During the 2 <sup>nd</sup> month	Sadler, p 106
The face is unmistakably human.	2 <sup>nd</sup> month after conception	Rugh, p 54
The face begins to look human.	5 <sup>th</sup> week after conception	Rugh, p 45
The face becomes fuller and starts to look human.	Day 48 after conception	Rugh, p 51
The rudiment of the face is created.	Days 49 – 63	Larsen, p 230
The face is more human-like.	Days 50-56 after fertilization	Sadler, p 110
The face appears to be quite human.	Day 56 after conception	Rugh, p 53
Facial development mostly occurs.	4 <sup>th</sup> -8 <sup>th</sup> weeks after fertilization	Moore, p 236
By the end of the 8 <sup>th</sup> week after conception, the face clearly looks human.	End of 8 <sup>th</sup> week after fertilization	Moore, p 239

The face has all the human characteristics.	12 <sup>th</sup> week	Sadler, p 116
The appearance is human. The eyes face anteriorly. The ears have almost reached their final position on the sides of the head.	16 <sup>th</sup> week after fertilization	Moore, p 113
The parts of the face that form first are the lower jaw and the lower lip.	NAp	Moore, p 239

## **FEET**

Foot plates are developing.	Day 34 after fertilization	Moore, p 5; Sadler, front pages
The ends of the limb buds become flattened to form foot plates.	6 <sup>th</sup> week of development	Sadler, p 172
The feet have become distinct.	Day 37 of development	Larsen, p 209
Foot plates are formed on the lower limb buds.	Day 37 after fertilization	Larsen, p xii
Digital rays are present in the foot plates.	Days 36-42 of development	Sadler, p 110
Digital rays are separating.	Days 43-49	Sadler, p 110
Digital rays can be seen clearly in the foot plates.	Days 44-46 after fertilization	Moore, p 91
Notches appear between the digital rays in the feet	Days 49-51 after fertilization	Moore, p 91
The feet are well-formed and distinctly human.	8 <sup>th</sup> week after conception	Rugh, p 53

## FETUS

The fetal period begins on day 57 after fertilization and ends at birth. The tissues and organs that were formed during the embryonic period continue to grow during the fetal period, but the changes aren't as pronounced. Ultrasonic measurements are used to measure embryonic growth.

Day 57

Moore, p 3

## FINGERS

The primordia of the fingers, called digital rays, start to develop.

6<sup>th</sup> week after fertilization

Moore, p 94

Finger rays are visible.

Day 38 of development

Larsen, p 209

Finger rays are developing.

Day 38 after fertilization

Sadler, front pages

The rudiments of the fingers become evident.

Day 42 after conception

Rugh, p 47

The fingers are developing.

Day 43 after fertilization

Sadler, front pages

Thumbs and fingers with pads are present.

7<sup>th</sup> week after conception

Rugh, p 44

All the fingers are present.

7<sup>th</sup> week after conception

Rugh, p 52

The fingers are separated.

About day 52 after fertilization

Moore, p 100

The fingers are free.

Days 50-56

Sadler, p 110

The fingers are free and longer.

Days 52-53 after fertilization

Moore, p 91

The fingers of both hands are usually found close to the nose.

Day 56 after conception

Rugh, p 53

Local stimuli may induce partial closing of the fingers.

8<sup>th</sup> week after fertilization

Williams, p 169

The fingers are differentiated.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
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**FINGERNAILS**

Fingernails begin to develop at the end of the digits.	About week 10 after fertilization	Moore, p 519
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Fingernail anlagen first appear.	About 10 <sup>th</sup> week	Larsen, p 311
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Fingernails are present.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
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**FOREARM**

The forearm region can be distinguished.	Day 33 of development	Larsen, p 209
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**FOREHEAD**

The forehead is developing.	Day 40 after fertilization	Moore, p 238
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**GALLBLADDER**

The gallbladder appears.	Days 27-30 after conception	Rugh, p 42
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The gallbladder is developing.	Day 30 of development	Larsen, p 155
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The gallbladder is developing.	4 <sup>th</sup> week of development	Sadler, p 274
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**HAIR**

The first hair follicles appear.	Day 44 after fertilization	Larsen, p xii
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Hair follicles first appear on the eyebrows, eyelids, upper lip, and chin.	End 2 <sup>nd</sup> month	Larsen, p 309
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Hair begins to develop.	9 <sup>th</sup> – 12 <sup>th</sup> weeks after fertilization	Moore, p 517
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Scattered rudiments of hair appear.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
Hair grows on the eyebrows and the upper lip.	End of 12 <sup>th</sup> week after fertilization	Moore, p 517
The first hairs appear in the region of the eyebrows and upper lip.	End of 3 <sup>rd</sup> month	Sadler, p 407
Scalp hair patterning is determined.	14 <sup>th</sup> week after fertilization	Moore, p 112
Some scalp hair is visible.	End of 18 <sup>th</sup> week after fertilization	Williams, p 154
Head hair is visible.	By the 5 <sup>th</sup> month after fertilization	Sadler, p 114
Hair becomes easily recognizable.	About 20 <sup>th</sup> week after fertilization	Moore, p 517
Head and body hair is visible.	20 <sup>th</sup> week after fertilization	Williams, p 155

## **HANDS**

Hand plates are present.	Day 33 after fertilization	Moore, p 5
Hand plates are developing.	Day 33 after fertilization	Larsen, p xii
Hand plates are developing.	Day 34 after fertilization	Sadler, front pages
Hand plates are formed and digital rays are present.	Days 33-36 after fertilization	Moore, p 91
Digital rays are present in the hand plates.	Days 36-42 of development	Sadler, p 110
Digital rays are clearly visible in the hand plates.	Days 41-43 after fertilization	Moore, p 91
Notches are present between the digital rays in the hand.	Days 44-46 after fertilization	Moore, p 91

Digital rays are separating.	Days 43-49 of development	Sadler, p 110
The hand plates are slightly flexed at the wrists.	Day 52 of development	Larsen, p 209
Digit separation in the hand is complete.	Day 56	Sadler, p 174
The hands are well-formed and distinctly human.	8 <sup>th</sup> week after conception	Rugh, p 53

## **HEART**

The embryo begins to form a heart.	Day 18 after conception	Rugh, p 17
The heart begins to pump.	Day 22 after fertilization	Larsen, p xi
The heart begins to beat.	Day 22 after fertilization	Moore, p 5; Larsen, p 104
The heart begins to beat.	Day 22 after fertilization	England, p 104
The heart starts to beat.	Day 24 after fertilization	Rugh, p 17
Blood begins to circulate throughout the embryo.	Day 24	Larsen, p 104
The heart begins to pump.	4 <sup>th</sup> week of development	Sadler, p 77
The separation of the heart into a primordial atrium and ventricle can be seen.	Day 28 after fertilization	Moore, p 95
Coronary vessels appear.	Day 32 after fertilization	Larsen, p xi
Echocardiography can detect heart movements.	About day 34 after fertilization	Williams, p 30
It is probable that the heartbeat of the embryo is similar to an adult's heartbeat.	Week 5 _ after conception	Rugh, p 53



The heart is contracting at a rate of 40 to 80 beats per minute, as measured with an electrocardiogram.	6 <sup>th</sup> – 7 <sup>th</sup> weeks after conception	Rugh, p 53
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The fetal heart is functionally complete and normal.	7 <sup>th</sup> week after conception	Rugh, p 53
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## **HEELS**

The heels are developing.	7 <sup>th</sup> week after conception	Rugh, p 44
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## **HUMAN LIFE**

Includes the period from conception to birth.	From conception to birth	Nijhuis, p xix
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## **INTESTINES**

The intestines are defined.	End of 1 <sup>st</sup> month after conception	Rugh, p 43
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The primary intestinal loop forms.	Day 32 after fertilization	Larsen, p xi
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The primary intestinal loop is forming.	Approximately day 32	Sadler, p 281
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The small intestine undergoes peristalsis.	9 <sup>th</sup> week after fertilization	Williams, p 169
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The intestines are developing in the abdomen.	10 <sup>th</sup> week after fertilization	Moore, p 109; Williams, p155
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## **JAWS**

The jaws are forming.	5 <sup>th</sup> week after conception	Rugh, p 45
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The upper and lower jaws begin to fuse in the midline of the face.	Day 38 after conception	Rugh, p 47
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The jaws are well-formed.	Day 40 after conception	Rugh, p 47
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The lower jaw is developing. Day 40 after fertilization Moore, p 238

The lower jaw is developing. About day 56 after fertilization Moore, p 100

## **KIDNEYS**

The kidneys begin to develop. Early in 5<sup>th</sup> week after fertilization England, p 153

The kidneys are forming. Day 40 of development Larsen, p 156

The permanent kidneys appear. 5<sup>th</sup> week Sadler, p 305

The permanent kidneys are actively forming. 8<sup>th</sup> week after conception Rugh, p 54

## **KNEES**

The knees are developing. Days 47-48 after fertilization England, p 180

## **LARYNX**

The larynx is developing. Approximately day 32 Sadler, p 281

## **LEGS**

Leg buds are present. Day 28 +/- 1 after fertilization Williams, p 153

Leg buds are present. Day 29 after fertilization Sadler, front pages

Leg buds begin to form. Day 31 after conception Rugh, p 43

The legs have become distinct. Day 37 of development Larsen, p 209

The legs are short and the thighs are relatively small. Beginning of the 9<sup>th</sup> week after fertilization Moore, p 111

## LIMBS

Upper limb buds appear.	Day 24 of development	Larsen, p 209
Lower limb buds appear.	Day 28 of development	Larsen, p 209
Upper limb buds are present.	Day 26 after fertilization	Moore, p 5
Upper limb buds appear.	Days 26-27 of development	Sadler, p 110
Lower limb buds appear.	Days 28-30 after fertilization	Moore, p 91
Hind limb buds appear.	Days 28-30 of development	Sadler, p 110
Limb buds become visible.	End of 4 <sup>th</sup> week of development	Sadler, 7 <sup>th</sup> edition, p 154
Forelimbs are paddle-shaped.	Days 31-35 of development	Sadler, p 110
The limbs are forming.	2 <sup>nd</sup> month	Sadler, p 106
The forelimbs and hindlimbs appear as paddle-shaped buds.	Beginning of 5 <sup>th</sup> week	Sadler, p 106
Limb development takes place.	5 <sup>th</sup> – 8 <sup>th</sup> weeks of development	Larsen, p 209
The upper limbs are longer and bent at the elbows.	Days 49-51 after fertilization	Moore, p 91
The upper limbs are slightly bent at the elbows.	Day 52 of development	Larsen, p 209
The limbs are long and bent at the elbows and knees.	Days 50-56 of development	Sadler, p 110
All regions of the arms and legs are well-developed, including the toes.	Day 56 of development	Larsen, p 213

All areas of the limbs are apparent. In addition, the digits have lengthened and are completely separated.	End of week 8 after fertilization	Moore, p 97
The upper limbs have almost reached their final relative lengths and are a bit better developed than the lower limbs.	End of the 12 <sup>th</sup> week after fertilization	Moore, p 111
The lower limbs are well-developed.	14 <sup>th</sup> week after fertilization	Williams, p 155; Moore, p 109

## **LIPS**

The upper and lower lips are forming.	Early in 6 <sup>th</sup> week after fertilization	Moore, p 523
The upper lip is forming.	Days 43-49 of development	Sadler, p 110
The upper and lower lips are forming.	9 <sup>th</sup> week	Sadler, p 376

## **LIVER**

The liver is the first gastric gland or organ to develop.	Nap	Rugh, p 42
Liver cells begin to draw together.	Day 21 after conception	Rugh, p 42
The liver is developing.	4 <sup>th</sup> week of development	Sadler, p 274
The liver bud is present.	End of 1 <sup>st</sup> month	Sadler, p 271
The liver bud sprouts.	4 <sup>th</sup> week	Larsen, p 157
The liver bud is present.	Approximately day 25	Sadler, p 281
Liver cells can be recognized as the liver.	Days 27-30 after conception	Rugh, p 42
Liver ducts are forming.	5 <sup>th</sup> week after conception	Rugh, p 46

The liver is developing.	Day 39 after fertilization	Sadler, front pages
The liver is developing.	About 48 days after fertilization	Moore, p 99
Red blood cells are formed primarily in the liver.	9 <sup>th</sup> week after fertilization	Moore, p 112

## **LUNGS**

The lung bud is present.	Day 22	Sadler, p 210
The lung bud appears.	Days 22-24	Larsen, p 82
Lung buds may be seen.	Day 27 after conception	Rugh, p 43
The lung bud branches into left and right bronchial buds.	Days 26-28	Larsen, p 82
The lung bud appears.	Approximately 4 <sup>th</sup> week of development	Sadler, p 260
The lung bud develops.	4 <sup>th</sup> week after fertilization	Moore, p 262
Bronchi begin to form in the right and left lung.	7 <sup>th</sup> week after fertilization	Moore, p 262
The lungs have lobes and many-branched bronchioles.	8 <sup>th</sup> week after conception	Rugh, p 53

## **MOUTH**

The mouth opens for the first time.	Day 28 after conception	Rugh, p 42
The primitive mouth is forming.	Day 31 after fertilization	Moore, p 5
The oral and nasal cavities are confluent.	Day 36 after fertilization	Moore, p 5

The oral cavity is developing.	6 <sup>th</sup> week	Sadler, p 376
The mouth is present.	About day 56 after fertilization	Moore, p 100
Opening the mouth may be induced by local stimuli.	8 <sup>th</sup> week after fertilization	Williams, p 169

## **MUSCLE**

Building blocks are present for 40 pairs of muscles, which are located from the base of the skull to the bottom of the spinal column.	Day 28 after conception	Rugh, p 35
Muscles appear in the pelvic region.	Day 31 after conception	Rugh, p 43
All of the muscle blocks have appeared.	Day 36 after conception	Rugh, p 46
Muscular layers of the stomach, esophagus, and intestines begin to proliferate.	Day 56 after conception	Rugh, p 53
The first indication of limb musculature is observed.	7 <sup>th</sup> week of development	Sadler, 7 <sup>th</sup> edition, p 168

## **NECK**

A distinct neck connects the head with the body.	7 <sup>th</sup> week after conception	Rugh, p 51
The neck region is established.	End of 8 <sup>th</sup> week after fertilization	Moore, p 99
The neck is developed.	End of 8 <sup>th</sup> week after fertilization	England, p 96
The neck is well-defined.	12 <sup>th</sup> week after fertilization	Moore, p 109; Williams, p 155

## **NERVOUS SYSTEM**

The nervous system begins to form.	Day 18 after conception	Rugh, p 33
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The foundation of the brain, spinal cord and entire nervous system is established. The eyes also begin to be formed.	Day 20 after conception	Rugh, p 33
Movement of the muscles is being controlled by the nervous system.	6 <sup>th</sup> week after conception	Rugh, p 34
<b>NIPPLES</b>		
Nipples are formed.	Days 43-49 of development	Sadler, p 110
Nipples appear.	Day 44 after fertilization	Larsen, p xii
Nipples are visible.	Days 44-46 after fertilization	Moore, p 91
<b>NOSE</b>		
Nasal placodes – the primordia of the nose and the nasal cavities – have developed.	End of 4 <sup>th</sup> week after fertilization	Moore, p 239
Nasal placodes are present.	Day 30 after fertilization	Sadler, front pages
The nasal pits, which are the primordia of the nostrils and the nasal cavities, are forming.	Day 30 after fertilization	Moore, p 5 & p 239
The nasal organs have started to form.	Day 30 after conception	Rugh, p 41
The nasal pits are visible.	Days 31-32 after fertilization	Moore, p 91
The nasal pits are formed.	Days 31-35 of development	Sadler, p 110
The nasal pits deepen to form the nasal cavity.	Days 35-42	Larsen, p 230
The nostrils are developing.	Day 40 after fertilization	Moore, p 238
The nose is formed.	Day 38 after fertilization	Moore, p 5

The nose is forming.	During the 2 <sup>nd</sup> month	Sadler, p 106
The nasal passages open to the outside.	Day 46 after conception	Rugh, p 51
The nasal chamber is developing.	7 <sup>th</sup> week	Sadler, p 376
The nose is stubby.	About day 52 after fertilization	Moore, p 100

## **OVARIES**

The ovaries are differentiated.	16 <sup>th</sup> week after fertilization	Moore, p 112 & p 113
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## **PALATE**

The palate is developing.	About day 32 after fertilization	Moore, p 98
The palate is forming.	Day 44 after conception	Rugh, p 50
The primary palate is developing.	7 <sup>th</sup> week	Sadler, p 376

## **PALMS**

Palm creases appear.	3 <sup>rd</sup> month	Rugh, p 217
Fine palm lines have formed, which can be used to permanently identify the fetus. Finger, palm, and foot prints are never duplicated among individuals.	4 <sup>th</sup> month	Rugh, p 217

## **PANCREAS**

The dorsal pancreatic bud begins to grow.	Day 26	Larsen, p 158
The pancreas is defined.	End of 1 <sup>st</sup> month after conception	Rugh, p 43
The pancreas is developing.	4 <sup>th</sup> week of development	Sadler, p 274



The ventral pancreatic bud is present. The pancreas is developing.	Day 32 Approximately day 36	Larsen, p 157 Sadler, p 281
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The pancreas is developing.	Day 39 after fertilization	Sadler, front pages
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**PELVIS**

The pelvis is developing.	6 <sup>th</sup> week	Sadler, p 308
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**PENIS**

The penis and scrotum form.	5 <sup>th</sup> – 6 <sup>th</sup> weeks	Larsen, p 175
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The penis begins to form.	Day 42 after conception	Rugh, p 47
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**PHARYNX**

The pharynx is developing.	4 <sup>th</sup> week	Sadler, p 274
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The pharynx is developing.	About day 32 after fertilization	Moore, p 98
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The pharynx is present.	5 <sup>th</sup> week after fertilization	Rugh, p 45
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**PITUITARY GLAND**

The pituitary gland is developing.	5 <sup>th</sup> week after fertilization	Williams, p 178; Rugh, p 45
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**PRENATAL DEVELOPMENT**

The beginnings of the various organs and systems are established, especially in the third week when certain key organs start to develop.	1 <sup>st</sup> – 3 <sup>rd</sup> weeks of development	O’Rahilly, p 23
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The nervous, muscular, vascular, digestive, and skeletal systems are in an incipient state.	End of 1 <sup>st</sup> month after conception	Rugh, p 35,
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The beginnings of many of the organ systems, including the cardiovascular system, are established.	End of 4 <sup>th</sup> week after fertilization	Moore, p 91
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The embryo grows in length from 5 millimeters to approximately 16 to 17 millimeters.	Day 27 to day 37 of development	Sadler, p 220
It is believed that the majority of women do not realize they are pregnant during the first six weeks after conception.	6 <sup>th</sup> week after conception	Rugh, p 54
Although the embryo begins developing immediately after conception, the most visible advances occur during the third to eighth weeks.	3 <sup>rd</sup> – 8 <sup>th</sup> weeks after fertilization	Moore, p 2
The most important features of the body's form are determined because of the formation of organs that occurs during this time.	3 <sup>rd</sup> – 8 <sup>th</sup> weeks	Sadler, p 108
Most major organs and organ systems are formed during the embryonic period. The mother may not be aware of her pregnancy during this critical period, especially in the third and fourth weeks when the embryo is quite vulnerable.	During 3 <sup>rd</sup> – 8 <sup>th</sup> weeks	Sadler, p 106 & p 107
Great changes occur in appearance because of the emergence of a disproportionately large head and the formation of the limbs, face, ears, nose, and eyes.	During the 2 <sup>nd</sup> month	Sadler, p 106
The embryo has a distinct human appearance.	About day 56 after fertilization	Moore, p 100
The term embryo refers to the developing human being during the first eight weeks after conception. At the end of this period, all major structures have started to form.	End of 8 <sup>th</sup> week after fertilization	Moore, p 3
The embryonic period concludes at the end of the 8 <sup>th</sup> week after fertilization and the fetal period begins. Few, if any, new structures are formed after this time. Development during the fetal period involves growth and maturation of structures that are already present.	End of 8 <sup>th</sup> week after fertilization	Williams, p 153
The beginnings of all essential structures are present.	8 <sup>th</sup> week after fertilization	Williams, p 154

The organs and systems of the body are formed.	From late in the 3 <sup>rd</sup> week through the 8 <sup>th</sup> week	Larsen, p 319
The embryonic period consists of the first eight weeks after the last ovulation. During this time, the overwhelming majority (several thousand) of the named human structures appear, and the embryo is about 30 millimeters in length.	End of 8 <sup>th</sup> week	O’Rahilly, p 55
Scientists have examined the embryonic period in far greater detail than the fetal period, which begins in the ninth week and continues until birth. Few new features appear during the fetal period. Instead, the structures that are already present continue to develop.	End of 8 <sup>th</sup> week	O’Rahilly. p 55
The initial formation and development of nearly all of the organs is complete and they can be identified in a grossly recognizable state.	End of 8 <sup>th</sup> week of pregnancy	Carlson, p 407
The head is disproportionately large compared with the rest of the body.	End of 8 <sup>th</sup> week of pregnancy	Carlson, p 407
The embryo has human characteristics. The neck area is established and the eyelids are obvious and are closing. The auricles of the external ears begin to take their final shape.	End of 8 <sup>th</sup> week after fertilization	Moore, p 99
Squinting, incomplete closing of the fingers, and opening the mouth can be induced by local stimuli.	8 <sup>th</sup> week after fertilization	Williams, p 169
The face is broad, the eyes are widely separated, the ears are low-set, and the eyelids are fused. Humans develop continuously, starting at conception, but the changes don’t stop at birth. Obvious examples of further growth are the development of teeth and female breasts. In addition, the brain triples in weight between birth and age 16 years. By age 25, most developmental changes are finished.	9 <sup>th</sup> week after fertilization Nap	Moore, p 110 Moore, p 2

Physicians can now measure how the fetus is growing and what its state of health is with a very high degree of accuracy. Through advanced surgical procedures, doctors can operate on the fetus without leaving a scar.

Nap

Carlson, p 407

Ultrasonic imaging is used to measure the stages of development of the embryo.

Nap

Moore, p 3

## **PRIMORDIUM**

This term refers to earliest discernable sign of development of a particular organ or structure in the embryo. Similar terms are “rudiment” and “anlage”.

Nap

Moore, p 3

## **PROSTATE**

The prostate and seminal vesicles develop in males.

10<sup>th</sup> – 13<sup>th</sup>  
weeks

Larsen, p 175

## **QUICKENING**

The first definite perception of fetal movement by the mother.

Most often occurs during 14<sup>th</sup> – 18<sup>th</sup> weeks after fertilization

Williams, 18th edition, p 501

## **RECTUM**

The anorectal canal is developing.

7<sup>th</sup> week

Sadler, p 316

## **RESPIRATION**

Respiratory movements can transport amniotic fluid in and out of the respiratory tract

Beginning of the 4<sup>th</sup> month

Williams, p 177

Respiration is evident.

12<sup>th</sup> – 14<sup>th</sup> weeks after fertilization

Williams, p 169

## **RIBS**

The ribs begin to form and lengthen.

Day 35 of development

Larsen, p 48

## **SALIVARY GLANDS**

Some salivary glands appear.	About 6 <sup>th</sup> week after fertilization	Moore, p 236
The salivary glands begin to develop.	6 <sup>th</sup> -7 <sup>th</sup> weeks after fertilization	England, p 90

## **SEX**

The sex of the embryo is determined genetically.	At fertilization	Sadler, p 319
Genetic sex is established.	At fertilization	Williams, p 180
The embryo's chromosomal sex is determined.	At fertilization	Moore, p 37
The difference between a male and a female is determined genetically at the time of conception.	At conception	Rugh, p 7
Microscopic examination can identify the embryo's sex because the ovaries and testes have differentiated.	Day 46 after conception	Rugh, p 51
The gonads acquire male or female characteristics.	7 <sup>th</sup> week of development	Sadler, p 319
External examination can reveal whether the embryo is male or female.	Day 50 after conception	Rugh, p 7
External genitalia are starting to indicate whether the fetus will be male or female.	End of 10 <sup>th</sup> week after fertilization	Williams p 154
The sex can be established by ultrasonic measurement of the external genitalia.	12 <sup>th</sup> week after fertilization	Sadler, p 113
The sex is clearly distinguishable.	End of 12 <sup>th</sup> week after fertilization	Williams, p 154
The sex of the child can be determined from external examination.	12 <sup>th</sup> week after fertilization	Moore, p 109

## **SHOULDERS**

The shoulder region can be distinguished.	Day 33 of development	Larsen, p 209
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The shoulders are developing.	About day 56 after fertilization	Moore, p 100
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## **SKIN**

The skin of the fetus is reddish and has a wrinkled appearance.	During the 6 <sup>th</sup> month after fertilization	Sadler, p 114
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## **SPINE**

The spinal cord is developing.	About day 28 after fertilization	Moore, p 97
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Spinal nerves begin to sprout.	Day 32 after fertilization	Larsen, p xi
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The spinal cord extends the entire length of the embryo.	3 <sup>rd</sup> month of development	Sadler, p 422
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## **SPLEEN**

The spleen appears.	Day 28 after fertilization	Larsen, p xi
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The spleen is forming.	5 <sup>th</sup> week after conception	Rugh, p 46
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The spleen is formed.	5 <sup>th</sup> week	Larsen, p 159
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## **STOMACH**

The stomach is developing.	Approximately day 25	Sadler, p 281
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The stomach is forming.	About day 28 after fertilization	Moore, p 97
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The stomach appears.	4 <sup>th</sup> week of development	Sadler, p 276
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The stomach is forming.	Day 30	Larsen, p 157
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The stomach begins to form.	Day 31 after conception	Rugh, p 43
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The stomach is a scale model of what it will be at the time of birth.	Day 48 after conception	Rugh, p 52
<b>SWEAT GLANDS</b>		
Sweat glands are developing.	About 20 weeks after fertilization	Moore, p 517
Sweat glands first appear.	About 20 weeks	Larsen, p 311
<b>TEETH</b>		
The teeth begin to form.	Day 40 after conception	Rugh, p 47
The primary teeth are at the cap stage.	Day 56 after fertilization	Larsen, p xii
Tooth buds form from dental lamina.	4 <sup>th</sup> – 8 <sup>th</sup> weeks of development	Larsen, p 304
Dental buds are present.	8 <sup>th</sup> week	Sadler, 7 <sup>th</sup> edition, p 341
The tooth buds for permanent teeth begin to appear.	About 10 <sup>th</sup> week after fertilization	Moore, p 523
The tooth buds for the second and third permanent molars are developing.	At birth	Moore, p 523
<b>TESTES</b>		
The testes become identifiable.	6 <sup>th</sup> week	O’Rahilly, p 210
The testes have begun to descend.	20 <sup>th</sup> week after fertilization	Moore, p 113
<b>THIGHS</b>		
The thigh has become distinct.	Day 37 of development	Larsen, p 209

## THYROID

The thyroid gland begins to develop.	Day 20 after fertilization	Moore, p 5
The thyroid gland primordium first appears.	Late in 4 <sup>th</sup> week of development	Larsen, p 249
The thyroid is developing.	Late in 5 <sup>th</sup> week	Larsen, p 249
The thyroid gland, which plays a critical role in metabolism, begins developing.	End of month 1 after conception	Rugh, p 42
The thyroid is developing.	Approximately day 36	Sadler, p 281

## TOES

The rudiments of the toes become evident.	Day 42 after conception	Rugh, p 47
Toe rays are developing.	Day 43 after fertilization	Sadler, front pages
Toe rays appear.	Day 44 after fertilization	Larsen, p xii
The toes are developing.	Day 48 after fertilization	Sadler, front pages
The toes are well-formed.	7 <sup>th</sup> – 8 <sup>th</sup> weeks	Sadler, p 108
The toes are free.	Days 50-56	Sadler, p 110
The toes are beginning to separate.	About day 52 after fertilization	Moore, p 100
The toes are free and longer.	Days 54-55 after fertilization	Moore, p 91
The toes are separated.	About day 56 after fertilization	Moore, p 100
The toes are differentiated.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154



## **TOENAILS**

Toenails begin to develop at the tips of the digits.	About 10 <sup>th</sup> week after fertilization	Moore, p 519
Toenails are forming.	End of 10 <sup>th</sup> week after fertilization	Williams, p 154
The nail anlagen form on the toes.	About 14 <sup>th</sup> week	Larsen, p 311
Toenails are present.	14 <sup>th</sup> week after fertilization	England, p 173

## **TONGUE**

The tongue appears.	Approximately 4 <sup>th</sup> week	Sadler, p 362
The development of the tongue begins.	Late in 4 <sup>th</sup> week of development	Larsen, p 247
The first sign of the tongue's development appears, the median tongue bud.	End of 4 <sup>th</sup> week after fertilization	Moore, p 233
The tongue appears.	Approximately 4 <sup>th</sup> week	Sadler, p 362
The tongue is developing.	Late in 5 <sup>th</sup> week	Larsen, p 249
The tongue is developing.	Early in 6 <sup>th</sup> week after fertilization	Moore, p 533
The tongue forms from the floor of the mouth.	Day 48 after conception	Rugh, p 51

## **TRACHEA (WINDPIPE)**

The trachea is developing.	During the 4 <sup>th</sup> week	Sadler, p 274
The trachea is developing.	Approximately day 30 after fertilization	Rugh, p 43
The trachea is developing.	Early in the 5 <sup>th</sup> week of development	Larsen, p 249

The trachea is developing. 5<sup>th</sup> week after fertilization Moore, p 262

## **URETER**

The ureter is developing. 6<sup>th</sup> week Sadler, p 308

## **URETHRA**

The penile urethra is forming. End of 3<sup>rd</sup> month Sadler, 7<sup>th</sup> edition, p 298

## **UTERUS**

The uterus forms. 6<sup>th</sup> – 7<sup>th</sup> weeks Larsen, p 175

The uterus is formed. 18<sup>th</sup> week after fertilization Moore, p 113

## **VAGINA**

The vagina forms. 6<sup>th</sup> – 7<sup>th</sup> weeks Larsen, p 175

Canalization of the vagina has begun. 18<sup>th</sup> week after fertilization Moore, p 113

## **VERTEBRAE**

Somites, which will develop into the 33 pairs of vertebrae in the spinal column, are growing. 3<sup>rd</sup> week after conception Rugh, p 35

## **VIABILITY**

The fetus is viable. 20<sup>th</sup> week after fertilization Moore, p 3

A premature fetus born at this time may survive if given intensive care. 22<sup>nd</sup> – 25<sup>th</sup> weeks after fertilization Moore, p 114

## **WRIST**

The wrist is developing. About day 48 after fertilization Moore, p 99

## **ZYGOTE**

An embryo, or a new human, comes into existence when a zygote is produced at fertilization by the combination of a sperm with an ovum. At conception Moore, p.2

The sperm has 23 chromosomes and so does the ovum, but the zygote has 46 chromosomes. Although half of its chromosomes come from each parent, the zygote is genetically different than either of them, and is, in fact, genetically unique. At fertilization Moore, p 37

### APPENDIX 3

## MOVEMENT AND LEARNING PATTERNS OF THE UNBORN CHILD AND THE DEVELOPMENT OF THE SENSES

### ARM MOVEMENTS

Isolated arm movements first occur.	About 7 _ to 8 _ weeks after conception	de Vries (1982), p 311
Stretching an arm is frequently accompanied by extending the fingers.	From 10 <sup>th</sup> week after conception	de Vries (1982), p 307

### BREATHING MOVEMENTS

First seen.	8 <sup>th</sup> week after conception	Roodenburg, p 32
A single, large displacement of the diaphragm is sometimes similar to a sigh.	8 <sup>th</sup> week after conception	Nijhuis/de Vries, p 6
First seen.	8-9 _ weeks after conception	Nijhuis/de Vries, p 5
Observed in 10 of 12 fetuses studied, with a median frequency of about 30 breathing movements per hour.	9 <sup>th</sup> week after conception	de Vries (1985), p 106
Observed in 12 of 12 fetuses studied, with a median frequency of about 60 breathing movements per hour.	11 <sup>th</sup> week after conception	de Vries (1985), p 106
The median breathing movement rate was 208 per hour in 12 fetuses studied.	17 <sup>th</sup> week after conception	de Vries (1985), p 105
The rate of breathing movements was much higher during the second hour after the mother's breakfast or lunch than during the third hour.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
Breathing movements occurred most often right after the mother's meal at noon.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337

The frequency of breathing movements changes during the day. In a study of 10 fetuses, such movements increased from a median of 2% of the observation time in the morning to 13% in the afternoon, and then fell to 11% in the evening.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
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A significant increase in fetal breathing occurred after giving glucose to the mother.	22 <sup>nd</sup> week after conception	Nijhuis/Visser, p 19
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**EMBRYOSCOPY**

Embryoscopy can directly visualize the embryo/fetus during the first trimester, paving the way to improved early prenatal diagnosis and treatment. Utilizing high-resolution fiberoptic endoscopy, testing can be done as early as 3 weeks after conception. The face can be visualized as early as 4 weeks. Numerous diagnoses have already been done but these just scratch the surface of the technology's potential.	3 <sup>rd</sup> –4 <sup>th</sup> weeks after conception	Reece, pages p 775, 777, & 778
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**EYE MOVEMENTS**

Slow eye movements first occur.	14 <sup>th</sup> week after conception	Nijhuis/de Vries, p 5; Birnholz, p 679
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First seen.	About 14 <sup>th</sup> week conception	Inoue, p 172
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First seen.	14 <sup>th</sup> – 16 <sup>th</sup> weeks after conception	Roodenburg, p 33
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In 9 fetuses studied, the median number of eye movements at 18 weeks after conception were 25 per hour, increasing to 101 per hour at 34 weeks.	18 <sup>th</sup> - 34 <sup>th</sup> weeks after conception	Roodenburg, p 28
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Rapid eye movements first occur.	21 <sup>st</sup> week after conception	Nijhuis/de Vries, p 5; Birnholz, p 679
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## **FINGER MOVEMENTS**

First occur.	10 <sup>th</sup> week after conception	Nijhuis/de Vries, p 5
Opening and closing one or more fingers can be seen.	10 <sup>th</sup> week after conception	Nijhuis/de Vries, p 6

## **GENERAL MOVEMENTS**

First occur.	6 <sup>th</sup> – 7 <sup>th</sup> weeks after conception	Roodenburg, p 31
First occur.	6 _ - 7 _ weeks after conception	Nijhuis/de Vries, p 5
In nine fetuses studied, there were a median of 57 general movements per hour, which were present during 24% of the observation time.	18 <sup>th</sup> week after conception	Roodenburg, p 23

## **HAND-TO-FACE CONTACTS**

Insertion of the fingers into the mouth has been observed.	8 <sup>th</sup> week after conception.	Nijhuis/de Vries, p 7
First occur.	8-10 _ weeks after conception	Nijhuis/de Vries, p 5
The hand touches the face slowly and the fingers often open and close.	8-10 _ weeks after conception	de Vries (1982), p 309 & p 311
Observed in 12 of 12 fetuses studied, with a median frequency of about 25 contacts per hour.	10 <sup>th</sup> week after conception	de Vries (1985), p 113
In a study of 9 fetuses, the median number of hand-to-face contacts was 95 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 33

## **HEAD MOVEMENTS (BACKWARD)**

First occur.	7 _ - 10 _ weeks after conception	Nijhuis/de Vries, p 5
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## HEAD MOVEMENTS (FORWARD)

First occur.	8 _ - 12 _ weeks after conception	Nijhuis/de Vries, p 5
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## HEAD ROTATIONS

First occur.	7 _ - 10 _ weeks after conception	Nijhuis/de Vries, p 5
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Observed in 12 of 12 fetuses studied, with a median rate of about 5 head rotations per hour.	11 <sup>th</sup> week after conception	de Vries (1985), p 113
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In a study of 9 fetuses, the median number of head rotations was 63 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 33
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## HEARING

“For at the moment the sound of your greeting reached my ears, the infant in my womb leaped for joy”.	Before birth	Luke 1: 44
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The fetus responds to sound.	10 <sup>th</sup> – 14 <sup>th</sup> weeks after conception	Nijhuis/Hep- per, p 133
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“Blink-startle” responses to vibroacoustic stimulation have been observed.	22 <sup>nd</sup> & 23 <sup>rd</sup> weeks after conception	Birnholtz & Benacerraf, p 516
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The fetus apparently hears some sounds <u>in utero</u> .	22 <sup>nd</sup> – 24 <sup>th</sup> weeks after fertilization	Williams, p 169
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Changes in fetal heart rate, eye blinks, and movements have occurred in response to sounds.	Not available	Nijhuis/Hep- per, p 137
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Evidence is growing that the fetus can hear voices in the womb.	Not available	Fifer & Moon, p 430
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## HEART RATE

The heart is contracting at a rate of 40 to 80 beats per minute, as measured with an electrocardiogram.	6 <sup>th</sup> – 7 <sup>th</sup> weeks after conception	Rugh, p 53
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The fetal heart rate decreases overnight.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 341
The daily pattern of changes in the fetal heart rate follows the changes in the maternal heart rate.	20 <sup>th</sup> -22 <sup>nd</sup> weeks after conception	de Vries (1987), p 345 & p 346

## HICCUPS

First occur.	6 <sup>th</sup> week after conception	Roodenburg, p 32
First occur.	6 _ - 8 _ weeks after conception	Nijhuis/de Vries, p 5
Observed in 12 of 12 fetuses studied, with a median frequency of about 50 hiccups per hour.	8 <sup>th</sup> week after conception	de Vries (1985), p 108
The frequency of hiccupping changes during the day. In a study of 10 fetuses, the median number of hiccups during 8 AM to 10 AM was 28 per hour, decreasing to 12 per hour during 1 PM to 3 PM.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 338

## HUMAN LIFE

Includes the period from conception to birth.	From conception to birth	Nijhuis, p xix
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## JAW OPENINGS

Jaw openings first occur.	8 _ - 10 _ weeks after conception	Nijhuis/de Vries, p 5
Jaw openings were observed in 10 of 12 fetuses studied with a median rate of about 18 per hour.	10 <sup>th</sup> week after conception	de Vries (1985), p 114
Jaw openings were observed in 12 of 12 fetuses studied with a median rate of about 30 per hour.	12 <sup>th</sup> week after conception	de Vries (1985), p 114



Jaw movements include isolated jaw movements, sucking, swallowing, yawning, and tongue movements. In 9 fetuses studied, the median frequency of any kind of jaw movements was 142 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 28 & p 29
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The frequency of jaw openings changes during day. In a study of 10 fetuses, the median rate was 51 per hour during 8 AM to 10 AM, increasing to 97 per hour during 1 PM to 3 PM.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 338
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## LEARNING

Newborns stopped crying and responded to songs played on shows that their mother watched while they were pregnant.	Immediately after birth	Nijhuis/Hep- per, p 144
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Newborns prefer the sound of their mother's voice when it is adjusted to resemble what was heard in the womb.	Immediately after birth	Nijhuis/Hep- per, p 138
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Newborns learned to change their pattern of sucking in order to hear their mother's voice instead of that of another woman. The preference appears to have been acquired before their birth.	Immediately after birth	Nijhuis/Hep- per, p 143;  DeCasper & Fifer, p 1174; Fifer and Moon, p 430 & 432
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Newborns changed their sucking pattern in order to hear a story that had been read to them before birth instead of an unfamiliar story.	Immediately after birth	Nijhuis/Hep- per, p 143
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Mothers who kept the same diet before and after they gave birth were more successful in breast-feeding than mothers who changed to a less spicy diet. This may reflect the child's preference for food she ate while she was pregnant because the mother's milk contains clues about her diet.	Immediately after birth	Nijhuis/Hep- per, p 146
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## LEG MOVEMENTS

Isolated leg movements first occur.	About 7 _ - 10 _ weeks after conception	de Vries (1982), p 311
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## MOVEMENTS

The technology of real-time ultrasonography can be used to detect movements such as breathing, cardiac contractions, and pulsations of the vessels.	Before birth	Williams, p 1023
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All fetal movements ever observed by the author are similar to those seen after birth and are easily recognizable to persons familiar with movements made by preterm and full-term infants. The pattern of yawns and stretches seen in the first trimester remains the same throughout life.	Before birth	Nijhuis/Pre- chtl, p 65 & p 66
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Fetal movement patterns are coordinated from the start and are similar to those after birth.	Before birth	de Vries (1985), p 100
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Heart activity can be measured with transvaginal ultrasonic scanning.	4 <sup>th</sup> week after fertilization	Williams, p 1027
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Spontaneous movements, such as twitching of the trunk and limbs, have been reported.	6 <sup>th</sup> week after fertilization	Moore, p 94
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The earliest reflexes begin.	Day 42 after conception	Rugh, p 47
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The fetus normally moves spontaneously.	6 <sup>th</sup> –8 <sup>th</sup> weeks after conception	de Vries (1982), p 318
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Neck and trunk muscles start contracting spontaneously.	7 <sup>th</sup> week after fertilization	England, p 206
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Purposeful limb movements first occur.	8 <sup>th</sup> week after fertilization	Moore, p 97
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Limb movements first occur during the 8 <sup>th</sup> week. By the 14 <sup>th</sup> week, they become coordinated.	8 <sup>th</sup> –14 <sup>th</sup> weeks after fertilization	Moore, p 112
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If the fetus is removed from the uterus, spontaneous movements may be observed. The most common movement patterns have emerged.	8 <sup>th</sup> week after fertilization 10 <sup>th</sup> week after conception	Williams, p 169 de Vries (1988), p 87
If the region near the mouth is stimulated, the fetus will open its mouth and suck a finger.	11 <sup>th</sup> week after fertilization	England, p 206
Reflex activity can be evoked in aborted fetuses, indicating muscular activity.	End of 3 <sup>rd</sup> month after fertilization	Sadler, p 114
Movements begin, but are usually not felt by the mother.	12 <sup>th</sup> week after fertilization	Sadler, p 116
The fetus responds to stimulation of the skin.	12 <sup>th</sup> week after fertilization	England, p 206
Stroking the lips causes the fetus to suck and stroking the eyelids results in a reflex response.	End of 12 <sup>th</sup> week after fertilization	Moore, 4 <sup>th</sup> edition, p 91
Slow eye movements occur.	14 <sup>th</sup> week after fertilization	Moore, p 112
The first day that movement is noticed by the pregnant woman is called “quickening”.	14 <sup>th</sup> – 18 <sup>th</sup> weeks after fertilization	Williams, p 23
In a study of 10 fetuses, the majority of movements occurred more frequently in the afternoon and evening than in the morning.	20 <sup>th</sup> – 22 <sup>nd</sup> weeks after conception	de Vries (1987), p 337
Signs of life (i.e. quickening) are felt by the mother.	18 <sup>th</sup> week after fertilization	Moore, p 109
Movement is usually recognized by the mother.	During the 5 <sup>th</sup> month after fertilization	Sadler, p 114
Rapid eye movements begin.	21 <sup>st</sup> week after fertilization	Moore, p 114

## QUIESCENCE

In a study of 12 fetuses, the longest median period of inactivity was 260 seconds.	6 <sup>th</sup> week after conception	de Vries (1985), p 102
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## **PAIN**

The fetal heart rate increases in response to scalp blood sampling and after tactile stimulation during amniocentesis, indicating that the fetus responds to stimuli that may be painful.

Before birth

Nijhuis/Hep-  
per, p 135

The sudden burst of body movements that occurred during amniocentesis may have been caused by painful stimulation. In each patient, the needle either struck the fetus or the fetus moved against the needle.

3<sup>rd</sup> trimester

Hill, p 690

Pain pathways run from sensory receptors in the skin to those in the brain. Nerve endings that sense pain are at least as dense in the skin of a newborn as in an adult. Such receptors appear around the mouth in the 5<sup>th</sup> week after conception, and are present in the face, the palms, and the soles of the feet by the 9<sup>th</sup> week, spreading to the trunk, arms, and legs by the 13<sup>th</sup> week, and to all areas of the skin by the 18<sup>th</sup> week. The development of the neocortex, the largest part of the brain, begins at 6 weeks after conception, and by 18 weeks a full complement of nerve cells is present. The evidence thus suggests that by late in gestation the fetus has developed sufficiently to sense pain.

from 5<sup>th</sup> week  
after conception

Anand and  
Hickey,  
p 1322  
& p 1326

## **SMELL**

The olfactory lobe, which is related to the sense of smell, is present in the brain.

Day 35 after  
conception

Rugh, p 44

The foundation of the sense of smell is established when nerve fibers connect with the olfactory lobe in the brain.

Day 39 after  
conception

Rugh, p 47

## **SOMERSAULTS**

The fetus can accomplish a complete change in position, usually with a backwards somersault.

By 13<sup>th</sup> week  
after conception

de Vries  
(1982),  
p 301 & p 309

## **SQUINTING**

Local stimuli may evoke squinting.	8 <sup>th</sup> week after fertilization	Williams, p 169
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## **STARTLES**

First occur.	6 – 7 _ weeks after conception	Nijhuis/de Vries, p 5
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First occur.	7 <sup>th</sup> week after conception	Roodenburg, p 33
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Startles were observed in 12 of 12 fetuses studied, with a median number of about 42 per hour.	7 <sup>th</sup> week after conception	de Vries (1985), p 104
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## **STRETCHES**

First occur.	8 <sup>th</sup> week after conception	Roodenburg, p 33
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First occur.	8 _ - 13 _ weeks after conception	Nijhuis/de Vries, p 5
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In a study of 9 fetuses, the median number of stretches were 6 per hour.	18 <sup>th</sup> week after conception	Roodenburg, p 28
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## **SUCKING**

First occurs.	10 _ - 12 _ weeks after conception	Nijhuis/de Vries, p 5
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## **SWALLOWING**

First occurs.	10 _ - 12 _ weeks after conception	Nijhuis/de Vries, p 5
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Swallowing is evident.	12 <sup>th</sup> – 14 <sup>th</sup> weeks after fertilization	Williams, p 169
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## TASTE

The fetus has many more taste buds than a newborn. It probably has a sense of taste.	Nap	Rugh, p 34
Taste buds begin to form.	8 <sup>th</sup> week after conception	Rugh, p 53
Taste buds are evident.	3 <sup>rd</sup> lunar month	Williams, p 169
Taste buds are developing.	11 <sup>th</sup> – 13 <sup>th</sup> weeks after fertilization	Moore, p 234
A facial response occurs when the fetus is given bitter-tasting substances. Reflexes between the taste buds and facial muscles are in place.	26 <sup>th</sup> – 28 <sup>th</sup> weeks after fertilization	Moore, p 234
A fetus swallowed more amniotic fluid when it was sweetened. In contrast, the fetus responded to the injection of a noxious-tasting substance into the amniotic fluid by reducing its sucking movements, possibly indicating that it did not like the taste of the substance.	Before birth	Nijhuis/Hep- per, p 136

## TONGUE MOVEMENTS

First occur.	9 <sup>th</sup> week after conception	Nijhuis/de Vries, p 5
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## YAWNING

Has been observed.	9 <sup>th</sup> week after conception	de Vries (1985), p 116
First occurs.	9 _ - 13 _ weeks after conception	Nijhuis/de Vries, p 5