

**MCDB 150 Global Problems of Population Growth
Lecture 23 Notes**

BIOLOGY OF ABORTION

1. The center of the abortion debate is the question “when does life begin.”

It is also a question that biology can say something about.

The most common statement

which I hear from virtually every right-to lifer that I meet -
and most pro-choicers also agree with
is that life begins at conception.

So for instance George Will (3/2000) - (famous Washington columnist):

“It is a biological fact, not a theological postulate, that such life is a continuum
from conception to death.”

Or in NYT just before I was first writing this lecture,

there was a letter to the editor from a pro-life writer:

"It is scientific fact, as any basic biology text will confirm, that life does begin at conception. The fetus is a live human being, distinct from, while dependent on, its mother. It deserves the full protection of its rights."

This letter emphasizes:

“as any basic biology text will confirm, that life does begin at conception”

2. Well, that's NOT what any basic biology text says.

The typical Freshman Biology Textbook first discusses ASEXUAL reproduction. Many organisms reproduce ASEXUALLY.

Organisms that reproduce by budding (yeast, hydra)

Organisms that reproduce by runners (rhizomes) like some grasses, strawberries, bracken (pricker bushes in all woods and backyards in the Northeast).

Organisms that reproduce by parthenogenesis (like some fish, without a male)

Etc.

The lifecycle of organisms that reproduce asexually does not involve conception.

So the idea that “life begins at conception’ certainly can’t be a general biological principle.

How about SEXUAL reproduction.

The essence of sexual reproduction is also a LIFECYCLE.

Maybe you remember this from HS Biology?

Textbook CYCLE #10

Campbell, Reece, Mitchell: Biology, 5th ed.

The essence of the cycle is the alternation of HAPLOID (one copy of each chromosome) and DIPLOID (two copies of each chromosome) stages.

#11

This textbook uses humans as one example of the several ways that organisms reproduce. Generalizing to all sexually reproducing organisms,

There are 3 different basic cycles

Sexual cycles #20

In some organisms (like humans) the DIPLOID stage is the large multicellular stage and for others it is the HAPLOID stage.

In most plants, BOTH STAGES ARE MULTICELLULAR

When sexual reproduction is used, fertilization is one step in the cycle.

It is not more, or less, important than any other step in the cycle.

That was a Freshman textbook. When you get to upper level courses in reproduction, the treatment is different.

From the textbook used in our Bio 240.

Here the story starts in the grandmother's womb.

Slide 24

This is inside your grandmothers womb.

The embryo in (a) is your mother or your father at three weeks.

Where are you? You are these little dots (primordial germ cells).

You start out, not even in the embryo, but in the yolk sac.

Some cells in the epithelium of the yolk sac start differentiating.

In (b), they crawl up into the embryo and deposit themselves in what will become the gonad. Most of them have gotten there by about 30 days.

Well, that's on page 7 of the textbook.

Fertilization doesn't come up until p201.

Coitus and Fertilization26

Again the emphasis is on the "establishment of diploidy"

And it reminds the reader that fertilization is not a necessary step

there are other ways to establish diploidy – in this case parthenogenesis.

Parthenogenesis 28

In a human, an unfertilized egg, can get to the stage of a beating heart and forelimbs. It eventually dies, but the problem is with the placenta, not the fetus.

So, we've done freshman textbook and advanced textbook.

Now lets look at research journals.

It again starts with events in your grandmother's womb.

In early embryo 40

That's the choice of whether to stay in the yolk sac as an epithelial cell or to differentiate as a germ cell and migrate to the gonad.

The aspect of the cycle they are interested in here is GERMLINE TO GERMLINE

"Full of changes" 42

Fertilization is one of the events in that cycle. It is mentioned as part of a sentence in the 5th of 7 paragraphs.

So, I'm writing this lecture and it seems that I'm finding just the right text and figures to illustrate what I want to explain: Life is a cycle, fertilization is one event of that cycle. I'm pretty happy.

Then I notice – Whoa! Here's this big picture that they use to illustrate the text.

And what is it? It's fertilization!

That kind of contradicts what I'm saying.

The picture headlines fertilization as the event that the SPECIAL SECTION is about.

Then I take a 2nd look. IT'S A FAKE PICTURE.

44

Fertilization doesn't look like that.

There's always a whole bunch of sperm clinging to the egg.

And there is no way to color the egg green and the sperm red.

Any scientist, if they paid attention at all, would immediately see that the picture is faked.

Well, the picture is put in by the artistic staff.

It was made by Getty Images/Visuals Unlimited.

To left of picture in 44

In fact, a couple of pages later, I find the original from which the fake was made.

It is exactly the same picture of the egg but no sperm!

46

They just laid a red picture od a sperm on the original picture of the egg.

That's getting laid.

The moral of the story is that even prestigious scientific journals,

When they are not thinking scientifically,

Will fall into the common parlance of the society in which they live.

The whole phrasing of the abortion debate in terms of "When does life begin?" is a cultural holdover from the many centuries before there was scientific understanding of reproduction.

What is the alternative to life being a cycle?

It is that life comes from something that was not alive.

This is called 'spontaneous generation'.

Spontaneous generation is the idea that life arises from something inanimate or dead.

It comes from various observations from pre-modern times:

1. People observed that caterpillars closed themselves up in cocoons.

If you open a cocoon at different times, you can see the caterpillar disintegrating and becoming a gooey mess.

Now, the cocoon is closed, so nothing else alive can get in.

Yet a completely different kind of creature, a butterfly emerges from the cocoon.

They had no idea that the butterfly and the utterly different looking caterpillar were the same animal.

The only reasonable conclusion is that the caterpillar died and decayed, and the butterfly emerged 'spontaneously' from the rotting goo.

2. Maggots come out of the rotting meat.

3. Where do fish come from?

In the 17th century, "otherwise sophisticated intellectuals believed that goldfish grew from reeds and that it was possible to create mice by putting a dirty shirt and a few grains of wheat into a sealed jar and letting it sit for 21 days. Matthew Cobb: "Generation: The 17th C scientists who unraveled the secrets of sex, life and growth." (Bloomsbury) quoted in NYT 8/2/06 pE8.

KSL: QP251 C616X 2006

As we'll see in a few moments, human life was presumed to come from curdled menstrual blood.

Again a transformation of something not alive into something alive.

Spontaneous generation was the dominant idea up into the 17th C.

In the 1660s the Italian scientist, Francesco Redi showed that spontaneous generation did not occur in insects. In (1668), he argued that all life comes from an egg, but he only showed it for insects.

Slowly the same was shown for other types of organism. A process that continued for 200 years

In 1838-9 Schleiden and Schwann showed that all organisms are made up of cells Cobb p245..

In 1855 Rudolph Virchow showed that 'every cell comes from a prior cell' Cobb p247

until around 1860 when Louis Pasteur (1822-1895) proved that even microorganisms come only from their parents Cobb p251.

Spontaneous generation was disproved, but science still had no clue about fertilization.

The idea of a female ejaculate used to be common – it probably comes from the observation of female sexual lubrication and the fact that females often expel some male semen after copulation. Aristotle, the most important of the Ancients for Christian theology believed that both males and females have seminal fluids that mix Maienschein p13. Aristotle regarded the menstrual blood as the material out of which the embryo is made. “After the discharge is over and most of it has passed out, then what remains begins to take shape as a fetus” Maienschein p13. The female menstrual blood, however is incapable of doing this by itself; it must have the stimulus of the male semen Maienschein p14. Male semen does not contribute material to the fetus, but its role is to curdle the menstrual blood (like rennet curdles milk in cheesemaking) – and it is this progressive curdling that is embryonic development. Needham p113 SLIDE 50

This theory is echoed in the Bible: Job 10:10 “Didst thou not pour me out like milk and curdle me like cheese.” The milk here is semen and the curdling of this fluid was the view of fetal development.

But how does a body develop from formless fluids? There must be some guidance: Aristotle thought there must be some agent: the Greek word he used, which had no religious connotations, was eventually transformed into the religious idea of a soul.

<http://www.nd.edu/Departments/Maritain/etext/aatcc12.htm> Aristotle believed there were three successive souls: first the “vegetative soul” which all living beings have. Then the locomotory soul for all beings capable of picking themselves up and moving. This basically separates plants from animals. Finally there is a rational soul for humans alone, since only humans have the power to reason (Jane Maienschein “Whose View of Life?, Embryos, cloning and stem cells.” Harvard Univ. Press 2003.)

Aristotle hypothesized a process, later called ‘animation’ manifested by the movement of the fetus in the womb. He thought this ‘animation’ took place on the 40th day after conception in the case of a male and on the 90th day for a female (p3 of 23 in Scott Gilbert “When Does Human Life Begin? In DevBio, A Companion to Developmental Biology (<http://7e.devbio.com/article.php?id=162>). Thus Aristotle is the origin of the ideas of ‘rational soul’ and ‘animation’ referred to in the Catholic Encyclopedia excerpt. Some interpretations of early Jewish Law argue that “For 40 days, the fluid of intercourse, that will become a fetus lacks “humanity”, is “like water”, and is not yet a “person” (Maienschein p17).

This idea that fetuses are formed from the mixing of male and female fluids lasted 2,000 years. Descarte, in 1662, argued that male and female semen come together and “ferment” (Needham, p156; Noonan, Abortion p35). It wasn’t until 1651 that William Harvey, the same guy who showed that blood circulated, dissected female deer shortly before and after copulation. He reported that he couldn’t find any female semen, nor any coagulum (Carlson, p32).

In 1677 Antony van Leeuwenhoek, considered the inventor of the microscope, published his observation of sperm in semen. He originally thought they were parasites (Maienschein p34).

During most of western history, it was not known that human females, or any other mammal, produce eggs.

The human egg is extremely tiny, it’s barely visible.

you need a microscope to really see it

SLIDE, MICROSCOPE & EGG 59b

It is almost impossible to find in the mass of tissue of the fallopian tubes and uterus.

In the 150 years after Leeuwenhoek's discovery of sperms, "no one had any real idea what eggs and spermatozoa were, what they represented or what they contained." Matthew Cobb: "Generation: The 17th C scientists who unraveled the secrets of sex, life and growth." (Bloomsbury) quoted in NYT 8/2/06 pE8.

Matthew Cobb: "Generation p242 An Italian Priest, Lazzaro Spallanzani (1729-1799), dressed male frogs in little taffeta shorts(1780). They ejaculated over eggs, but their sperm could not reach the eggs. No tadpoles were born. But if he dipped a paintbrush into the sperm – and touched the eggs with it – tadpoles were born. But he remained an ovist preformationist – convinced that the sperm contributed nothing. His conclusion - the millions of tiny spermic animals were merely parasites. Semen did nothing but nothing more than provoke the activity of the already present fetal heart.

His ideas were dominant: understanding was in a strange place. Everyone could see sperm in semen – but they didn't think the sperm did anything. No-one had seen an egg in a viviparous organism – but it was almost universally believed that animals were embedded in these unseen eggs.

It wasn't until 1827 that Karl Ernst von Baer, using better microscopes, discovered an egg in a dog (Cobb p244). Baer was flabbergasted: " I shrank back as if struck by lightning, for I clearly saw a miniscule and well-developed yellow sphere of yolk. Before I found courage to look at it a 2nd time, I had to recover, since I was afraid of having been deluded by a phantom. It seems odd that a sight expected and so much longed for could frighten one when it actually occurs." Nevertheless, von Baer remained an ovist preformationist. He resolutely argued that something in semen – but certainly not the 'spermic' animals, - merely awoke the egg" Cobb 245. It was gradually shown that all mammals have eggs.

The discovery of sperms and later eggs led to a heated argument as to which of the two gave rise to the embryo. No one knew that they joined.

Fertilization was finally discovered by George Newport in the 1840s.

Although Mendel postulated the existence of genes in the 1860s, his theories were unknown until about 1900. It wasn't until 1915 that the role of genes and chromosomes in fertilization were discovered.

The usual reason now given for considering conception as the start point is that when the sperm fertilizes the egg, it is claimed that "final genetic constitution" of the "new individual" is set.

Most believe that this is the traditional point of view and certainly that it is the traditional Christian teaching?

More simply, one can see that the idea that life begins at fertilization can't predate the discovery of fertilization (1840s) and the genetic part of the argument can't predate 1915.

So this claim can not be the basis for a longstanding religious opposition to abortion.

In short, the idea that life begins at fertilization is a modern idea.

The idea that the "final genetic constitution" of the individual is set at sperm entry is false. The genetic details are complex. You can find them in the appendix at the end of this section.

So, when does life begin?

To a scientist, the only possible answer to that question is:

~3.5 Billion years ago when the first cells appeared.

Since the first cells evolved billion of years ago, life has continued via the constant division of cells.

APPENDIX

The “Final Genetic Constitution” Of The Individual Is NOT Set At Sperm Entry

(MORE INFORMATION THAN WAS IN LECTURE)

Here is the complex story of what actually happens to ‘genetic constitution’ before, during and after fertilization.

Every cell of the mother has two copies of each chromosome; they are ‘diploid’. At the time of sperm entry, the oocyte (technical term for the egg) is still diploid. But the mother can pass on only one copy of each chromosome to the next generation. One copy of each chromosome has to be thrown away. When the sperm enters, it makes the cell triploid, with 3 copies of each chromosome, a lethal condition if it persists.

The details of what happens are complex. Before fertilization, each of the oocyte’s chromosomes has undergone “crossing over” which intermixes some genes from the grandmother and some genes from the grandfather on each chromosome. In every oocyte this intermixing is different. The vast number of possibilities for this intermixing (and a comparable process during sperm production) is the main factor establishing the great diversity and individuality of genetic constitution. After sperm entry, the oocyte undergoes a kind of cell division called the “second meiotic division” or the reduction division. Which chromosomes are thrown away is again random, leading to yet more diversity. The chromosomes that are thrown away are encased in a degenerate cell called “polar body 2”. After this the ‘female pronucleus’ (the maternal chromosomes remaining in the oocyte) duplicate; the chromosomes in the “male pronucleus” (those brought in by the sperm) also duplicates (the cell is quadruploid). After this the pronuclei migrate together, the oocyte divides and finally, at the two cell stage, first establishes a diploid nucleus with the final complement of chromosomes.

However, were not done yet. Each cell in a female has two X-chromosomes, while males have only one. Cells cannot survive with two active X-chromosomes. Hence, in females, each cell “inactivates” one or the other X-chromosomes. During inactivation, the chromosome crumples up into a dark staining, inactive lump, called a Barr body. Which X chromosome inactivates in each cell is random. So females are a mix of cells, some having one genetic constitution, others having a different one. The process happens in different cells at different times during embryogenesis. Hence, the final genetic constitution of the individual is not set until after the period of inactivation is over.

Calico cats are a common result of X-inactivation. There are two versions (alleles) of the X-chromosome gene for coat color. Males always inherit one X and have a coat that is either all-black or all-yellow. Females however may inherit one of each. Cells in which the chromosome carrying the black allele is inactivated become yellow, and those which inactivate the yellow become black. The final cat is a mix of black and yellow patches, a calico.

The details of all this genetic machinery are not critical. The conclusion is: the “final genetic constitution” of the conceptus is not set at sperm entry, but set by a complex of events starting before fertilization and continuing into embryogenesis.

Elof Axel Carlson. Mendel’s Legacy: the origin of classical genetics. Med Hist QH428 C248 2004

John T. Noonan, The Morality of Abortion HQ767 N66 (LC)

At every stage of development, there are large losses.

THE SELECTION OF THE NEXT GENERATION

1) Humans develop an enormous number of germ cells, which are then whittled down to the few that will make it into the next generation. Spontaneous abortion is part of a massive winnowing of the potential next generation.

Eggs and sperms for the next generation start developing before the mother's (or father's) birth.

Since each time a cell divides, it runs the risk of making a mistake while copying its DNA, cells that are going to make the next generation are usually set aside, early in embryogenesis, and kept in a non-dividing state.

The cells which will make the next generation are called the germ line cells and the process is called sequestration of the germ line.

The germ line starts to differentiate when your parent is a tiny embryo within your grandmother's uterus.

At about 3 weeks of embryogenesis, some cells from OUTSIDE the embryo

24

become recognizable as germ cells.

FIG 1.3a IN ESSENTIAL REPRO

These emerge from the epithelium of the yolk sac.

In the next 2 weeks these cells migrate into the embryo and into the developing gonad (ovary or testis). ER Fig 1.3b

By week 16-20 of the male embryo (your father as an embryo) the germ cells become quiescent and remain that way until puberty.

In the female the germ cells multiply (in your embryonic mother) until there are 7 million potential eggs.

By birth, they have stopped multiplying. ER Fig 4.2

They start the process of going from the diploid stage (2 copies of each chromosome) to the haploid stage (1 copy of each chromosome). This is also finished by birth. ER Fig 4.2

They are now called oocytes) (oo = egg, cyte = cell)

From birth onward, this next generation sits, in as inactive a state as possible, until puberty when the oocytes are ovulated and resume development.

Some of the germ cells will sit quiescent for 50 years waiting to be ovulated.

ER p79

So, what happens to these 7 MILLION POTENTIAL EGGS?

MOST DIE BEFORE the BIRTH OF THE MOTHER

Johnson & Everitt Fig 1.11 SLIDE #57

A GIRL HAS ~2 Million POTENTIAL EGGS LEFT AT BIRTH.

But oocyte death continues so that, at puberty, about 400,000 eggs are left.

After puberty, one egg each month starts to mature

SLIDE OF OVARY & FOLLICLE #58

A female WILL OVULATE ~400 EGGS DURING LIFE.

SLIDE w/ EGG & finger#59

Arrow points to egg, finger for size comparison

In the average (current) female, ~18 eggs WILL BE FERTILIZED making a conceptus. (more in a pre-contraceptive culture)

After fertilization, the winnowing continues and

More than 60% and maybe as many as 90% of fertilized eggs (~14 of them) will die in spontaneous abortions. Most of this death is caused by genetic abnormalities.

This stage of loss is called 'pregnancy wastage'.

Of the 4 surviving conceptuses, 1 will be the subject of an induced abortion

AND 3 WILL DEVELOP TO TERM. (~Average TFR for world.)

Continuing the chanciness of the life cycle – until modern ideas of sanitation took hold. The death rates of infants and children were ~1/3.

SO, IN EACH GENERATION, 7 Million potential members of the next generation are narrowed down to 2 (contracepting countries) or 3.5 survivors (pre-contracepting countries).

The males, of course, have had billions and billions of their potential births die.

Scientists separate out three different stages that are usually assumed by the public to be identical:

1. Fertilization: the events that start occurring at sperm entry.
2. Pregnancy: Pregnancy is a statement about the physiological state of the mother. Since the mother's body has no way to become aware of the fertilization event, her body does not respond. It is only after implantation, about a week after fertilization, that the conceptus starts communicating with the mother, inducing hormonal response from the mother. This is the time when pregnancy can be detected by an antibody test for the hormones. Physicians always use the word 'pregnancy' to refer to this stage.
3. Formation of the embryo: In the first two weeks the conceptus is primarily making membranes that will not be part of the baby. In these first two weeks there is nothing that can properly be called an embryo. Only after that do tissues develop that will give rise to the fetus and then the baby.

In everyday language there is little difference between the use of the words conception, fertilization, the beginning of pregnancy. For doctors and scientists, however they are not synonymous.

Lay people generally don't distinguish between these three terms and also conception, so they are used synonymously. Biologically cognizant individuals differ on the stage at which an interruption of the life cycle constitutes an abortion (spontaneous or induced). Because of this, there is much confusion in the abortion debate on what contraceptives are, or are not, abortifacients.

The extent of pregnancy wastage in humans is unusual. Other mammals don't have as high a rate of death. Why does human biology kill off so many of its conceptuses?

One theory says that the rate of spontaneous abortion should be proportional to the amount of parental investment required. If little investment is required, then an individual has more offspring by letting all survive and playing the odds on how many will survive. However, if a lot of post-conception investment is required – like the 9 mos of human pregnancy and the several years of child rearing, then it is only worthwhile making that investment for the best embryos.

Similarly, if an animal has large litters, it does not matter much if one or two die.

But humans usually carry only 1 fetus. If that fetus, or the resulting child, dies, then the mother has wasted 9 months or more of her reproductive span. So again, evolution would favor a rapid destruction of conceptuses which were not of the highest quality.

78% is probably the best number we have for early death of conceptuses.

When deaths at all gestational stages are included, some calculations conclude that more than 90% of conceptions fail to survive to term. E.g. Johnson & Everitt, 3d Ed

Most of the death in the post conception period occurs in the first two weeks and is due to genetic abnormalities.

Primarily the *conceptus* either doesn't have the proper complement of chromosomes or carries lethal mutations.

Further death occurs when implantation fails.

These fertilized eggs die mostly in the first few weeks of development.

MOST DIE BEFORE THE FIRST MISSED PERIOD.

The woman is never aware of the fertilization and there is no medical problem.

The next period can occur at or near its normal time.

When the conceptus doesn't die right away, but survives somewhat longer than two weeks, then the next period is late. Again the woman doesn't perceive this as a pregnancy, but as an irregularity in the menstrual cycle.

Probably, most of the time that a woman is engaging in intercourse and misses a period' she had in fact had a conception which then was spontaneously aborted.

For each pregnancy that a woman knows about, she may have had about 4 fertilizations that she didn't know about that were aborted.

For a normal, healthy, sexually active young woman (who's not using contraception), it takes an average of about 5 months to become pregnant.

Johnson, Everitt 4th ed. p251, last para

But we know that ~4 out of 5 fertilizations don't result in implanted embryos.

Johnson, Everitt 4th ed. p251-3

So, in the four months in which the mother didn't get pregnant, there was probably a conception in each of those months. In the 5 months, four of the five conceptuses were spontaneously aborted – and one resulted in a pregnancy.

This has enormous implications. If, legally or religiously, life begins at fertilization, then basically for every sexually active, unprotected woman, every month the legal and religious formalities of

death must be brought into action. There should be some sort of coroners inquest and death certificate issued. There should be a religious funeral service and burial.

The religious significance is because all most all Christian denominations believe that resurrection is not just “in the spirit”, but in the actual flesh of the person. That is the point of the doubting Thomas story in the Bible. After the crucifixion, the Apostle Thomas doesn't believe that the person standing in front of him is the supposedly dead Jesus. Jesus asks Thomas to put his hands into Jesus' wounds to convince himself.

But if 80% of conceptuses die when they are a few celled embryo, and they are resurrected in their flesh, then 80% of the souls in heaven must be living in test tubes.

Life IS A CYCLE, and cycles don't have beginning or ends.

There is no unique way to assign a start to a cycle.

The seasons are a cycle. So the day chosen as New Years is arbitrary.

Different cultures put New Years at different times in the year.

We put it at Jan 1, near the winter solstice.

The Romans put it at the Ides of March, March 15.

– though they changed that several times.

The Chinese put the new Year in February,

The Jewish New Year begins in September.

SIMILARLY DIFFERENT CULTURES HAVE DIFFERENT CONVENTIONS FOR ASCRIBING A 'BEGINNING' TO THE CYCLE OF LIFE.

Traditional cultures often consider life to begin only AFTER THE WORST PERIOD OF INFANT MORTALITY is over.

For instance, among the Fulani of West Africa (Nigeria), an infant becomes a person and is given a name 7 days after birth.

p93 in Derrick Stenning in Jack Goody, ed. Developmental Cycles in Domestic Groups, Cambridge Papers in Social Anthropology, Cambridge U Press 1962. KSL Anthro GN480 G66

The Navajo don't consider that a child is alive until it is over worst period of infant mortality. After delivery, it is kept in a cradle board as kind of an extension of pregnancy. When the child laughs for the first time, they have a big ceremony and this marks the child's birth.

OR AT PUBERTY.

In some New Guinea tribes an infant stays with the women until puberty and even boys are considered to be women. At puberty, the males steal the boy away and then have a birth ceremony. You read about this.

OR UPON BECOMING A MOTHER

In traditional times, in some parts of China a woman has two lives.

A mother is considered to start life over again at the birth of her first son.

The mother takes a new name at this time and the son never learns first name of mother.

There are versions of this in many places.

You read about a woman named Om Gad in Egypt.

“Om Gad” means “Mother of Gad”.

MEDICAL PERSPECTIVES

Within medicine, specialists in different fields focus on different developmental stages in deciding ‘when life begins’.

Because the vast majority of fertilizations do not result in a fetus,

And because there is no maternal response to fertilization,

Obstetricians recognize the beginning of pregnancy at implantation

about 1 week after fertilization.

Fertility specialists are generally also interested in pregnancy. Fertilization can be done in a dish and almost always works. Implantation is the difficult step.

The ability to move spontaneously was considered one of the two defining characteristics of life by St. Thomas Aquinas. In this view quickening is the key event when life begins. In *Roe v. Wade*

Traditional legal opinion also holds that quickening (when the mother feels the fetus kick) is the first sign of life.

Fetal viability is of interest to neonatologists.

It is the stage where the lungs can function outside the uterus.

Neurologists usually argue that life begins when there is some specified form of mental function:

sensation or MOTOR response or myelination of the nerve axons, or brain waves, etc.

One variant on the neural function argument is the ability to feel pain.

Although there is not much research on this question. Activity signaling pain is transmitted to the cortex at the beginning of the 7th month. What, if anything, the cortex does with this information at that stage is not known.

Rebecca Slater et al., (2006) *J. Neurosci.* 26:3662-3666.

“According to the definitions of pain and feeling, a fetus definitely cannot feel pain.” Van de Velde (2006) *Seminars in Fetal and Neonatal Medicine* .11:232-236

The process of human development is cyclical and continuous.

There is no objective way of setting a dividing line in that cycle.

It's kind of like the Chicken and egg problem.

The law however has to specify a time after which termination is considered murder. When the law has to decide on a boundary line on a continuum, good legal policy is to define what is called

a 'CLEAR BRIGHT LINE'. That is, a demarcation event that is unequivocally clear to everyone whether it has happened or not.

That's why the courts, until recently, have stuck pretty much to birth.

it's out in the open, it's obvious to everyone.

While no-one knows whether conception has occurred until about a month after the event, there is never a question as to whether a child has been born.

BIRTH CONSTITUTES A BRIGHT LINE IN A WAY THAT NO OTHER BOUNDARY DOES.

WHEN DOES LIFE BEGIN? Is not a scientific or empirical question.

It is the arbitrary assignment of a beginning point to a continuous cycle.

So, if life beginning at conception is not a scientific idea,

And it is very different in different cultures

How come in the west, it is such a prevalent idea?

Is it biblical?

The idea that life begins at conception does NOT come from the Bible.

Let us see what the Biblical says about when life begins:

The Old Testament says "God created man in his own image" (Gen 1:27) (presumably not a fertilized egg.)

We know that Adam was created at an age when he could understand God's commands and needed a woman to be his mate.

In short, Adam was created as an adult.

The Bible also understands that life is a cycle.

The biblical cycle is earth to earth, or soil to soil.

Gen 2:7 says: "God formed man of dust from the ground."

Gen 3:19: "till you return to the ground, for out of it you were taken, you are dust and to dust you shall return. RSV, King James: (almost identical).

This is kind of the ecological cycle – the food you eat comes from the ground and in the end you decay back to earth.

There is no discussion of when life begins in the New Testament:

The most important of the early Christian theologians, Augustine, didn't know.

Confessions Bk 1 (Chadwick, p7-8) "Tell me, God, ... tell me whether there was some period of my life ... which preceded my infancy? Is this period that I spent in my mother's womb? Was I anywhere, or any sort of person? I have no one able to tell me that – neither my father nor my mother nor the experience of others nor my own memory."

In short, the answer is not in Judaeo-Christian scripture.

In recent times, since the 1970s, when the abortion debate got hot, those right to life people who base their views religiously have chosen several Bible passages to support their position.

I have included in your reading the most quoted of these passages.

The most referred to is.

God says to Jeremiah: (1:5)

“BEFORE I formed you in the womb I knew you”

Read literally, this is a simple statement of god’s omniscience: god knows everything and even before birth knows what is going to happen to Jeremiah. One has to go considerably beyond the text to conclude that this passage means that life begins at conception.

BIBLICAL PASSAGES RELATING TO ABORTION

The Ten Commandments are in Exodus 20.

6th commandment: You shall not kill.

In the following chapters, there is an explanation of how to interpret these laws.

The bible describes various violent acts that men do and what should be the punishment for these acts.

Exodus 21: what to do in cases of murder, what if one man hits another with a stone or his fist, what if a man kills his servant, what if a man kills a thief, etc.

The old testament contains only 1 passage directly discussing abortion: Exodus 21:22.

It describes a much worse crime than a modern abortion where a woman asks a doctor to perform the procedure. Here a man violently causes an abortion, against the woman's will. Yet, even in this extreme case, the penalty is only a fine. It is treated as a property crime.

"When men have a fight and hurt a pregnant woman, so that she suffers a miscarriage, but no further injury, the guilty one shall be fined as much as the woman's husband demands of him, and he shall pay in the presence of the judges.

But if injury ensues, you shall give life for life, eye for eye, tooth for tooth, etc."

The Catholic Bible, Oxford U. Press, 1995. See also Leviticus 24 for ‘lex talionis’)

This is the typical Hebraic legal formula for a property crime (here against the husband). If the only harm caused is the miscarriage, the victim proposes a monetary fine, but it must go before a judge who determines whether the amount of the fine is reasonable.

But if injury ensues, the punishment is severe. The fetus is already miscarried, so who is left to suffer the injury? Only the mother. This is reinforced by the inclusion of “tooth for tooth”; fetuses don’t have teeth; only the mother does.

So, if the woman is injured, then the punishment is severe, up to the death penalty if the woman dies.

This emphasis on the mother, rather than the fetus, is reflected in the US Supreme Court Roe v. Wade decision.

The sole reference to abortion in Jewish Talmudic Law says:

“If a woman is in hard travail {and her life cannot otherwise be saved}, one cuts up the child within her womb and extracts it member by member, because her life comes before that of {the child}. But if the greater part {of the head} was delivered, one may not touch it, for one may not set aside one person’s life for the sake of another.” Talmud, Tohoroth II Oholoth 7:6; as cited by Jakobovits

1973 from Scott Gilbert 4/23

This describes almost exactly a late term (or ‘partial birth’) abortion. The procedure was common from Biblical times into the 20th century. Mohr, *Abortion in America*, describes its use in 19th C US. It is now a rare desperation measure for late term complications.

Even though abortion was common at the time, the New Testament is silent on the issue.