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Iowa Legislature
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To the Chair and Honored Members of the Committee,

Thank you for the opportunity to testify on House Study Bill 255, which limits abortions when it has been determined that the unborn child has a detectable heartbeat. I am testifying on behalf of the Charlotte Lozier Institute. Based on my professional experience, I believe HSB 255 would improve the lives of women and provide necessary protections for developing human beings in your state.

I am a scientist with over 20 years' experience in academic research and clinical medicine. I studied heart development at Harvard, directed a medical college research lab studying congenital heart disease, and established a hospital lab that performed genetic testing on children with heart defects. I am published in medical journals and textbooks and am a member of the U.S. Department of Health and Human Services Secretary's Advisory Committee on Infant and Maternal Mortality. My Ph.D. in Biochemistry is from the Medical College of Wisconsin and fellowship training in Cell and Molecular Biology from Harvard Medical School and Children's Hospital Boston. Before joining the Charlotte Lozier Institute as Senior Fellow and Director of Life Sciences, I was an appointed faculty member at the Medical College of Wisconsin, Scientific Director of Molecular Diagnostics at Children's Hospital of Wisconsin, and scientific consultant for the Milwaukee County Medical Examiner and TAI Diagnostics biotechnology company.

Human life begins at conception, and abortion during any stage of pregnancy ends the life of a human being.

The dynamics of human development are well-established. The *Carnegie Stages of Human Development*, first established in 1942, are *the* standard used by *all* embryologists to describe

human embryo development (Carnegie stages 1-23).[1] The very first stage of human development, Carnegie Stage 1a, is marked by the moment of fertilization.[2]

It is a scientific fact that from the **moment of fertilization**, also known as conception (when the sperm fuses with the egg) a single-celled human (the zygote) is created, which contains every instruction necessary for the zygote to develop.[3] The "cells, tissues and organs produced during development do not somehow 'generate' the embryo … they are produced by the embryo as it directs its own development to more mature stages of human life."[4] This organized, coordinated behavior is "the defining characteristic of a human organism."[5] These facts are based on centuries of biological discovery, technological advancement, and validated, objective science.

There is a beating heart in every living human being by 6 weeks gestation.

The heart is the first organ to form and function in the developing human embryo.[6] The heart is a **vital source for circulation of nutrients and oxygen-carrying blood** once the nutritional requirements of the embryo can no longer be met by diffusion from the placenta alone.[7]

About **22 days after fertilization (6th week gestation)**, the heart starts to beat (pumps blood) rhythmically.[8] The heart beats around **110 beats per minute** at 6.2 weeks, increasing to approximately 159 beats per minute at 7.6-8.0 weeks, and peaking during the 9th week to twice the heart rate of the mother's at over 170 beats per minute.[9] By the end of the 6th week, the human heart will have already beat **over 1 million times**, by 7 weeks almost 2.5 million times, and by the 9th week over 5 million times. This same heart will beat **54 million times before**

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[1] "Developmental Anatomy," National Museum of Health and Medicine, https://www.medicalmuseum.mil/?p=collections.hdac.anatomy.index (accessed November 13, 2020). ***Embryologists date pregnancy from the start of fertilization, known as "post-fertilization," date. Unless otherwise noted, the age of the preborn for the remainder of my testimony will be based on gestation age, which dates pregnancy based on the woman's last menstrual period (LMP),approximately 2 weeks greater than post-fertilization age (e.g., a human embryo at 4 weeks' post-fertilization is approximately 6 weeks' gestation in pregnancy)***

[2] Ronan O'Rahilly and Fabiola Müller, *Developmental Stages in Human Embryos: Including a Revision of Streeter's "Horizons" and a Survey of the Carnegie Collection* (Washington D.C.: Carnegie Institution of Washington, 637, 1987).

[3] Sadler, Thomas W., *Medical Embryology*, 14th edition, 2019. Page 14.

[4] Dr. Maureen Condic, Charlotte Lozier Institute, On Point "*A Scientific View of When Life Begins*", available at: https://lozierinstitute.org/a-scientific-view-of-when-life-begins/, June 2014.

[5] *Ibid*

[6] Tan C, M, J, Lewandowski A, J: *The Transitional Heart: From Early Embryonic and Fetal Development to Neonatal Life*. Fetal Diagn Ther 2020;47:373-386

[7] Hill, M.A. (2023, January 28),*Cardiovascular System Development*, Available at: https://embryology.med.unsw.edu.au/embryology/index.php/Cardiovascular_System_Development

[8] Sadler, Thomas W., *Medical Embryology*, 14th edition, 2019. Page 181; and Hill, M.A. (2023, January 28), *Cardiovascular System Development*, Available at: https://embryology.med.unsw.edu.au/embryology/index.php/Cardiovascular_System_Development

[9] Murugan VA, Murphy BO, Dupuis C, Goldstein A, Kim YH. *Role of ultrasound in the evaluation of first-trimester pregnancies in the acute setting.* Ultrasonography. 2020 Apr;39(2):178-189. doi: 10.14366/usg.19043. Epub 2019 Oct 16. PMID: 32036643; PMCID: PMC7065984; *and* Hornberger LK, Sahn DJ. Rhythm abnormalities of the fetus. Heart. 2007 Oct;93(10):1294-300. doi: 10.1136/hrt.2005.069369. PMID: 17890709; PMCID: PMC2000955.

birth, and over 3.2 billion more times into adulthood, constantly pumping blood through the entire human body for a lifetime.[10]

Even at this early embryonic stage, the heart has begun to form **primitive heart valves** that act as physical barriers that prevent the backflow of blood through the heart tube and assist in the forward propulsion of blood as it is pumped through the heart and out through the rest of the body.[11]

Anyone who denies that an unborn child is alive and has a beating heart at 6 weeks is blatantly ignoring the science.

Below are quotes from top leading medical journals and embryology textbooks confirming these scientific facts.

> *"Prenatal age begins at fertilization, postnatal age at birth."*[12]
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> *"By 5–6 weeks the normal mean fetal heart rate is 110 beats/min (bpm)…there is a subsequent increase in the rate to 170 bpm by 9–10 weeks."*[13]
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> *"Cardiac activity is seen as early as the sixth week of gestation…The fetal heart rate gradually increases with gestational age from approximately 110 beats per minute (bpm) at 6.2 weeks to approximately 159 bpm at 7.6-8.0 weeks. Slow embryonic heart rates are associated with a worse short-term prognosis, with fetal heart rates less than 100 bpm before 6.3 weeks or below 120 bpm at 6.3-7.0 weeks linked to an increased rate of embryonic demise. The overall prognosis improves with increasing heart rate."*[14]
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> *"…the heart becomes a continuous expanded tube…and begins to pump blood [reference to figure of 22-day embryo heart]"*[15]
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> *"The human heart is one of the first organs to form and function during embryogenesis… the fetal heart becomes vital for oxygen and nutrient distribution. The initiation of the first heartbeat via the primitive heart tube*

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[10] "Prenatal Form and Function – The Making of an Earth Suit," at Appendix A – Calculations (The Beat Goes On – *Tracking the Total Number of Heart Beats During Pregnancy and Beyond*), The Endowment for Human Development, https://www.ehd.org/dev_article_appendix.php (accessed November 21, 2020).

[11] Combs MD, Yutzey KE. *Heart valve development: regulatory networks in development and disease.* Circ Res. 2009 Aug 28;105(5):408-21. doi: 10.1161/CIRCRESAHA.109.201566. PMID: 19713546; PMCID: PMC2777683.

[12] O'Rahilly R, Müller F. *Developmental stages in human embryos: revised and new measurements.* Cells Tissues Organs. 2010;192(2):73-84. doi: 10.1159/000289817. Epub 2010 Feb 26. PMID: 20185898.

[13] Hornberger LK, Sahn DJ. *Rhythm abnormalities of the fetus.* Heart. 2007 Oct;93(10):1294-300. doi: 10.1136/hrt.2005.069369. PMID: 17890709; PMCID: PMC2000955.

[14] Murugan VA, Murphy BO, Dupuis C, Goldstein A, Kim YH. *Role of ultrasound in the evaluation of first-trimester pregnancies in the acute setting.* Ultrasonography. 2020 Apr;39(2):178-189. doi: 10.14366/usg.19043. Epub 2019 Oct 16. PMID: 32036643; PMCID: PMC7065984

[15] Sadler, Thomas W., *Medical Embryology*, 14th edition, 2019. Page 181

begins at gestational day 22, followed by active fetal blood circulation by the end of week 4 [post-fertilization]."[16]

"The heart is the first organ to form within the embryo and this complex developmental process begins during the fourth week [post-fertilization]."[17]

"The embryonic heart begins to beat at 22 to 23 days…The cardiovascular system is the first organ system to reach a functional state. The embryonic heartbeat can be detected using Doppler ultrasonography during the fourth week, approximately 6 weeks after the last normal menstrual period [Fig.4.14 showing an ultrasonogram of a 6-week gestation embryo with cardiac activity at 116 beats/min]."[18]

The heartbeat can be detected as early as 6 weeks' gestation.

The early embryonic heartbeat is detected using doppler **transvaginal ultrasonography**.[19] This measures the movement of the beating heart. Ultrasonography does not measure electrical activity; it measures pulses of high-frequency sound reflected off solid objects—that is the heart pumping blood. The image of a beating heart from a living human embryo in the 6th week of gestation (4 weeks and 4 days post-fertilization) has been **captured on video**.[20]

The heartbeat is a strong indicator and **marker of health**; and the absence of a detectable heartbeat is diagnostic of pregnancy failure.[21] Fetal heart rates less than 100 beats per minute before 6.3 weeks are linked to an increased rate of embryo death.[22] **Researchers have found that the presence of a heartbeat at 6-8 weeks indicates that the unborn child has a very high chance of surviving to childbirth, sometimes as high as 98%, and overall prognosis improves with increasing heart rate**.[23]

Furthermore, the **diagnosis of multiple gestations** relies upon the detection of an early heartbeat. If two embryos are visualized by ultrasonography, the chance of successfully

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[16] Tan C, M, J, Lewandowski A, J: *The Transitional Heart: From Early Embryonic and Fetal Development to Neonatal Life.* Fetal Diagn Ther 2020;47:373-386

[17] Hill, M.A. (2023, January 28), *Basic Cardiac Embryology*, Available at: https://embryology.med.unsw.edu.au/embryology/index.php/Basic_Cardiac_Embryology

[18] Moore, Keith L, TVN Persaud, and Mark G. Torchia. *The Developing Human, Clinically Oriented Embryology.* 10th ed. Philadelphia: Elsevier, 2016. Pages 149; and 541.

[19] Murugan VA, Murphy BO, Dupuis C, Goldstein A, Kim YH. *Role of ultrasound in the evaluation of first-trimester pregnancies in the acute setting.* Ultrasonography. 2020 Apr;39(2):178-189. doi: 10.14366/usg.19043. Epub 2019 Oct 16. PMID: 32036643; PMCID: PMC7065984

[20] The Endowment for Human Development. *The Heart in Action.* Available at: https://www.ehd.org/movies/21/The-Heart-in-Action

[21] Murugan VA, Murphy BO, Dupuis C, Goldstein A, Kim YH. *Role of ultrasound in the evaluation of first-trimester pregnancies in the acute setting.* Ultrasonography. 2020 Apr;39(2):178-189. doi: 10.14366/usg.19043. Epub 2019 Oct 16. PMID: 32036643; PMCID: PMC7065984

[22] *Ibid.*

[23] Hyer, J.S., Fong, S., and Kutteh, W. H. *Predictive value of the presence of an embryonic heartbeat for live birth: comparison of women with and without recurrent pregnancy loss.* Fertility and Sterility, Vol 82 (5): 1369, 2004.

delivering twins increases from 57% to 87% if cardiac activity is detected in both embryos by 6 weeks."[24]

The heart is **vital to the continued growth** of the unborn child. By 10 weeks gestation, she will already have over 90% of the more than 4,500 named structures in the adult body including arms, legs, fingers, toes, a face and eyelids.[25] She will also bring her hands together, touch her face, and suck her thumb, with a preference for her right or left hand.

The early heart at 6 weeks' gestation may not be a 4-chambered heart yet, nor should it be at this stage. The human body is always in a constant state of change. **The prenatal heart organ is still moving, pumping blood, beating rhythmically, and circulating essential nutrients through the embryo.**

The process of **human development is a growth continuum** marked by numerous key stages or events that occur during pregnancy, and a human being does not suddenly stop developing once he or she is born. There are several human organ systems that remain underdeveloped and continue to grow and mature after birth.

The circulatory system, heart, and lungs undergo considerable change and function differently before and after birth. Before birth, the fetal circulatory system uses shunts, like highways, that direct blood flow and bypass the lungs.[26] Two of these shunts (the foramen ovale and the ductus arteriosus) develop in the prenatal heart and then close *after* birth to prepare for newborn blood circulation. **The fetal heart does not look and function the same as an adult heart, nor is it supposed to.**

The brain also undergoes complex and life-long changes. Some of the most important stages of brain maturation occur during fetal development, early childhood, and adolescence. Brain activity has been recorded in the unborn as early as 45 days during the 9th week gestation,[27] but **it is a well-known fact that the frontal cortex continues to mature well into adulthood and is not complete until around 25 years of age.** A human being under the age of three has a thin skull with only one layer. As we age, the brain gets thicker and develops three layers. **Do we suggest that a toddler or teenager does not actually have a true brain until full maturation is complete? Are they somehow less human?**

The intrinsic worth of a human being is not governed by their development stage, abilities, organ function, or capacity to do certain things. If that were so, then all newborn babies, toddlers, the disabled, and anyone whose human body is not fully "functional" or dependent on another, would not be a *real* human being.

SB 1223 would provide necessary protections for developing human beings. By passing this bill, Iowa will send the strong message that ***every* human being is created with purpose, has**

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[24] Creasy and Resnik's, *Maternal-Fetal Medicine: Principles and Practice*, 8th Edition. Elsevier, 2019.

[25] The Endowment for Human Development. *Carnegie Stage 23 Introduction.* Available at: https://www.ehd.org/virtual-human-embryo/intro.php?stage=23

[26] Stanford Children's Hospital, Fetal Circulation. Available at: https://www.stanfordchildrens.org/en/topic/default?id=fetal-circulation-90-P01790

[27] Borkowski, Winslow J., and Richard L. Bernstine. "Electroencephalography of the Fetus." *Neurology* 5, no. 5 (May 1, 1955): 362. https://doi.org/10.1212/WNL.5.5.362.

intrinsic value, and worth. This law will protect children from the lethality of abortion, which ends the beating heart of a human being *every* time.

Thank you for the opportunity to contribute to the discussion on this important issue.