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Physically, Mentally, and Emotionally Drained

Kaitlin Medina
Regis University

PHYSICALLY, MENTALLY, AND EMOTIONALLY DRAINED

How hormonal cycles affect academic productivity, mood, and stress levels in college students

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Kaitlin Medina

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Thesis written by

Kaitlin Medina

Approved by

_____ _____Thesis Advisor

_____ _____Thesis Reader

Accepted by

____ _____Director, Regis College Honors Program

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Even when life seems impossible and too hard to handle, put one foot in front of the other and move forward.

ABSTRACT

Name: Kaitlin Medina Majors: Biology and Neuroscience

Physically, Mentally, and Emotionally Drained: How Hormonal Cycles Affect Academic Productivity, Mood, and Stress Levels in College Students

Advisor's Name: Amanda Miller Ph.D.

Reader's Name: Jay Campisi Ph.D.

Hormonal cycles play an essential role in the development and maturation of young boys and girls into men and women. As teenagers enter their late teens and early twenties, their hormonal cycles are primarily responsible for functions related to fertility and hormone production. During this period of time, these men and women are often in their collegiate years. Overall, the college experience is enjoyable for many students, but it can also be a very stressful time due to a difficult class load and the students' need to balance their academic, social, and personal lives. Recent studies have analyzed the effects that hormonal cycles and stress levels have on college students. However, it is important to note the differences between genders. The education system is often divided into daily and seasonal sections, with the average school day occurring daily and semesters occurring somewhat seasonally. With this knowledge, it is evident that the college experience aligns with the male hormonal cycle. Nothing about the education system caters to the monthly hormonal cycle of females. As a result, I conducted a study to determine if there is an impact of reading comprehension and mood on academic productivity in female college students. My results demonstrated that there was no difference in reading

comprehension or mood levels based on phase of the female hormonal cycle and stress. Even though I did not find any statistically significant results, it is still important to consider how to level the playing field. Therefore, I propose methods, such as exercising, increasing Vitamin D intake, and practicing methods of mindfulness, that women can utilize in their daily lives to accommodate for hormonal fluctuations.

CHAPTER 1: HIGHER EDUCATION FROM MY PERSPECTIVE

When I first started brainstorming my thesis topic, I never would have imagined where it was going to take me. My initial idea was to talk about my mental health journey, but I thought that it would become something way too personal. I did not think that I was ready to talk about my struggles and somehow weave in research to back up my claim. Talking about mental health has always been something that I struggle with because I am so used to keeping things inside. At one point in my college career, I wrote a short paper that talked about mental health, but it barely scratched the surface of the inner workings of my brain. The paper was more about discussing my research process than diving deep into my mental health struggles. Therefore, spending almost 50 pages with my thoughts seemed too daunting. I was not ready to be that vulnerable and put something like that out into the world.

As a result, I went for a safe option for my thesis topic. I decided to write about the difference between male and female hormonal cycles. Everyone has a hormonal cycle in some capacity, and that seemed like something I could see myself studying. I had taken Human and Comparative Physiology the semester before, and my favorite part of the entire class was learning about the mechanisms behind the male and female hormonal cycles. I was passionate about it. I was probably not as passionate about it as I am when it comes to mental health, but it seemed like the next best thing. So, it was a no-brainer that I could spend about a year of my academic career researching and writing about this topic.

Once I started this process of brainstorming and writing my thesis on this topic, I began to reflect on my own hormonal cycle. What types of things do I experience on a daily basis? Is that similar or different to the females around me? As I began reading through articles, I was

pleasantly surprised to see how hormonal cycles could be so similar and so different at the same time. Researching the mechanisms of the female hormonal cycle opened my eyes to see how the hormonal cycles of various females could be the same. Each of us do go through the same phases during each hormonal cycle. In the simplest of terms, we as females menstruate, proliferate, ovulate, secrete hormones, and repeat every 28 days (Thiyagarajan et al., 2022). There are three main phases of the female hormonal cycle that are important to highlight: menstrual, follicular, and luteal. The menstrual phase is what we know as the one week of the month where we bleed nonstop, otherwise known as our period. The follicular phase is the next week and a half following our period where the egg matures in the ovary. Lastly, the luteal phase is when estrogen levels will drop to either prepare the body for pregnancy or for another period (Libretexts, 2022). More information on this cycle will come up later, but this basic explanation is essential while I tell my story.

However, each phase could look different at times for each female (Mayo Clinic Staff, 2023b). As I read about and began to research the tendencies and behaviors that females have during certain phases of their cycle, I realized how different our hormonal cycles really are. The symptoms that we experience could be milder or more severe based on the person. Some females' cycles are exactly on time every month, while others only go through a few cycles a year. Some females do not get their period at all, and some struggle to make it through the day when it is their time of the month. The moods of some females can stay pretty consistent across the entirety of their cycle, or they could fluctuate without warning. Some females bleed much more than others and require a higher level of absorbance when it comes to purchasing period products (Harvard T.H. Chan School of Public Health, 2023).

My hormonal cycle is considered to be irregular. It is typical for my cycle to be completely off or disappear for a bit. For years, I felt like I was always guessing as to when my next cycle was going to begin, which caused a lot of uncertainty in my life. Was my period going to be two days early or two weeks late? Was it going to ever come at all? Is there something wrong with me that is causing this? When discussing this with my mom as well as my peers, they all told me that this was normal. They told me that my cycle was not going to be perfect and on time each month. Things would fluctuate, and there was nothing that I could do about that. With their advice in mind, I carried on with my life, and I even changed some habits that would hopefully aid in my cycle becoming more regular. I ate balanced meals, exercised, stayed hydrated, and focused on my sleep. However, nothing changed.

I talked to my doctor about my menstrual irregularities at the beginning of my sophomore year of college, and she told me that it was because my stress levels were consistently too high. I had been diagnosed with anxiety, obsessive compulsive disorder, and depression the year before. Therefore, I was fully prepared and had accepted that I would experience things that were considered out of the normal. The interaction between these three conditions played a role in my stress levels being high, even when I am "relaxing." Additionally, I overthink a lot, and I often let things get to me too easily. At this point, it was just a part of who I was. I was dealing with it, one day at a time. Everyone around me, including my physicians, made it seem like my mental health issues were a direct explanation for my irregular menstrual cycle. Therefore, I had accepted that these could be the only possible reasons for my symptoms for many years. Because of this, I worked on lowering my stress levels and worrying less about the things that were out of my control. Instead, I shifted my energy into the things that I could control, such as my diet,

amount of physical activity, and time management skills for school and work. For a while, it seemed like it was working, but then there was a slight shift in my symptomology.

During the spring semester of my junior year, I started getting a lot of headaches, was becoming nauseous at all parts of the day, and was on the brink of passing out at the most random times. Out of nowhere, my life began to be ruled by these new symptoms that had never been present in my life before. I searched for answers to this odd change in my daily life. Automatically, I thought about my anxiety. In the past, my anxiety had caused a lot of problems in my daily life, especially pertaining to my appetite. When I am anxious, I tend to lose my appetite and ignore my rumbling stomach. At that point in my life, I was very overwhelmed with schoolwork and life in general, so it was easy to blame my new symptoms on my anxiety. Furthermore, I was certain that the dizziness, nausea, and headaches were a result of low blood sugar and dehydration. It was the only explanation that made sense at the time.

Therefore, beginning in February, I made it my mission to take care of myself by eating healthier and staying hydrated. I changed my daily routine and added things that were going to help me in the long run. I was optimistic that these adjustments could be the solution to my long-lasting problems. I was adamant on maintaining consistent habits and behaviors. However, my symptoms were not getting better even with all the lifestyle changes. Living my daily life seemed to weigh me down. It felt like a chore to go to school and hang out with family and friends, but I still did it. I decided to go on with my life, whether I was at my best or not. I finished the rest of the school year, and then I was planning to start a new job at the Shaw Cancer Center in my hometown. After a few weeks, I began to bond with all of my coworkers, and I became part of the Shaw family very quickly. Although my life looked like it was starting to get back on track, I

was still struggling with dizziness, nausea, and headaches. That is when I finally decided that it was time to seek out some answers.

I met with my primary care provider once again, and she still did not know what was wrong with me. So, I got referred to an endocrinologist for a second opinion. In my initial assessment, we discussed the diagnosis possibilities and how they could each be treated, but we needed to do some further testing to rule out some of the possible conditions. After the bloodwork results came back, we had a definitive answer: polycystic ovarian syndrome (PCOS). This was definitely something that I was not expecting to come from some dizziness and nausea. Consequently, I was tasked with more alterations to my daily life. I needed to track my hormonal cycles more closely and start taking medication to increase some reproductive hormones within my body.

These changes to my life became present during the thesis writing process, which could not have been better timing. If I am being completely honest, I felt as though I was missing a personal connection to my topic as I began writing. To me, it felt like my thesis was starting off too technically because of the vast amount of research it required. Now that I had received this new diagnosis, I was curious as to how my condition would affect me and influence how I act and feel. Therefore, I thought that it would be interesting to journal on a daily basis. This is relevant especially to this project since I am an undergraduate student. As a female college student, I have personally felt hardships and struggles when it comes to balancing what I am feeling in my personal life and what I am learning in the classroom. Some days and even some weeks are harder than others, and I know that my hormonal cycle can be the culprit most of the

time. But what does that mean exactly? How do our hormonal cycles affect our success in the classroom?

Throughout my time here at Regis so far, I have had my fair share of ups and downs. There have been times when I have been on top of the world because I was getting great grades and understanding the material that the professors are teaching me. I felt motivated to finish my homework, and I looked forward to every class every day. But then, there were other times when I felt like I was retaining no information no matter how many times I studied and worked through practice problems. I would stare at the same line for hours and still nothing would stick in my brain. At these times, I felt like a failure because I could not live up to my potential or other people's expectations. Even though I faced many endeavors, I knew that I was going to pop right back up immediately after I got knocked down. Regardless of how I was feeling at any time, I always did my best to be successful in the classroom. I always want to excel at my studies and receive grades that I know will help me in the future. Occasionally, I will stop and think to myself about how it just seems so unfair. Why am I struggling so much during certain times of the month? It can make you feel alone every once in a while, and sometimes, I wonder if I am the only person who is going through it. I think that is my reason for writing this thesis. I want other women to know that they are not alone. They are not the only people who are feeling these things. There is a light at the end of the tunnel, even if you can barely see it in the distance. From my own personal experiences, what I have noticed is that I tend to struggle during my menstrual cycle and improve immediately after. The rest of my cycle is pretty much a wild card; I never know where I am going to stand, but there is often a pattern to what I feel.

During my menstrual cycle, I am usually at my lowest physically. Even though each phase has its fair share of physical symptoms, I think that the menstrual cycle is the time when they dominate the most. Cramps, muscle aches, acne, bloating, and headaches are common symptoms that are present during the first five days of my cycle. Although physical symptoms tend to dominate my cycle, I still find that my feelings and emotions can play a role as well. My anxiety tends to be a little higher during this time, and I often feel on edge. My mood swings back and forth as the day passes. I can be ecstatic and in high spirits at one moment, upset and angry at the next, and then depressed and discouraged the next moment. When the school week is lighter during these times, I feel like I can focus on making myself feel better physically, whether it be that I lay in bed with a heating pad or take a nice hot shower. On the other hand, when the school week is filled with multiple exams and big assignments, I struggle having any motivation to complete them or study. All that I want to do is lie in bed, curl up in my favorite blanket, and watch movies all day. Though this is true, I still push through and get things done even if it means that I procrastinate slightly.

Immediately after my period during the follicular phase, I can feel myself starting to get ahold of myself better. After the troubles that I encountered during my period, this phase is more manageable. I can finally stand on my feet without feeling like I could fall apart at any moment. I can tell that I am much happier during these weeks, and I am more willing to finish what I need to accomplish. At this time, I am ready to start working and stay busy. I tend to be more successful when I am busier because I am motivated to sit down and get things done. It works the best for me if I am more stressed here than the rest of my cycle. I spend most of my time sitting at my computer, cranking out homework, and working toward good grades. I tend to ignore my other responsibilities like chores around the house and prioritize my schoolwork over

everything else. I finally have the motivation to sit down for long periods of time and study, so I take advantage of my ambition and utilize it as a strength. At this time, I am much more likely to be ahead of my studies, and I often feel proud of myself. Additionally, I tend to be in higher spirits because I have more free time due to my homework being done early. I am usually more social and more pleasant to be around during this phase.

During my luteal phase, I feel like this is the time when I struggle the most mentally and emotionally. For me, this is the time when I feel the most depressed. I am not certain if it is due to my diagnosed depression, fluctuations in reproductive hormones, or a combination of both. My mood is severely low during this phase, and this is the time when I am the most antisocial. I do not want to interact with others, and I find it difficult to get out of bed in the morning. These two weeks have always been the hardest for me. I dread going to my classes and doing my homework, even when they are classes that I typically enjoy. I cannot pay attention as well as I usually do; I find myself zoning out and thinking of other things. Since I am not paying attention, my notes tend to be less effective and detailed, which hurts me later on when I need to study for the exam. I utilize breaks as a motivator for me to keep going and finish my homework. However, I often take too many breaks, and they become longer as I work on homework more. Time usually gets away from me, and I cannot stay on topic. I would rather do anything besides my schoolwork. Laundry? Let me do that really quick. Grocery shopping? What is another hour? I need the food anyway. As a result of this procrastinating, I put off studying for any exams and completing assignments that should only take me about an hour. I find it difficult to sit still long enough to memorize everything that I need to. My depression rules over me during this time, but I still need to get things done, so once again, I must push through and try my best to succeed in the classroom.

When I began this journey of writing my thesis, I would have never imagined that it would directly relate to my life. The reason that I chose this topic was because I did not want to write about something too personal. But here I am. What are the odds that I chose the topic of hormonal cycles, and then I would start having troubles with my own hormonal cycle? Initially, the goal of this thesis was to bring awareness and propose solutions that could benefit everyone. However, I think that this may also serve as a coping and healing opportunity for me as the author. I am going through some huge changes in my life right now, and it all seems so new to me. At this point, I do not know what my next steps are, and so many things are unknown. They are out of my control. I understand that it is so easy to blame your hormones for making you feel the way you do. They can often be utilized as a reason to excuse actions and outcomes, and I know that I am definitely guilty of this. I have this first-hand experience, so why not take note of what I have encountered and compare it to what previous research has found and what my study will possibly find?

This then brings up the question: why study this? It is possible to claim that since every female's cycle is different, there is no way to connect each perspective and experience. You cannot place everyone in the same box, but I would say that this is the exact reason why I want to research and conduct a study on this topic. The world around us tries to group everyone together into one category, and that is not fair. I plan to utilize my research to come up with possible solutions to this problem that females can use to their advantage. Additionally, in 2021, there were more women that earned a bachelor's degree than men (Fry, 2022). However, I would argue that this is a byproduct of the fact that females make up more of the college student population. In 2021, 58 percent (8.9 million students) of the undergraduate population were women, while 42 percent (6.5 million students) were men (National Center for Education

Statistics, 2023). With this in mind, hypothetically, if all of the undergraduate students were to receive their bachelor's degree, there were more females in college so that number would be higher as a result.

For that reason, I intend for this thesis to analyze the hormonal cycle differences between male and female college students in order to find out how fluctuations in reproductive hormones influence their academic productivity, mood, and stress levels. As my paper will highlight, hormonal cycles have different effects on women compared to men, which can alter certain behaviors and tendencies that each sex has. The female hormonal cycle is dissimilar to the male hormonal cycle in that women experience a full cycle every 28 days while men experience a full cycle every day or seasonally (Brambilla et al., 2009; Stanton et al., 2011; Svartberg et al., 2003). Because of this factor in addition to the structure of the education system, I will argue that women are more affected during certain phases of their hormonal cycle than men are during their overall hormonal cycle when it comes to academic productivity, memory performance, mood, and stress.

CHAPTER 2: HORMONAL CYCLES, STRESS, MOOD, AND MEMORY

The human body implements many homeostatic techniques to keep different aspects of our physical, mental, and emotional lives in balance. When something tips the scale to one side or the other, the body has the tendency to put natural mechanisms in motion to assist in maintaining homeostasis. One such example of these homeostatic mechanisms is the hypothalamic-pituitary-gonadal (HPG) axis. The HPG axis is responsible for the regulation of hormonal activities regarding reproductivity and endocrine activity (Janes & Schermer, 2020). The overall mechanism of the HPG axis involves the hypothalamus releasing gonadotropin-releasing hormone (GnRH), causing the pituitary to release luteinizing hormone (LH) and follicle-stimulating hormone (FSH). The release of these two hormones ultimately leads to the gonads releasing testosterone, estrogen, and progesterone (Figure 1; Ortiz et al., 2022; Russell & Coghill, 2015). Any changes in any stage of the HPG axis generate a counteractive outcome. For example, an increase in LH and FSH levels causes a negative feedback loop in the hypothalamus which will slow down the production of GnRH (Blair et al., 2015).

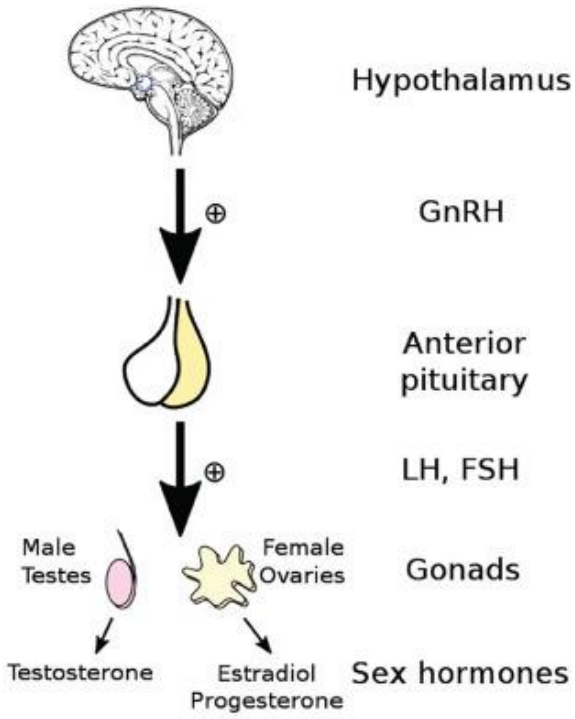

Figure 1. The Schematic Mechanism of the Hypothalamic-Pituitary-Gonadal (HPG) Axis (Ortiz et al., 2022)

The HPG axis connects the brain and the reproductive system. Therefore, when there is a change in a factor pertaining to the brain, it could adversely affect various components of the reproductive system. The same is true for the opposite situation. If there is a change in a factor pertaining to the reproductive system, then it could affect something within the brain. During puberty and early adulthood, most young adult male and female bodies are maturing. Throughout this period, their hormone levels fluctuate constantly with the development of the gonads and the reproductive nature of maturing men and women (Breehl & Caban, 2022). Testosterone, estrogen, and progesterone are the main hormones that influence the hormonal cycles of their daily lives. Even though both males and females are developing, the hormonal cycles between the sexes are quite different from each other (Childs et al., 2010; Eisenbarth, 2019).

To begin, the male hormonal cycle is responsible for spermatogenesis, fertility, and testosterone production. After the HPG axis has run its course from the brain to the male gonads, two separate types of cells further the male reproductive cycle. Leydig cells from the testes produce and release testosterone, while Sertoli cells produce immature sperm cells. Once the sperm cells have been cultivated, the cells undergo meiosis I and II, meaning that they divide twice, in order to produce four mature sperm cells each. The literature has described the male hormonal cycle in two different manners: seasonal and diurnal, meaning that it occurs over a span of 24 hours (Dadín, 2009; Lee & Lee, 2021).

The hormone that plays the biggest role in the male hormonal cycle is testosterone. For many men, testosterone reaches its peak around the age of 17 to 18, and it stays somewhat consistent at that level for the next few decades (Harvard Health, 2008). This hormone is responsible for regulating the sex drive, muscle mass, strength, fat distribution, bone mass, development of sperm, and production of red blood cells in males (Wein, 2016). Additionally, testosterone is a key contributor when it comes to mood, behavior, and self-perception (Zitzmann, 2020). Research showed that testosterone is correlated with aggression, mating, sexuality, and other behaviors related to challenging others (van Anders, 2013). Therefore, fluctuations in this reproductive hormone can greatly affect how males feel and act.

As previously described, the male hormonal cycle is often defined as diurnal because testosterone levels fluctuate throughout the day. Some research demonstrated that testosterone levels are higher in the morning and lower in the evening (Dadín, 2009; Nassar, 2022). An older study claims that testosterone levels for males in their early 20s is often higher during the hours of 8am and 4pm (Resko & Eik-nes, 1966). The only other evidence that we have for this idea

originates in the medical field. When males plan to get a blood test to either monitor or check their testosterone levels, physicians recommend a morning blood draw (Graf, 2019). They receive the best testosterone readings between the hours of 8am and 10am, and the accuracy of the readings decline as the day progresses (Crawford et al., 2015; Figure 2). This suggests that testosterone is most abundant in the morning and less prevalent later in the day.

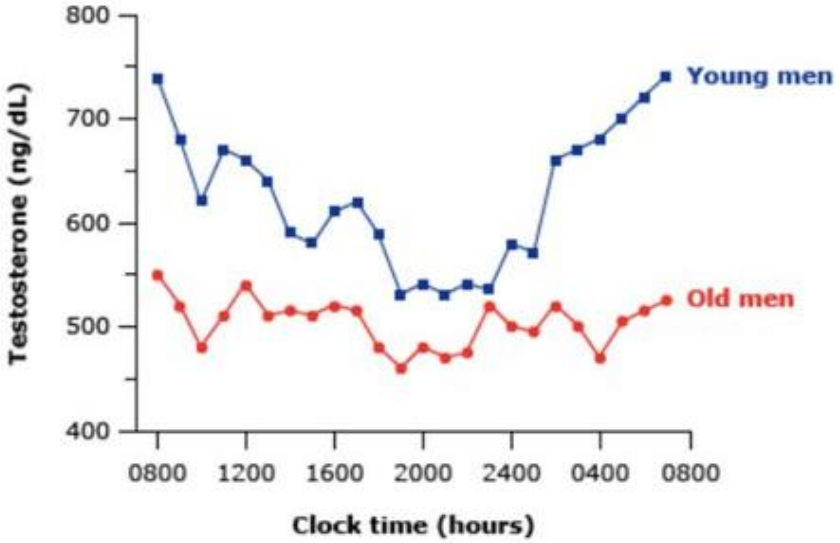

Figure 2. Diurnal Cycle of Testosterone Secretion (Bremner et al., 1983)

There is less evidence for seasonality in the testosterone cycle. Some sources state that testosterone levels are higher in the fall and lower in the spring (Kimura & Hampson, 1994; Sanders et al., 2002). However, another study found that testosterone levels were at their highest during January and the lowest in May (Lee & Lee, 2021). This research is inconsistent across the board because there is not much research that pertains to male hormonal cycles.

Compared to the simplicity of the male hormonal cycle, the female hormonal cycle is more complex. The entire female hormonal cycle typically lasts around 28 days (about 4 weeks)

and is comprised of two smaller cycles: the ovarian cycle and the uterine cycle (Figure 3; UCSF Health, 2022). The goal of the ovarian cycle is to prepare the egg for fertilization. Within the ovarian cycle, there are three phases: follicular, ovulation, and luteal. The follicular phase is where the egg matures within the ovary during the first 13 days. At the end of this phase, there is a surge in LH that stimulates ovulation. On day 14, the egg bursts from the ovary and travels down the fallopian tube. The luteal phase occurs from days 15 through 28 and is characterized by a dramatic drop in estrogen levels. Here, the corpus luteum, which helps sense whether a woman is pregnant, degenerates (Reed & Carr, 2018; Warren et al., 2021).

The uterine cycle occurs simultaneously with the ovarian cycle. The goal of the uterine cycle is to prepare the uterine wall for the fertilized egg and shed the lining of the uterus if a woman does not become pregnant. Within the uterine cycle, there are three distinct phases: menstrual, proliferative, and secretory (Libretexts, 2022). The first five days is defined as the menstrual phase. Often referred to as the menstrual period, this phase is where the uterine lining is shed and is characterized by cramps, bleeding, and other symptoms. The proliferative phase occurs from days 6 through 13 and is the process in which the lining of the uterus thickens and secretes mucus to assist sperm so that they can reach the egg in the fallopian tube for fertilization. The secretory phase occurs from days 14 to 28. During this phase, there is a rise in progesterone, which allows for the production of thicker mucus to help the egg implant into the uterus. Unlike the diurnal male hormonal cycle, the female hormonal cycle occurs monthly, which means that the behaviors and habits of females change over the course of 28 days (Thiyagarajan et al., 2022).

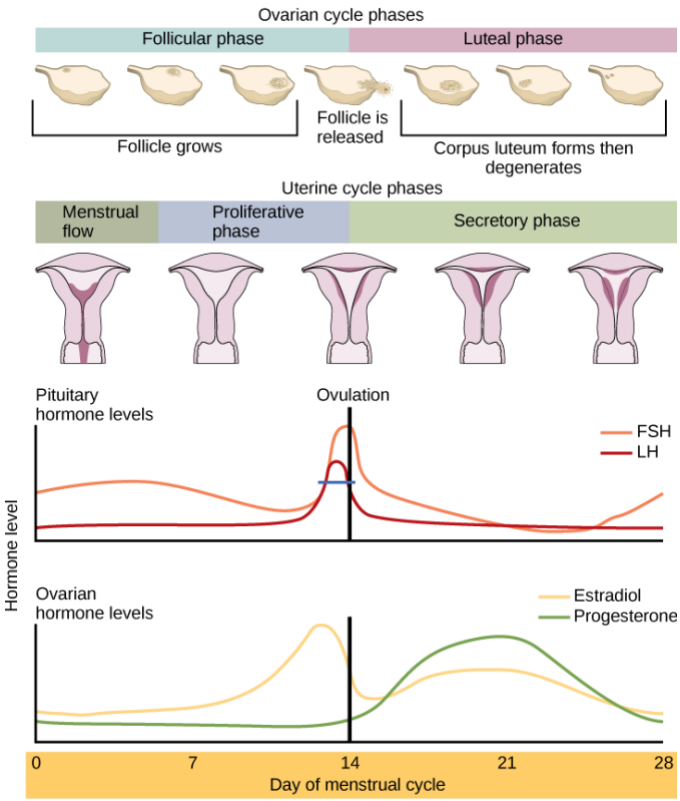

Figure 3. The Female Hormonal Cycle (Warren et al., 2021)

During the female hormonal cycle, there are two hormones that drive the changes that occur within the female body. The first is estrogen, which is primarily produced by the ovaries in order to regulate the menstrual cycle. It works in conjunction with other hormones, such as progesterone, to alter the physical characteristics of maturing young women, assist females' ovaries in releasing an egg during ovulation, and prepare the lining of the uterus for thickening (Cleveland Clinic Medical, 2022). Estrogen is responsible for changes in the hormonal cycle and can also affect "the urinary tract, the heart and blood vessels, bones, skin, hair, mucous membranes, pelvic muscles, and the brain" (Johns Hopkins Medicine, 2022). Without estrogen, many bodily systems could become imbalanced, leading to conditions and disorders that could alter the lifestyle and course of someone's entire life.

In addition to estrogen, progesterone is another hormone that plays a role in the female hormonal cycle. It is responsible for preparing the uterine lining for implantation and maintaining the pregnancy if the woman becomes pregnant. The presence of progesterone is essential to the female hormonal cycle because without it, there is a surplus of estrogen which causes many problems regarding fertility, immunity, and myelin proliferation in the nervous system (Cable & Grider, 2023).

Most students are approaching or are in their collegiate years during late puberty and early adulthood. Memory is a key factor for college students because it is what allows them to store and remember everything that they have learned. There are two main types of memory: short-term and long-term. Short-term memory allows students to remember information for a short period of time. Long-term memory, on the other hand, is long-lasting and can be stored for an unlimited amount of time (University of Queensland, 2018). One of the goals of college is to enhance students' long term memory capabilities so that they can carry the knowledge that they gained into future experiences and situations.

Memory is analyzed and stored in the brain. When we take in information, it first travels to the thalamus where it is relayed to the appropriate parts of the brain (Aggleton et al., 2010). For memory, the portion of the brain that is responsible for storing and retrieving information is the hippocampus. The hippocampus is located in the central part of the brain within the temporal lobe. Buried deep inside the brain, the hippocampus is heavily involved in the functions of learning and memory. There are direct connections between the hippocampus and the prefrontal lobe, which is responsible for executive functions, decision making, memory, and emotions (Anand & Dhikav, 2012). The prefrontal cortex plays a huge role in the processes of storing and

retrieving memory. When it comes to making decisions or planning something out, we utilize our memory to help us arrive at a solution (D'Ardenne et al., 2012). This interaction between the prefrontal cortex and the hippocampus is what allows this process, which also makes things like recognition and working memory easier to achieve (Funahashi, 2017). Therefore, there is a need for a balance between these brain structures in order to encode and retrieve information essential to everyday life, especially for those who are learning and being tested on a daily basis like college students.

Immediately next to the hippocampus is the amygdala. The amygdala is an almond-shaped structure that is also found in the temporal lobe. Its primary responsibility is mood regulation, more specifically managing feelings of anxiety, fear, and aggression (AbuHasan et al., 2023). Since the amygdala is located directly next to the hippocampus, it also plays a role in attaching emotional significance to memories (Queensland Brain Institute, 2018). When you think about your most fond memories, there is usually an emotion associated with each one. Memories pertaining to Christmas morning are typically associated with feelings of excitement and happiness, while memories of failing a test can be associated with feelings of disappointment and sadness. Adding an emotional connection to memories can aid in retention and memory retrieval, especially when it is related to stressful stimuli (Rajmohan & Mohandas, 2007).

It would be easy to assume that everything related to memory is solely focused within the hippocampus because that is what most people are taught in school. However, contrary to belief, memory is a very complicated process that involves many parts of the brain, such as the amygdala and prefrontal cortex. Additionally, there are many things that can affect this process, with stress being one of them. The hippocampus contains the largest density of glucocorticoid

receptors, which are the end products of the stress response (Nicolaides et al., 2020). This means that the hippocampus is very sensitive to the presence of glucocorticoids and stress in general (Conrad, 2008). The hippocampus is also in close proximity to the amygdala, which also contributes to the idea that memory is modulated by stress.

Even though higher education is beneficial to students, it is also a stressful time in students' lives (Barbayannis et al., 2022). The reasons most undergraduate students attend college are for the educational and career elements. Because of the desire to succeed in both of these aspects, many want to excel and be extremely successful in the classroom (Schultz & Higbee, 2007). The academic rigor of higher education is more demanding than high school, with many students being responsible for balancing a tough class load, a job, a social life, a new living situation, and other factors which can often lead to overwhelming feelings, loneliness, and depression (Krendl, 2023; Mofatteh, 2020). Even though students have a lot on their minds, the thing that causes the most stress is the work assigned for the classes that they are taking. Stress levels in college students are especially high due to constant worrying regarding their grades, fear of failing, and upcoming exams (Spiljak et al., 2022).

Feelings of stress, pressure, and tension are our body's way of responding to hurtful or threatening stimuli. Like the HPG axis mentioned earlier, the hypothalamus-pituitary-adrenal (HPA) axis is another technique that our bodies utilize to maintain homeostasis. While the HPG axis is responsible for regulating hormonal activities, the HPA axis is in charge of the stress response in the human body. The overall mechanism of the HPA axis begins in the hypothalamus when it releases corticotropin-releasing hormone (CRH), which leads the anterior pituitary to release adrenocorticotropic hormone (ACTH). This ultimately causes the adrenal glands to

release cortisol, a hormone associated with stress (Figure 4; Henley, 2021; Plusquellec, 2013; Sheng et al., 2021). Cortisol is often regulated by a system known as the glucocorticoid feedback inhibition. If there are high levels of glucocorticoids in the circulatory system, the hypothalamus and pituitary respond by inhibiting their production of either CRH or ACTH (Smith & Vale, 2012). This mechanism prevents certain hormones from rising too much, and it allows the body to compensate accordingly based on the response that someone is having.

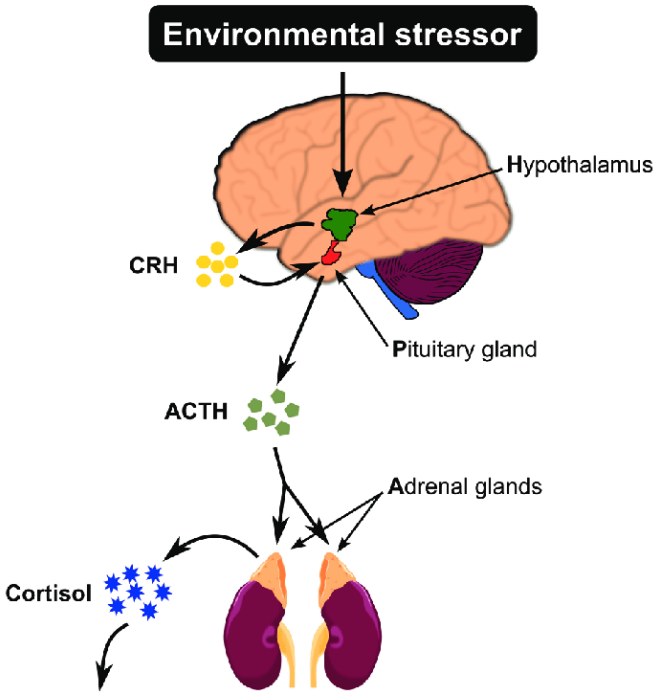

Figure 4. The Schematic Mechanism of the Hypothalamic-Pituitary-Adrenal (HPA) Axis (Plusquellec, 2013)

Another mechanism in which the body responds to stress is the sympathetic adrenomedullar (SAM) axis. Like the HPA axis mentioned above, the SAM axis assists in maintaining homeostasis and quickly responding to stressful stimuli. The mechanism of the SAM axis begins in the spinal cord which will release acetylcholine (ACh) that will travel

through sympathetic neurons to the chromaffin cells of the adrenal medulla. From there, the adrenal medulla will release epinephrine and norepinephrine into the bloodstream, which will then travel through the entire body (Baritaki et al., 2019; Folk, 2022; Figure 5). While the HPA axis is a slower process, the SAM axis is a fast-acting response that can yield almost immediate results (Sharpley, 2009). Epinephrine and norepinephrine have a lot of receptors present in the central nervous system and other systems throughout the body, meaning that they have more of a chance to bind to the receptors and activate a response (Chu et al., 2022). With mechanisms like the HPA and SAM axes in place, the human body is able to react to stressful stimuli or situations by initiating bodily actions in order to help us cope and recover from our daily experiences.

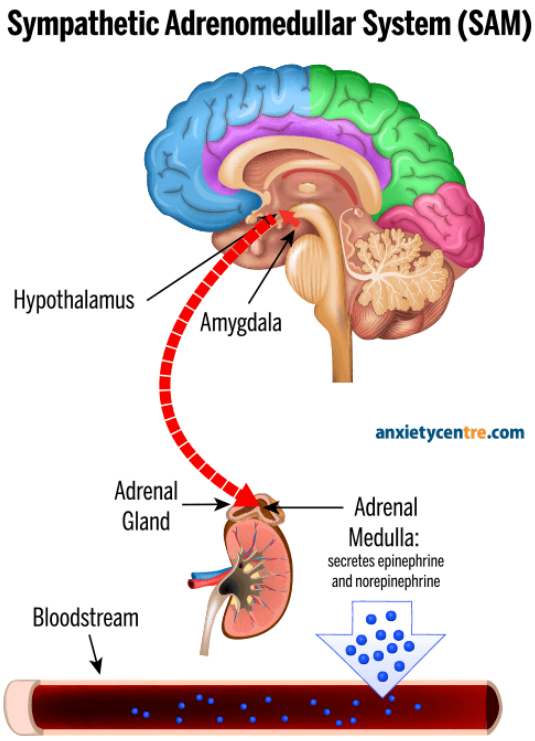

Figure 5. The Schematic Mechanism of the Sympathetic Adrenomedullar (SAM) Axis (Folk, 2022)

Stress causes the body to react to various situations as if it were a do-or-die situation, resulting in the fight-or-flight response (Wallenstein, 2003). This concept is most relevant in the context of survival. When a person experiences a stressful or threatening situation, their body reacts in order to help them either conserve energy and focus on essential tasks or flee from the task at hand to survive. For example, when we feel like we are being attacked by another person, we shift the way we move, act, and feel so that we can focus solely on surviving. This natural tendency puts us on high alert, causing an increase in heart rate, a rise in blood pressure, dilation of the pupils, blood being shunted to the legs, and an inhibition of digestion (American Heart Association, 2022; Dimitriev et al., 2008; Goldstein et al., 2010). Our bodies react in this manner every single time we feel stressed, even if our lives are not in danger. In today's day and age, people tend to feel the most stressed when they feel like they are under lots of pressure, are facing big changes in their lives, are worried about something that is out of their control, or are even being overwhelmed with things that occur during their daily life (Mind, 2022).

The overall concept of stress is beneficial to the lives of humans in general. This fight-or-flight response is put into action in order to keep us all alive and safe. Without it, people would be unaware of danger that surrounds them, and that could negatively affect their likelihood of survival as a result. However, like many things throughout our world, some factors are only advantageous to a certain point. Too much stress puts the health of many people at risk and often contributes to long-term problems with anxiety, depression, heart disease, high blood pressure, sleep, and memory (Mayo Clinic Staff, 2023a). When someone in the fight-or-flight response is only experiencing it for a short amount of time, it sharpens their memory so that they can make quick decisions and develop an emotional connection to the stressful stimuli in order to be able to remember the situation better in the future (Yaribeygi et al., 2017).

Even though small amounts of stress are beneficial to memory, too much stress can have a detrimental effect on memory, causing drastic declines in memory recall, memory retrieval, and other cognitive patterns (Cohen et al., 2020; Klier & Buratto, 2020). Chronic stress directly affects the HPA axis, which is the pathway that is responsible for the fight-or-flight response. Being exposed to high levels of stress is harmful, especially as the brain is developing (McEwen, 2011). The brain develops until the age of 25, and the end of this process typically occurs during the collegiate years. If college students are experiencing chronic stress as they are growing older and maturing, there could be long-term effects on many aspects of their everyday lives, such as their ability to control their behaviors, excel cognitively, produce and release gonadal hormones, and maintain physiological homeostasis (McCormick & Mathews, 2010). When someone's body is used to being on high alert all the time, that is what their body expects to feel all the time. Therefore, this cycle continues to repeat itself until someone or something intervenes.

The HPG and HPA axes may be separate pathways within the human body, but they can interact to cause changes in our daily lives. These are both responsible for different mechanisms, with the HPG axis controlling reproductive hormones and the HPA axis controlling the fight-or-flight response. However, stress can greatly affect the success and the effectiveness of the HPG axis. Literature shows that an increase in cortisol inhibits the overall system of the HPG axis (Rivier et al., 1986; Ullah et al., 2021). In females, cortisol inhibits the release of LH which has downstream effects (Saketos et al., 1993). With a decrease in LH, estrogen and progesterone levels will also decrease. In males, there are similar effects. Increased cortisol prevents the release of testosterone from the testes in males (Hayashi & Moberg, 1987). Therefore, too much stress is associated with lowered levels of reproductive hormones within the body and a decline in reproductive success.

In addition to affecting people on a physical level, stress also alters their mood patterns because it has a hormonal effect on the brain. When we are scared or feel threatened, the brain releases different neurotransmitters, such as cortisol, dopamine, epinephrine, and norepinephrine, that trigger feelings of anxiety and overwhelming stress (Kumar et al., 2013). For college students in particular, fearful thoughts and emotions while in the classroom can create stress significant enough to impact learning (Bledsoe et al., 2018). A lot of pressure is put on students to succeed, which can cause worrying feelings to arise, leading to academic stress (Sprung & Rogers, 2021).

Besides stress, reproductive hormones are also a factor in determining levels of memory performance. Some research has demonstrated that variations in cognitive functions could be correlated with fluctuations in hormonal levels (Carpenter, 2001; Dadín et al., 2009; Sundström Poromaa & Gingnell, 2014). Additionally, one study found that the brain structure of menstruating women can slightly change as a result of various levels of hormones. Increased FSH and progesterone were correlated with greater cortical thickness, more gray matter, and an overall increase in brain matter volume (Sohn, 2023). Multiple studies discovered that women performed better on memory tasks when they had high estrogen levels (Kimura & Hampson, 1994; Sanders et al., 2002). On the other hand, the male hormonal cycle also affects males' memory performance and cognitive patterns. High levels of testosterone have been associated with higher brain activation, productivity, and cognitive performance because testosterone targets the amygdala and hippocampus regions (Ackermann et al., 2012; Heany et al., 2016). Higher scores on spatial and memory tasks were reported when testosterone levels were also high (Kimura, 1999; Sanders et al., 2002).

Hormonal cycles also have a huge effect on mood. Fluctuations in reproductive hormones like estrogen and progesterone greatly influence mood based on what phase of their hormonal cycle females are in. Healthy women reported better moods and increased energy levels right after their menstrual period in the follicular phase as a result of high estrogen levels (Handy et al., 2022). During ovulation, females typically experience a lower mood because of a sudden drop in estrogen. Females may experience low mood and depression during their luteal phase (Brighten, 2022).

Previous studies show that hormone levels could influence memory performance as well as stress levels (McEwen, 2012). Women who have high levels of estrogen and low levels of progesterone have less frequent declines in memory performance, meaning that their memory is slightly better than those who have low estrogen and high progesterone levels (Cohen et al., 2020). Research also shows that the trends between epinephrine levels fluctuate in association with different phases in the female hormonal cycle. There is a slight increase in epinephrine levels in both the follicular and luteal phases of the female hormonal cycle, suggesting differences in stress levels (Gordon & Girdler, 2014).

From the research that I have gathered thus far, it is evident that there are variations in memory and hormones throughout the female hormonal cycle. With women in the education system today, it makes me wonder how the education system came about and how its history has influenced the way that it runs today.

CHAPTER 3: THE AMERICAN EDUCATION SYSTEM: MADE FOR MALES?

The education system has been a part of the American lifestyle since its initial founding by the British in the late 15th century. Prior to its establishment in the United States, the idea of an education system was present throughout the world, but it was unlike how we experience it today. For indigenous people living in the United States before the arrival of Columbus in 1492, their main focus through their method of education was to teach survival skills to their young so that they could live and reproduce (Juneau, 2001). Everyone in their community had a distinct role to play, so they were taught how to be successful in their role. Since then, the Puritans settled on this land, and they created a civilization from which they could grow. One of the first things that they decided to focus on was their method of education. While the education system began with each town having its own small schoolhouse, it changed to large school communities where many people sat in a classroom to learn, similar to what we experience today. This aspect of the education system mainly included primary and secondary education, up until the end of what we would call 12th grade (Judd, 1935).

The idea of higher education and college was not prevalent until the early 17th century. Even though civilization was present in the United States since 1497, the settlers developed higher education only when the rest of their society's structure was more stable. They did have primary and secondary institutions scattered throughout the colonies, but they did not develop any colleges until many years later. In 1636, the Puritans founded the first college: Harvard College, which was a liberal arts institution at this time (Early American Colleges). The institution of higher education was initially developed to preserve Christian civilization and promote its interests (Ford, 2017). The early days of American education were dominated by

religious motivations and ideations because of the need for teaching the next generation about their beliefs and roots. As years passed, more institutions were founded and developed across the United States with 49 colleges in 1819 and 289 in 1859 (Goldin & Katz, 1999).

Although the number of American colleges increased, formal schooling was heavily restricted to wealthy males, resulting in the exclusion of women from all forms of higher education (Rose, 2018; University of Minnesota Libraries, 2016). For years, women of all ages were denied the right to education. Instead of being accepted in academic settings, they were restricted and expected to play a different role in society. Women were required to stay home and take care of the household. Their responsibilities consisted of cooking, cleaning, and caring for children. While men had the flexibility to work, attend school, and gain additional knowledge, women were left at home and were forced to essentially depend on men for everything (Ryan, 2019).

Following years of being excluded, women began getting tired of being stuck at home, so they decided to fight for their right to be educated. This led to them being allowed to enter into primary and secondary education in the mid-18th century. As women increased their presence in the classroom, they slowly started to build their way up to being accepted in higher education settings. In 1789, women were finally granted admission into colleges and this newfound equality introduce both sexes into education. However, women were only allowed to attend between the months of April and October (Cheney). It was not until the mid-19th century that women began to attend and participate in higher education (Women's College Coalition). Instead of being restricted to a few months out of the year, women were being encouraged to attend for full school years. As a result, there was a development of women's colleges for the purpose of

engaging women in intellectual conversations. In 1837, Oberlin College was the first college in the United States to admit female students full-time, which was more than 200 years after the founding of Harvard College (Chamberlain).

Beginning in the late 19th century, the goal of higher education shifted from preserving Christian civilization to advancing the national interest. At this point in history, the government was trying to advance the nation industrially and politically. The government passed the Morrill Acts of 1862 and 1890, which distributed federal land for the sole purpose of building colleges. In order to receive the funds, the only condition that the future institution had to abide by was that they would specialize in agriculture and mechanical arts (National Archives and Records Administration). As a result, this became the overall purpose of higher education during this time period. The importance of chemistry, physics, agriculture, and manufacturing turned into topics that were needed on a daily basis, and because of this, there was a greater demand for trained scientists (Goldin & Katz, 1999). The focus on practical arts in higher education was developed to help assist the industrial and political goals of the United States.

Moving into the early 20th century, the need for specialization and rigorous scientific training increased, thus shifting the focus of higher education once again. Even though higher education began as a means of teaching and learning, research was introduced into higher education, and it became one of the sole focuses. These newfound colleges referred to as "research universities" came about for the cultural benefit of society (Ford, 2017). It was now possible for students and professors to engage in an overall learning community while also conducting various research projects during school hours. Higher education was utilized to advance technology as well as the knowledge that students could gain.

With this in mind, World War I and World War II had a huge impact on the American education system. As a result of an increased need for military weapons and technological improvements, there was a huge push for more educated, qualified adults. Additionally, US leaders had noticed that the veterans returning from war would become unemployed after the end of WWII. Therefore, they created the Serviceman's Readjustment Act of 1944, also known as the GI Bill. This bill allowed veterans to get jobs, buy homes, and attend college because of increased federal aid (National Archives and Records Administration, 2022; U.S. Department of Defense, 2019). The Civil Rights Movement also influenced the foundation of higher education in the United States. President Lyndon B. Johnson passed the Civil Rights Act of 1964, which prohibited any form of discrimination in the education system (Davis, 2022). Thus, this encouraged people from all different races, sexes, religions, and national origins to attend higher education (U.S Department of Education, 2020).

Consequently, college enrollments soared immediately after WWII (University of Minnesota Libraries). However, this created a widespread problem because it limited those who could attend. By the 1940s, there was a huge discrepancy between those who could afford college and those who could not (Goldin & Katz, 1999). Starting in 1837, higher education was a public good that was available to majority of the American population. However, it shifted to become more like a private good, one that was only available to those that could afford it (Ford, 2017). Consequently, this led to a massive inequality in the number of enrolled undergraduates. In 1947, there was still a gender imbalance between male and female college students, with a ratio of 2.3 men to every woman (Goldin et al., 2006).

Higher education was dominated by males, which often deterred women from pursuing further schooling past secondary education. The purpose of the institution of women's colleges was to combat this gender imbalance within higher education. Even though it could not be used as a clear solution, it helped encourage more women to attend college and give them an environment where they felt comfortable to learn and collaborate with their peers. By 1960, 230 women's colleges existed throughout the United States (Women's College Coalition). Because of this, the attendance of women in college began to skyrocket, resulting in women exceeding men's enrollment in the late 1970s (Women's College Coalition). However, women were limited to a few fields that they could study, including education, nursing, English, art, and home economics (Jacobs, 1996). Even though they were able to attend college, they did not have as many fields to choose from, unlike men. As the years passed, women began to have more choices when it came to what they wanted to study, so they were able to try other specialties. Since then, the number of women's colleges has declined until 2014, with only 47 women's colleges being in existence (Women's College Coalition). The decline of women's colleges in recent years is most likely due to the acceptance of women in formerly all-male colleges and universities. There was a decreased need for women's college because they were enrolling in co-ed institutions and excelling there.

The education system is essential for the way that the world runs today. In this day and age, the goal of education in general has changed again, but this time, its aim is to grow the global economy. Now that the United States has become one of the world's powerhouses, it is important that they stay on top. Higher education plays this role because it is producing the future generations that will take over eventually. Today, some may argue that the purpose of colleges and universities is purely economic because of the recent development of for-profit

universities (Ford, 2017). In order to receive a lot of funding from the government, some colleges and universities are expected to conduct various research projects and produce results that could contribute to what we already know about certain topics. This causes competition between institutions so that they can be the best at what they do. Who will discover something first? Whose name or names will be tied to the success of the project? Who will be considered the best of the best?

Even though the first college was founded 1636, it took centuries for women to have the opportunity to attend alongside men. The education system was developed as a means of furthering the national agenda, but it only allowed men to do so. Women were hindered from learning and increasing their knowledge for so long, but finally, they were given an equal chance to be successful academically. As higher education became more available to women, there was a dramatic increase in enrollment, resulting in higher percentages of women in education. By the early 2000s, women and men were found in almost equal amounts. As of 2021, men made up around 41 percent of the students attending college (Liu et al., 2022). Men are now the "minority" in higher education because women outnumber them (Liu et al., 2022).

This so-called "gender crisis" seems to be a widespread problem now, according to some sources (Reeves & Smith, 2022; The Chronicle of Higher Education, 2023). However, where was this language for women? There was never a crisis when women were being fully excluded from education altogether. It made sense when women could not attend school, but once men are in those shoes, there is panic. Just because women are the majority, there needs to be a solution to this problem. This directly demonstrates how education began as a means to benefit men and not women. There only seems to be problems when it does not go in their favor. And even

though there is now an overrepresentation of women in higher education according to statistics, women are still underrepresented in the workforce (Liu et al., 2022).

In society today, there has been a huge shift when it comes to earning and maintaining jobs, and this directly correlates with the education system. College degrees are more important than ever. Graduating with a college degree improves future career opportunities and opens a lot more doors than if you did not have a degree (Krakoff, 2023). Lately, it has become much more common that jobs require an education level of a bachelor's degree to even be considered for the position (Krakoff, 2023). Having those extra credentials seems to give applicants a slight advantage when trying to get a job or get promoted within their company. Therefore, young adults are encouraged to at least complete a bachelor's degree. It would look better on their resumé to have a master's degree or PhD, but at this point, a four-year degree seems like the bare minimum.

The education system is a longstanding structure that has persisted through the years and benefited those who were able to engage in it. However, it started out as a means of expanding the knowledge of men. Women were excluded from not only higher education but also the overall education system itself. For years, men dominated the educational world, while women were left behind. The system that was designed for men by men has contributed to social and societal impacts as a result. By hindering women from contributing to higher education in the first place, it created an environment where women did not feel wanted. It prevented women from expressing their opinions and perspectives in academia. It was easy for women to not feel wanted, and many felt as though they were inferior. Keeping women out of the education system promoted the idea that women were not capable of "keeping up with men." This was also what

caused the development of the achievement and gender gaps that are still present today (Eisenmann, 2006). It is evident that because of these ideas, our society tends to favor men even when it tries not to (Llorens et al., 2022).

Therefore, how can women possibly thrive in a world where they never had a chance in the first place? If the education system was designed by men for men, was there any implicit bias that contributed to its structure so that they can be successful? As women, since we have a different hormonal cycle than men, how does that impact our success in the classroom? This is what sparked my curiosity in this topic. I wanted to better understand how women have been impacted by this structure of higher education. As a result, I decided to run a study at the university that I attend to see how women, many of which were my peers, are affected by these ideas.

CHAPTER 4: THE ROLE THAT HORMONAL CYCLES AND STRESS PLAY IN THE LIFE OF FEMALE COLLEGE STUDENTS

Section 1: Introduction

Creating a balance within the human body is an essential mechanism in maintaining homeostasis. The Hypothalamic-Pituitary-Gonadal (HPG) axis is responsible for the regulation of hormonal activities regarding reproductivity and endocrine activity (Janes & Schermer, 2020). During puberty and early adulthood, hormone levels fluctuate constantly with the development of the gonads and the reproductive nature of maturing men and women. Testosterone, estrogen, and progesterone are the main factors influencing the hormonal cycles of our daily lives (Breehl & Caban, 2022; Russell & Coghill, 2015). For women, their hormonal cycle lasts around 28 days and is comprised of two smaller cycles: the ovarian cycle and the uterine cycle (UCSF Health, 2022). The goal of the three phases of the ovarian cycle is to prepare the egg for fertilization, while the goal of the three phases of the uterine cycle is to prepare the uterine wall for the fertilized egg and shed the lining of the uterus if a woman does not become pregnant.

Most females are in college during early adulthood when their hormonal cycle is at its peak. College is the time when undergraduate students attend classes to expand their knowledge, so many want to receive good grades and be successful in the classroom (Schultz & Higbee, 2007). Higher education is also when many students are on their own for the first time in their lives. Therefore, they adjust in order to balance school, a job to make money, a social life with new friends, and more. As a result, they can experience a lot of stress in their daily lives. A lot of pressure is put on students to succeed, which can cause worrying feelings to arise, leading to academic stress (Sprung & Rogers, 2021). Stress levels in college students are especially high

due to constant worrying regarding their grades, fear of failing, and upcoming exams (Spiljak et al., 2022). Stress causes the body to react to various situations as if it were a do-or-die situation, resulting in the fight or-flight response (Wallenstein, 2003). The fight or flight response puts us on high alert, increases our blood pressure, makes our heartbeat faster, and sharpens our memory (American Heart Association, 2022; Dimitriev et al., 2008). Small amounts of stress are beneficial to memory performance; however, too much stress can have a detrimental effect on memory, causing drastic declines in cognitive processes like memory recall, memory retrieval, and reading comprehension (Cohen et al., 2020; Klier & Buratto, 2020).

Furthermore, stress can also influence the mood of college students. The brain releases various neurotransmitters, such as cortisol, dopamine, epinephrine, and norepinephrine in response to feelings of anxiety and overwhelming stress (Kumar et al., 2013). Therefore, this could lead to fluctuations in reproductive hormones like estrogen and progesterone. Based on the phase of their hormonal cycle that females are in, they could experience different moods, such as better moods in the follicular phase and worse moods at the end of the luteal phase (Handy et al., 2022). These changes in reproductive hormones can also influence memory processes (Carpenter, 2001; Dadín et al., 2009; Sundström Poromaa & Gingnell, 2014). Women sometimes perform better on memory tasks when they have high estrogen levels and low levels of progesterone (Cohen et al., 2020; Kimura & Hampson, 1994).

Other previously published literature has focused on the interaction between physical hormone levels and stress levels. In many of the studies, the data measured estrogen and cortisol levels. My goal, however, is to examine whether it is possible to obtain the same findings with a self-reported study. Most published studies tightly control every aspect of their experiments by

implementing hormone-detecting tools, using distinct cognitive measures, and excluding participants who were on hormonal birth control (Childs et al., 2010; Klier & Buratto, 2020). These factors are ideal to increase the internal validity of a study, but it does not take into account the external implications. There are a lot of young women in today's world who are currently on some sort of hormonal birth control. According to the CDC, around 65% of women between the ages of 15 to 49 were using at least one method of hormonal contraception in 2017 (Daniels & Abma, 2018). Since then, the idea of safe sex and using contraception has become slightly more socially acceptable to discuss, so people are utilizing it more. Not including things like hormonal birth control in a study about female hormonal cycles seems odd because it is widely used, so excluding that factor could not only limit the sample size of a study, but it could also affect the overall data that researchers could collect. The goal of birth control is to prevent a female from getting pregnant, whether it is by hindering the ovaries from releasing the egg during ovulation, making it unlikely for the egg to implant into the uterus, or prevent sperm from ever reaching the egg in the first place (Office on Women's Health, 2022).

Even though the main reason why hormonal birth control is prescribed is for contraception, it also can serve other purposes. 14% of women are given hormonal birth control to regulate menstrual-related pains, irregular menstruation, acne, menstrual-related migraines, excess testosterone, and hirsutism (Cooper et al., 2022; The ESHRE Capri Workshop Group, 2005). Additionally, hormonal birth control can be utilized as a prevention or treatment for certain diseases and disorders, such as premenstrual syndrome (PMS), dysmenorrhea, polycystic ovarian syndrome (PCOS), endometriosis, pelvic inflammatory disease (PID), rheumatoid arthritis, multiple sclerosis (MS), ovarian cancer, benign breast disease, colon cancer, and endometrial cancer (Schindler, 2013). There are many uses for hormonal birth control in this day

and age; therefore, it is not uncommon that if you ask someone that you know, there is a pretty high chance that they will confirm that they take it. Between 2017 and 2019, about 65% of women between the ages of 15 and 49 were using some type of hormonal birth control (Daniels & Abma, 2020). Whether it was for contraceptive or non-contraceptive reasons is unclear, but what is clear is that hormonal birth control is being widely utilized as a method for preventing, regulating, or treating something.

Therefore, my goal was to include women on hormonal birth control and analyze measures of academic success in order to investigate whether these studies could also be applicable in real-world situations in addition to a controlled environment. It was also important to acknowledge factors that were present in our everyday lives because they do affect how we look, feel, and act. Thus, this increased the external validity of my study which has not been seen in the literature. My study aimed to educate participants with the ultimate goal of making them aware of how their hormone levels could affect their everyday activities. This study recruited female college students in particular so that they can know how to plan ahead when it comes to being successful in the classroom.

In the study that I conducted, the independent variable was hormonal cycle phase with three levels of menstrual, follicular, and luteal. The dependent variables were reading comprehension as measured by number of questions answered correctly and mood. I also measured stress levels by analyzing the number of assignments that students had during the previous week, heart rate, and respiratory rate for each participant.

For the first dependent variable, reading comprehension, I hypothesized that there will be a main effect of hormonal cycle phase on reading comprehension in that women in the follicular

phase will have the best reading comprehension while women in the menstrual phase will have the worst reading comprehension. I also hypothesized that there will be a main effect of stress on reading comprehension in that women who are not stressed will have better reading comprehension than women who are stressed. Lastly, I hypothesized that there will be an interaction effect between hormonal cycle phase and stress on reading comprehension in that women who are not stressed during their follicular phase will have the best reading comprehension while women who are stressed during their menstrual phase will have the worst reading comprehension.

For the second dependent variable, mood, I hypothesized that there will be a main effect of hormonal cycle phase on mood in that those who are in their follicular phase will have the best mood while those in their menstrual phase will have the worst mood. I also hypothesized that there will be a main effect of stress on mood in that those who are not stressed will have better moods than those who are stressed. Lastly, I hypothesized that there will be an interaction effect between hormonal cycle phase and stress on mood in that women who are not stressed during their follicular phase will have the best mood while women who are stressed during their menstrual phase will have the worst mood.

Section 2: Methodology/Protocol

Subsection 1: Participant Recruitment

I recruited college-aged students from Regis University in Denver, Colorado. I recruited participants by word of mouth and social media to any of the following populations: friends, classmates, or other students. In order to participate in the study, every individual needed to be a Regis University student, over the age of 18, and have a menstrual cycle. The exclusion criteria

for participation in this study were the male population and medical conditions related to the reproductive system, such as endometriosis, amenorrhea, polycystic ovary syndrome (PCOS), and early menopause.

Additionally, I recruited participants from the General Psychology and Neuroscience Subject Pool, and their participation either fulfilled a course requirement or earned extra credit for their participation. In certain introductory courses, students are required to complete research credits, which helps them learn about research in the field of Psychology or Neuroscience. In some other courses, students can receive extra credit for completing research credits. Research credits can be earned by either participating in a research study that takes up to one or more hours, or by reading a brief article and writing a one-page summary of the article, as an equitable alternative to the research participation since it should also take less than one hour to complete. Other students participated as volunteers, so they received nothing in return for their participation. These volunteers also signed up through the Subject Pool. Because this study required three distinct time points and took place over the span of a month, participants earned two research credits as compensation.

Subsection 2: Materials

Baseline Survey. The baseline survey collected the date of participant's last menstrual period. Using that date, I was able to figure out when the participant was in the follicular and luteal phases. In addition, the baseline questions asked about the participant's stress levels, ranging from a score of 1 to 15. They were asked how many exams, presentations, and papers that they have had in the past 24 hours, how the amount of schoolwork that they had due in the past week compared to a normal day, how difficult or draining they rate the amount of schoolwork that they

had, how they feel about their class load, and how they rate the difficulty of their class load (Appendix B).

Physiological Measures. I collected physiological measures including baseline heart rate, average heart rate, and respiratory rate. If the participant had access to a smart watch, then they reported both their baseline and average heart rate for the day. If they did not have access to a smart watch, then there were instructions on the survey to guide the participants to take their carotid pulse. Additionally, the survey included detailed instructions on how to report their respiratory rate (Appendix C).

Mood Survey. The mood survey had 12 questions, asking how happy, sad, stressed, and calm the participant was. All items were scored on a 5-point Likert scale based on the question, so the scores ranged from 12 to 60. The mood survey had been adapted from one found within the literature that has been utilized in many studies (Appendix D; Underwood & Froming, 1980).

Reading Comprehension Assessment. There were three reading comprehension assessments per survey. For each assessment, participants read a short passage and then answered 4 comprehension questions based on what they just read, so the scores ranged from 0 to 12 for each survey. The passages and comprehension questions were adapted from ones that were found in the literature (Learning Express, 2010). By the end of the study, each participant completed nine assessments in total (Appendix E).

Subsection 3: Procedure

To begin, I emailed each participant a survey that contained the consent form (Appendix A). After reading about what the study entails, I asked the participants to electronically sign and indicate the date of their last menstrual cycle. I used this to calculate which phase the participants were currently in, as well as estimate the date range they would be in the next phase of their

cycle. From there, I counted nine days from that date in order to determine the participant's follicular phase. I also counted 18 days from the start date of the participant's menstrual period in order to determine the participant's luteal phase. After I had received their consent form, I emailed each participant their first survey. After completing the survey, the participant signed with a unique code that allowed me to compare the three surveys at the end without associating answers with specific participants. Their unique code consisted of their birth year and the last four digits of their Student ID. I emailed them the link to survey two when they reached the appropriate date and emailed them the link to survey three when they reached the appropriate date for the next phase of their cycle, according to my calculations.

Then, the participants completed the baseline survey online. After these baseline questions, I asked participants to report their physiological measures, either manually or by a smart watch. Next, participants filled out the mood survey. Afterwards, participants read three passages and completed the three assessments associated with them in order to analyze their reading comprehension. I administered three different assessments at each time point, and I counterbalanced the different forms across the three time points. At the end of each survey, I provided contact information for myself and my advisor so that participants could contact the researchers if they had any comments, questions, or concerns regarding the experiment. Lastly, I debriefed the participants at the end of the last survey (Appendix F). The entire experiment took participants about 60 minutes to complete, which was equal to 20 minutes for each survey.

Subsection 4: Analyses

For statistical analyses, I computed descriptive statistics for each measure, including stress heart rate, respiratory rate, and mood. Then, I ran a Repeated Measures ANOVA to compare the results for both dependent variables, reading comprehension and mood, to

determine if there were any statistically significant differences across the phases. Next, I ran correlations between heart rate, respiratory rate, and stress. Lastly, I computed a series of multiple linear regressions for each phase in addition to each dependent variable.

Section 3: Results

There were no significant differences between the factors of stress, heart rate, respiratory rate, reading comprehension, or mood across phases of the menstrual cycle (Table 1, Table 2). Across all phases, there were no statistically significant or strong correlations between heart rate, respiratory rate, and stress (Table 3).

Table 1

Means (with Standard Deviations) of Stress, Heart Rate, Respiratory Rate, Reading Comprehension, and Mood Across Phases of the Female Hormonal Cycle

Phase	Stress	Heart Rate	Respiratory Rate	Reading Comprehension	Mood
Follicular (n = 21)	11.62 (3.93)	75 (10.71)	18.71 (9.04)	7.43 (2.13)	35.05 (3.15)
Luteal (n = 20)	11.35 (2.37)	74.35 (11.92)	17.5 (5.35)	6.90 (2.45)	35.6 (3.63)
Menstrual (n = 20)	11.15 (3.20)	78.1 (14.15)	17.65 (5.80)	7.20 (1.94)	35.55 (2.21)

Table 2

Repeated Measures ANOVA Results for Reading Comprehension and Mood

Dependent Variable	F	p
Stress	0.10	0.91
Heart Rate	0.58	0.56
Respiratory Rate	0.15	0.86
Reading Comprehension	0.38	0.68
Mood	0.13	0.88

Table 3

Correlations between Physiological Measures and Stress

Phase	Variables	Pearson r	p
Follicular	Heart Rate x Respiratory Rate	0.01	0.97
	Heart Rate x Stress	-0.07	0.75
	Respiratory Rate x Stress	0.42	0.056
Luteal	Heart Rate x Respiratory Rate	-0.02	0.92
	Heart Rate x Stress	0.08	0.73
	Respiratory Rate x Stress	0.37	0.11
Menstrual	Heart Rate x Respiratory Rate	-0.11	0.65
	Heart Rate x Stress	-0.15	0.54
	Respiratory Rate x Stress	0.26	0.27

I used the linear regression model shown in Table 4 to test if heart rate, respiratory rate, and stress predict reading comprehension. Heart rate, respiratory rate, and stress in the follicular phase did not significantly predict reading comprehension, $F(3,17) = 0.56$, $p = 0.65$. Additionally, heart rate, respiratory rate, and stress in the luteal phase did not significantly predict reading comprehension, $F(3,16) = 0.75$, $p = 0.54$. Furthermore, heart rate, respiratory rate, and stress in the menstrual phase did not significantly predict reading comprehension, $F(3,16) = 1.45$, $p = 0.27$.

Table 4

Linear Regression Model for Reading Comprehension

Phase	R	R^2	Predictor	Estimate	SE	t	p
Follicular	0.30	0.09	Intercept	5.54	3.91	1.42	0.17
			Heart Rate	0.04	0.05	0.76	0.46
			Respiratory Rate	-0.06	0.06	-1.05	0.31
			Stress	0.04	0.14	0.27	0.79
Luteal	0.35	0.12	Intercept	13.24	4.52	2.93	0.01*
			Heart Rate	-0.04	0.05	-0.77	0.45
			Respiratory Rate	-0.04	0.12	-0.34	0.74
			Stress	-0.26	0.26	-0.97	0.34
Menstrual	0.46	0.21	Intercept	13.74	3.25	4.22	<.001*
			Heart Rate	-0.04	0.03	-1.42	0.18
			Respiratory Rate	-0.07	0.08	-0.93	0.36
			Stress	-0.17	0.14	-1.20	0.25

I used the linear regression model shown in Table 5 to test if heart rate, respiratory rate, stress, and phase predict mood. In the follicular phase, the overall model was significant, $F(3,17) = 10.55$, $p < .001$. Stress was the only predictor that explained unique variance in mood in the follicular phase, heart rate was a marginally significant predictor. Furthermore, in the luteal phase, the overall model also significantly predicted mood, $F(3,16) = 3.49$, $p = 0.04$. Heart rate was the only predictor that explained unique variance in mood in the luteal phase, and stress was a marginally significant predictor. However, heart rate, respiratory rate, and stress in the menstrual phase did not significantly predict mood, $F(3,16) = 0.76$, $p = 0.53$.

Table 5

Linear Regression Model for Mood

Phase	R	R^2	Predictor	Estimate	SE	t	p
Follicular	0.81	0.65	Intercept	21.84	3.57	6.11	<.001*
			Heart Rate	0.08	0.04	2.00	0.062
			Respiratory Rate	-0.04	0.06	-0.77	0.45
			Stress	0.66	0.13	5.17	<.001*
Luteal	0.63	0.40	Intercept	36.43	5.57	6.54	<.001*
			Heart Rate	-0.13	0.06	-2.20	0.043*
			Respiratory Rate	0.07	0.14	0.48	0.63
			Stress	0.68	0.32	2.10	0.052
Menstrual	0.35	0.12	Intercept	32.42	3.92	8.26	<.001*
			Heart Rate	0.02	0.04	0.48	0.64
			Respiratory Rate	-0.06	0.09	-0.60	0.56
			Stress	0.24	0.17	1.45	0.17

Section 4: Discussion

From the results above, I found that heart rate, respiratory rate, and stress had little to no effect on reading comprehension across the phases of the female hormonal cycle. However, I did discover that stress significantly predicted mood in the follicular phase and heart rate significantly predicted mood in the luteal phase. This was an interesting finding because we would expect that the same would be true across all phases, but there were no statistically significant results within the menstrual phase. When thinking about this in the context of the female hormonal cycle, hormonal levels throughout the menstrual phase are pretty consistent when it comes to estrogen and progesterone. However, with the follicular and luteal phases, there is either a dramatic rise or drop in one or more hormones. That sudden fluctuation could be the reason why we saw differences in only two out of the three phases.

Overall, my results are inconsistent with previous research. It is evident that there are many factors that play a role in our everyday lives, especially things that are out of our control. With the influence of the hormonal cycles present, literature has demonstrated that our hormones can affect how our brain acts. Hormonal changes within the brain affects the neuronal networking of the brain, which has a direct effect on cognitive functions (Ali et al., 2018). With reading comprehension as a measure of cognitive function, fluctuations in hormones like estrogen, progesterone, and testosterone led to changes in memory recall (Ackermann et al., 2012; Carpenter, 2001; Dadín et al., 2009; Heany et al., 2016; Sundström Poromaa & Gingnell, 2014). High levels of estrogen and progesterone, as seen in the follicular and luteal phases, are highly correlated with greater memory performance (Kimura & Hampson, 1994; Sanders et al., 2002).

In addition to influencing cognitive functions, hormones can also directly affect how we feel daily. In society today, it is easy to associate a female's cycle with mood fluctuations. Whenever a female is moody, the first answer is that they are on their period. Literature has stated that variations in hormone levels seem to predict what kind of mood a woman will have during her cycle (Del Rio et al., 2018). Females report better moods during their follicular phase and worse moods during their luteal phase (Brighten, 2022; Handy et al., 2022). According to multiple studies, women are more at risk for developing mood disorders because of the hormonal fluctuations that they experience during their hormonal cycle (Steiner et al., 2003; Wharton et al., 2012).

Even though these results have been reported time and time again, I did not arrive at these results in my study, but it was most likely due to limitations that I faced throughout the

process. First off, I had a very small sample size. In total, I had 28 participants. However, not every participant participated in each part of the study. When looking through my data and trying to compare results within subjects, I noticed that some participants only filled out one or two of the surveys. This could have skewed my results because I did not receive a full set of data. Additionally, I relied solely on self-reporting to carry out my experiment. This meant that participants told me the day of their last period as well as what they were feeling during each survey. I relied on their memory to run my study, which could have had some implications because I could not standardize the data myself. Furthermore, the study was completely online for ease of both the participants and the researcher. This hindered my ability to interact with the participants during each part of the study and left everything up to interpretation on the participant's side. It is possible that I was not clear in some parts of the instructions because I could not explain exactly what I wanted from them. Therefore, this could have affected the quality of the data. Lastly, I adapted the reading comprehension questions from a list that I found online. It was used in some other studies, but there is a possibility that the test could have been too easy or too hard, which could have affected my results by causing a floor or ceiling effect.

In the future, if I were to rerun this study, I would first try to recruit more participants. I would also make the study more interactive and in person. Instead of relying on self-reporting, I would use a more biological method to determine where each participant was in their cycle. This could be done through blood, urine, or ovulation testing. By utilizing these methods, it would provide more accurate tracking of each participant's cycle so that I could send out the surveys at a more appropriate time. Additionally, a change that I would make in the future is to conduct the study in person. This would allow me to collect the biological measurements mentioned earlier, fully explain instructions so that there are no misinterpretations, and standardize data collection

better than I did in my study. Lastly, it would be interesting to conduct a study to look at how the phases of the menstrual cycle can influence memory or mood in response to a stressor. In my study, I focused on stressors that surrounded each week, but it would be interesting to see how stress could directly affect these factors in real-time.

While there were no statistically significant results, I think that it is still important to address the differences between male and female college students that the literature has mentioned. Thus far, research shows us that there seems to be a difference in the behaviors, habits, and physiological aspects of male and female college students (Ngun et al., 2011; Szadvari et al., 2023). Because of this, I intend to propose some ideas that may aid female college students when they feel like they are struggling.

CHAPTER 5: CATERING THE COLLEGE EXPERIENCE TOWARD FEMALE STUDENTS TO ENSURE SUCCESS IN THE CLASSROOM

There is a difference between the experiences of male and female college students (Grebennikov & Skaines, 2009; Smith et al., 1994). Hormones and stress can affect memory and mood, so it is important to address these differences in a way that benefits those who need it most. Therefore, I propose some ideas that everyone, especially females, can utilize in their daily lives.

The first is sleep. This seems like it is the first answer that comes out of anyone else's mouth whenever someone is feeling stressed, anxious, or overwhelmed. Sleep always seems to be the answer, but why is that? What matters the most, according to some studies, is the quality of sleep instead of the quantity (Bassett et al., 2015; Galambos et al., 2009). The number of hours that a person sleeps each night is important. It is evident that getting 8 hours of sleep is much better and more refreshing for the body than 2 hours of sleep. However, the difference between 7 and 8 hours does not seem to be significant. A poor quality of sleep negatively impacts the HPA axis and makes dealing with challenges much more difficult (Bassett et al., 2015). Additionally, the reverse effect is also present in the life of college students. Having a high amount of stress during the day can lead to a lesser quality of sleep (Campbell et al., 2018; Garett et al., 2017; Ulrich et al., 2023).

Exercise is another mechanism that women can utilize to cope with stress and low mood. The fight-or-flight response caused by stress greatly affects the body. Through exercise, we can try to reduce the stress seen physically by helping maintain a healthy weight, providing more energy, lowering blood pressure, and helping control blood sugar level (America Heart Association, 2021). When people are stressed, it becomes more difficult to get through the day,

so the idea that comes into play here is: If you feel better physically, then you will feel better mentally (Anxiety and Depression Association of America, 2023; Association for Applied Sport Psychology; The Nutrition Source, 2023b). Those who regularly exercise maintain a consistently more positive mood, less negative mood overall, and an increased ability to cope with stress (Childs & De Wit, 2014; Giacobbi et al., 2005; Rocheleau et al., 2004; Steptoe et al., 1998). Additionally, studies have shown that physical activity increased psychological well-being, self-esteem, and intrinsic motivation while decreasing feelings of stress and depression (Granero-Jiménez et al., 2022; Norris et al., 1992).

The food that people eat may have a direct effect on their mental health through their mood and cognitive function (Perry, 2022). There is a link between the gut microbiome and mental health; therefore, what we eat can predict how we feel (Bremner et al., 2020; Hill et al., 2022; Lach et al., 2018). It is important that everyone eats regularly and stay hydrated because it can prevent low blood sugar, dehydration, nausea, and fatigue (Mental Health Foundation, 2022). If people are taking care of their basic needs like sleeping, eating, and staying active, then it is much more likely that they will feel better in general. It is difficult to feel good if there is neglect of everything else.

Within the daily diet, it is essential to incorporate some aspect of each food group: fats, proteins, carbohydrates, and vegetables. It seems as though there is a stigma attached to fats; eating too much can cause fluctuations in weight. However, finding the right balance of fats is important to maintain energy levels and allow your brain to keep chugging along (Mental Health Foundation, 2022). Good sources of healthy fats include fish, nuts, seeds, and vegetable oils (The Nutrition Source, 2019b). Incorporating proteins into the daily diet aids in the synthesis of

neurotransmitters because they contain necessary amino acids that are essential to overall brain function (Lieberman, 1999). A common misconception is that protein can only be found in meat and animal products. There are other ways to incorporate protein into your diet. Sources of protein include legumes, nuts and seeds, whole grains like quinoa and oats, vegetables like broccoli and brussels sprouts, red meat like pork and beef, and dairy products like yogurt (The Nutrition Source, 2023a). Carbohydrates are especially important to one's diet because they supply the body with glucose which in turn is converted into energy through cellular respiration (Holesh et al., 2023). The energy can either be utilized immediately or it can be stored in the liver and muscle tissue. Excellent sources of carbohydrates include whole grains, vegetables, fruit, and beans (The Nutrition Source, 2019a). Incorporating all of these for every meal could have overall benefits both physically and mentally.

The concept of mindfulness has been implemented into modern society in recent years. Mindfulness is a mental state in which you are completely conscious and aware of the present moment. Methods of mindfulness include mindful moving, conducting a full body scan, mindfulness coloring or drawing, yoga, and meditation (Mind, 2021; Ohio State Integrative Health, 2023). Mindfulness has become more widely used as a technique recommended by therapists to combat feelings of stress, anxiety, and depression. By participating in acts of mindfulness, people can experience many positive long-lasting benefits. Mindfulness facilitates the relationship between sleep quality and stress and thus reduces the likelihood of burnout in students (Gan et al., 2023). Because students were getting better quality sleep, their overall happiness and well-being improved over time (Crowley et al., 2022; Nardi et al., 2022). Incorporating mindfulness into your daily life can lead to more positive emotions and less perceived stress (Liu et al., 2023; Miller et al., 2022; Ramasubramanian, 2017; Zahra & Riaz,

2017). Additionally, people have reported improvements in symptoms associated with anxiety and depression because mindfulness facilitated the development of resilience to stress and better mental health outcomes (Chiodelli et al., 2022; Dark-Freudeman et al., 2022; Gallo et al., 2023).

Another solution I propose is increasing the level of neurotransmitters, such as dopamine, serotonin, and oxytocin. Dopamine is part of the reward pathway which allows us to feel pleasure, learn and pay attention, move, and regulate our mood (Baik, 2020; Watson, 2021). Serotonin is a natural mood stabilizer that helps regulate mood, memory, and behaviors in humans (Bamalan et al., 2023). Oxytocin is typically known for its role in childbirth and lactation, but it also helps promote feelings of positivity and reduce stress (LeWine, 2023). By increasing these neurotransmitters naturally, it is possible to reduce feelings of fear and anxiety by inhibiting amygdala activation and decreasing salivary cortisol levels (Love, 2018; Olff et al., 2013). Furthermore, this lowers physiological stress by reducing HPA axis activity and acting on norepinephrine levels, heart rate, and blood pressure (Olff et al., 2013). One way to achieve this is by getting more exposure to bright lights because it increases your intake of Vitamin D and helps regulate your sleep-wake cycle (Young, 2007). Maintaining healthy relationships with friends, family, pets, animals, or significant others also promotes neurotransmitter production (Uvnas-Moberg et al., 2014). Lastly, music is another method that helps regulate mood, reduce stress, improve mental health, and promote self-awareness (Henry et al., 2021; Schafer et al., 2013; Stewart et al., 2019).

CHAPTER 6: FINAL THOUGHTS

Wow! I did it! I made it through most of the thesis process! Looking back at this journey, I had my fair share of ups and downs. When I started this process, I chose a topic that seemed like the easy way out. It was easier to write about something that I had no connection to because I did not think that I was ready to face my inner thoughts and write about my mental health journey. But as I mentioned in the first chapter, life works in mysterious ways. Using my life to connect to the material present in this thesis made it more interesting and enjoyable to write about.

As a college student, stress ruled my life, and I was having trouble with how I felt daily. At one point, my grades dropped for a bit, and I did not understand why. This thesis allowed me to explore literature to hopefully find some answers. As a result, I wanted to explore how hormones can affect the daily lives of female and male college students. I read about the different pathways within the human body, like the HPA, HPG, and SAM axes. Then, I moved on to researching the differences between the male and female hormonal cycles. I discovered that fluctuations in hormones like estrogen, progesterone, and testosterone can affect levels of stress, mood, and memory. After finding out that there is a difference for males and females, I wanted to see if women are more affected during certain phases of their hormonal cycle than men are during their overall hormonal cycle. Since academic productivity, memory performance, mood, and stress are important for success in the classroom, it was important for me to look into the origin of the American education system.

The American education system was initially created for religious purposes and to bring the nation together after the Puritans' settlement in the New World. When I began this research, I

wondered about what role that women played in its development. And not so surprisingly, women were excluded from attending school at all for years. Keeping women out of the education system led to things escalating outside of the educational world, such as the gender gap. The gender gap haunts our world today. Women do not make as much money as men, and men dominate the highest-paying jobs.

Thus, this research led me to want to run my own study at the college that I attend. I wanted to gather data on people that I pass every day on the way to class. People just like me. I wanted them to indirectly tell their stories through the data they provided me. Everything was done completely anonymously to hopefully encourage more honesty in their answers. My goal was to get real-life results instead of solely relying on literature from years ago. My study was not perfect, and I did not get statistically significant results, but I did find some results that are worth talking about.

Because of that, I proposed some suggestions that could aid female college students when they feel like they are struggling. The first few that I mentioned seem obvious: sleep, exercise, and better eating habits. These three options always seem to be the first answers that people bring up. They appear to be the easy solutions, and I was always annoyed whenever someone would mention these. But now that I have researched them, I understand the science behind their benefits. And then, I decided to take it one step further. Yes, those are the easy answers, but how else can we help ourselves as women?

Therefore, I dug a little deeper. I discovered how mindfulness and meditation can help reduce negative emotions and student burnout. Then, I researched ways to increase the natural neurotransmitters that we have in our bodies like dopamine, serotonin, and oxytocin. Through

listening to music, spending more time in the sun, and bonding with other people, it is possible to regulate your mood, improve your mental health, and reduce feelings of stress. Even if the outcome is minimal, any small step in the right direction is considered a success.

The world that we live in is always going to try to knock us down, whether we are in college or out in the real world, whether we are male or female, or whether we are thriving or struggling. However, if you find something that makes your day even the slightest bit better, stick with that and remember: YOU ARE NOT ALONE!

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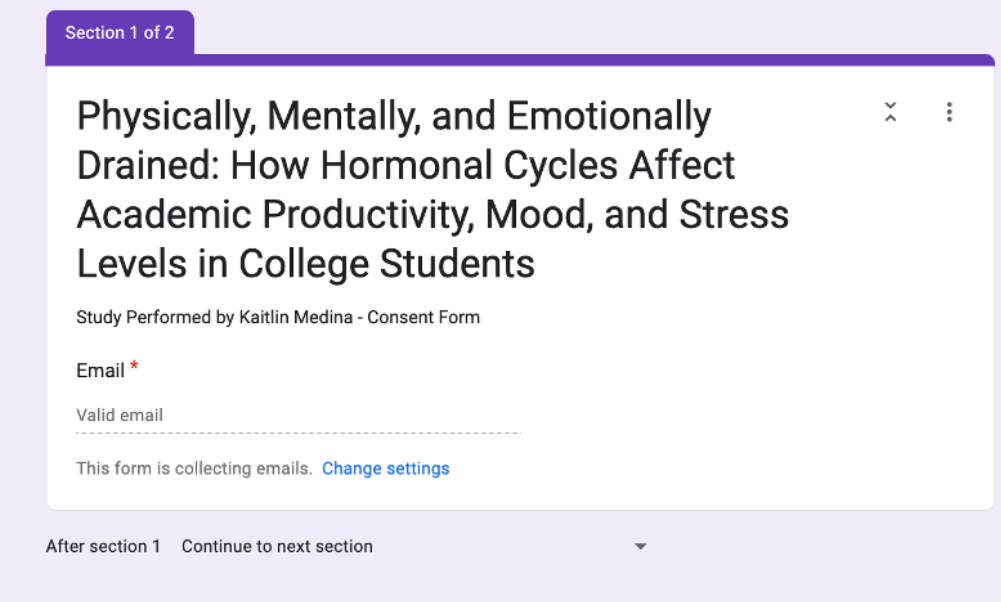
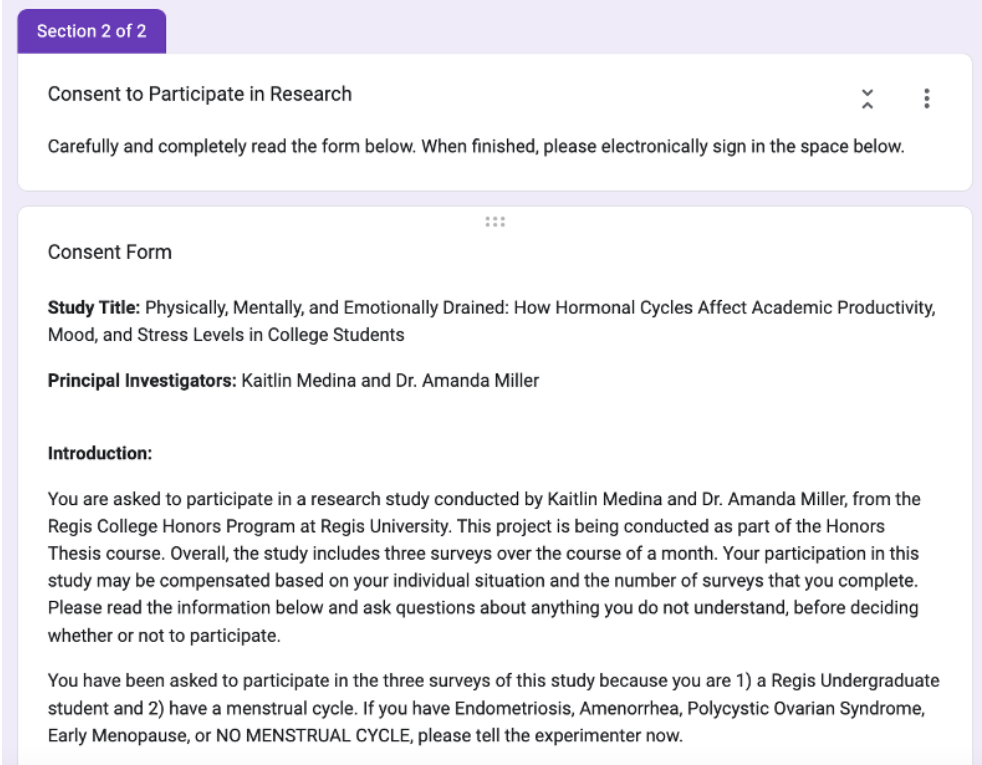
APPENDICES

Appendix A: Consent Form

This is the consent form sent as a separate survey before the rest of the surveys.





Procedures:

- You will fill out three surveys over the course of a month.

  For each survey:

  - You will be asked to take a survey regarding your mood and stress levels.
  - Then, you will be asked to report your heart rate and respiratory rate.
  - Then, you will undergo three brief assessments to analyze your reading comprehension.
  - After completing the assessments, I will debrief you and provide contact information if any questions you have about the study come up. Each survey should take approximately 20 minutes to complete.

Potential Risks and Discomforts:

There are no anticipated risks to you from your participation in this study. We believe that the risk from participation is no greater than that encountered in everyday life. However, in case you do experience any mild distress from the experiment, a debriefing process will be provided at the end of the experimental session. At any time, you are welcome to contact either Kaitlin Medina or Dr. Amanda Miller with any comments, questions, or concerns pertaining to the study or your participation.

Potential Benefits:

You will benefit by learning about research in the fields of Biology, Psychology, and Neuroscience, and will benefit by learning more about the topic of the effects of hormonal cycles on academic productivity, stress levels, and success in the classroom. Research may contribute to understanding the relationship between hormonal cycles and classroom performance.

Financial Information:

As a participant, if you are participating as part of the Psychology & Neuroscience Subject Pool, you will receive two Research Credits for participation. This Research Credit may either count as a course requirement or be used for extra credit in a course. If you complete one or two surveys, you will receive 1 Research Credit. If you complete all three surveys, you will receive 2 Research Credits. If you are not part of the Subject Pool, you are participating as a volunteer with no compensation.

Confidentiality:

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. A coding procedure will be used so that the researcher will use a numerical code for your data that cannot be identified with you, and your name will not be recorded with the data. The researcher and the researcher's faculty advisor will have access to the raw data, and results of data will be presented in aggregate form. After completion of the study, the consent forms and data will be stored for 3 years in a locked filing cabinet in the Regis College Department of Psychology & Neuroscience.

This research is being conducted by a student as part of a course requirement. Therefore, records that identify you and the consent form signed by you may be looked at by others. They are:

- Regis IRB that protects research subjects like you
- Officials at Regis University who are in charge of making sure that we follow the rules of research.
- Any faculty members who are co-investigators on this project may also contact you about your participation in the project.

What are your rights as a research participant?

Participation in this study is voluntary. You do not have to answer any question you do not want to answer. You may choose not to participate or to withdraw from this research at any time without penalty. If you decide not to participate or to withdraw from this study, please inform the researchers. The researchers may ask you if the information already collected from you can be included in the research project.

This will not affect your class standing, grades, employment, or any other aspects of your relationship with Regis.

Who can you contact if you have questions or concerns about this research study?

If you have any questions or concerns about this research, you are free to ask them at any time. You may contact any and/or all researchers: Kaitlin Medina or Dr. Amanda Miller.

Kaitlin Medina: kmedina001@regis.edu (970) 390-1855

Dr. Amanda Miller amiller@regis.edu (303) 964-5348

If you have any questions about your rights as a participant in this research, you can also contact the following office at Regis University:

Regis Institutional Review Board

Regis University

Denver, CO 80221

Phone: (303) 458-4188 Email: irb@regis.edu

Do you understand what is being asked of you and therefore consent to participating in this research? If yes, please electronically sign your first AND last name in the space below.

Short answer text

Menstrual Cycle

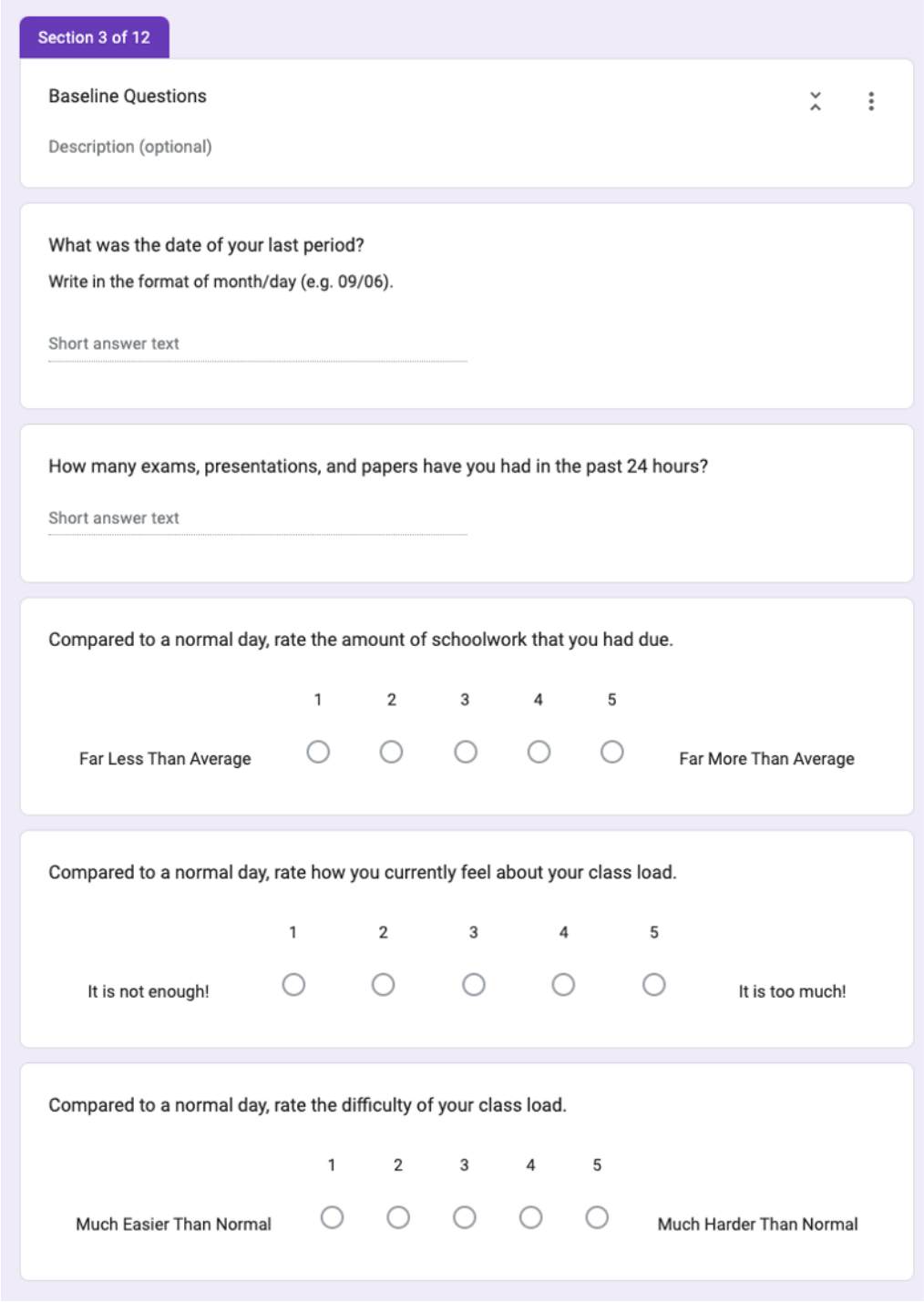
Thank you so much for agreeing to be a part of my study! I only need one piece of information from you before we start!

What was the start date of your last period? Write in the format of month/day (e.g. 09/06).

Short answer text

Appendix B: Baseline Survey

These are the baseline questions that the participants were asked during each survey to determine their phase of hormonal cycle and stress level.



Section 3 of 12

Baseline Questions

Description (optional)

What was the date of your last period?

Write in the format of month/day (e.g. 09/06).

Short answer text

How many exams, presentations, and papers have you had in the past 24 hours?

Short answer text

Compared to a normal day, rate the amount of schoolwork that you had due.

	1	2	3	4	5	
Far Less Than Average	○	○	○	○	○	Far More Than Average

Compared to a normal day, rate how you currently feel about your class load.

	1	2	3	4	5	
It is not enough!	○	○	○	○	○	It is too much!

Compared to a normal day, rate the difficulty of your class load.

	1	2	3	4	5	
Much Easier Than Normal	○	○	○	○	○	Much Harder Than Normal

Appendix C: Physiological Measures

These are the instructions that assisted the participants in reporting their baseline heart rate, average heart rate, and respiratory rate for each survey.

Section 4 of 12

Physiological Measures

Description (optional)

What was your baseline heart rate for the day?

If you have access to a smart watch, you can check on your watch or in the Health app on your phone and it should tell you what your baseline heart rate was. If you do not have access to a smart watch, type n/a.

Short answer text

What was your average heart rate for the day?

If you have access to a smart watch, you can check on your watch or in the Health app on your phone and it should tell you what your average heart rate was. If you do not have access to a smart watch, you may have to take your heart rate manually. To take your heart rate manually, place your pointer and middle finger on the front of the neck just below the angle of the jaw (see picture below for reference). Feel for your pulse (it may be difficult to find at first. Try the other side if you are having trouble). Set a timer for 30 seconds and press start. As the timer goes, count the number of times that you feel a pulse on your finger and stop when the time stops. Take the number that you counted and multiply it by 2. Type that number into the field below.

Short answer text

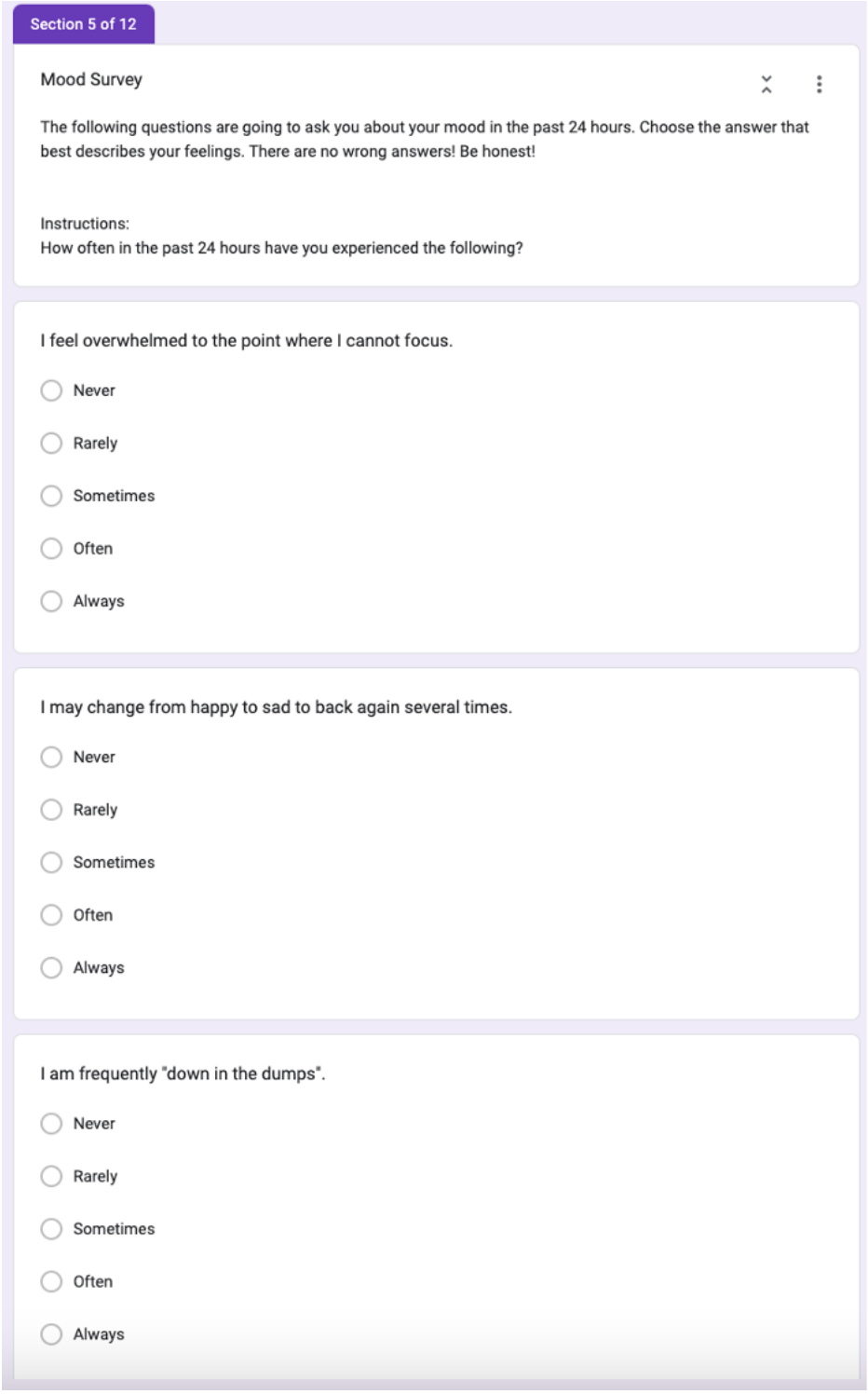
What is your respiratory rate?

Your respiratory rate is the number of times you breathe in a minute. To determine this, set a timer for 30 seconds and press start. As the timer goes, count the number of times that you breathe. Breathing in and out once is equal to one breath. Stop counting when the time stops. Take the number that you counted and multiply it by 2. Type that number into the field below.

Short answer text

Appendix D: Mood Survey

These are questions used to determine the mood levels of the participants for each survey.



Section 5 of 12

Mood Survey

The following questions are going to ask you about your mood in the past 24 hours. Choose the answer that best describes your feelings. There are no wrong answers! Be honest!

Instructions:
How often in the past 24 hours have you experienced the following?

I feel overwhelmed to the point where I cannot focus.

- Never
- Rarely
- Sometimes
- Often
- Always

I may change from happy to sad to back again several times.

- Never
- Rarely
- Sometimes
- Often
- Always

I am frequently "down in the dumps".

- Never
- Rarely
- Sometimes
- Often
- Always

I usually feel quite cheerful.

- Never
- Rarely
- Sometimes
- Often
- Always

I look at the sunny side of life.

- Never
- Rarely
- Sometimes
- Often
- Always

I am not as cheerful as most people.

- Never
- Rarely
- Sometimes
- Often
- Always

I feel as though I am bubbling over with joy.

- Never
- Rarely
- Sometimes
- Often
- Always

I feel like I am stuck at where I am at.

- Never
- Rarely
- Sometimes
- Often
- Always

I have no worries at the moment.

- Never
- Rarely
- Sometimes
- Often
- Always

I feel like I can breathe.

- Never
- Rarely
- Sometimes
- Often
- Always

I feel like the walls are closing in.

- Never
- Rarely
- Sometimes
- Often
- Always

I feel like I know what I am doing.

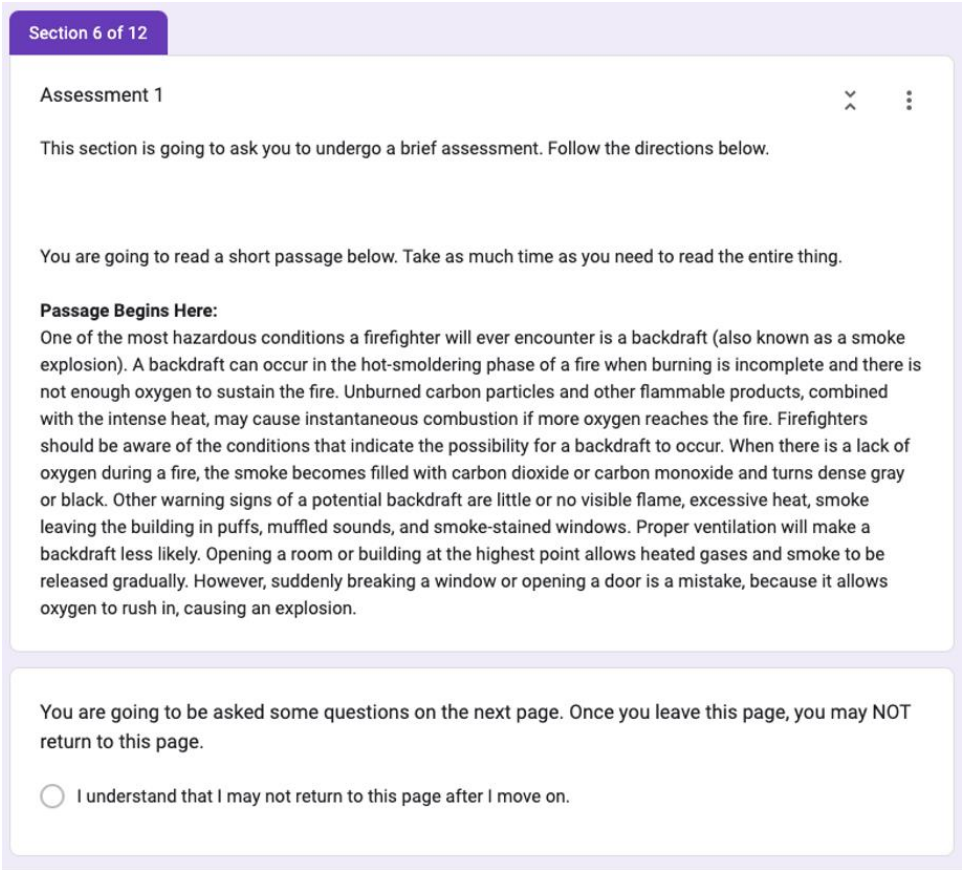
- Never
- Rarely
- Sometimes
- Often
- Always

After section 5 Continue to next section

Appendix E: Reading Comprehension Assessment

These are the passages and reading comprehension questions that were asked to each participant. There were three passages and sets of questions for each survey.

1. **Survey 1 Passages and Comprehension Questions**



Section 6 of 12

Assessment 1

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
One of the most hazardous conditions a firefighter will ever encounter is a backdraft (also known as a smoke explosion). A backdraft can occur in the hot-smoldering phase of a fire when burning is incomplete and there is not enough oxygen to sustain the fire. Unburned carbon particles and other flammable products, combined with the intense heat, may cause instantaneous combustion if more oxygen reaches the fire. Firefighters should be aware of the conditions that indicate the possibility for a backdraft to occur. When there is a lack of oxygen during a fire, the smoke becomes filled with carbon dioxide or carbon monoxide and turns dense gray or black. Other warning signs of a potential backdraft are little or no visible flame, excessive heat, smoke leaving the building in puffs, muffled sounds, and smoke-stained windows. Proper ventilation will make a backdraft less likely. Opening a room or building at the highest point allows heated gases and smoke to be released gradually. However, suddenly breaking a window or opening a door is a mistake, because it allows oxygen to rush in, causing an explosion.

You are going to be asked some questions on the next page. Once you leave this page, you may NOT return to this page.

I understand that I may not return to this page after I move on.

Section 7 of 12

Assessment 1 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

A backdraft is a dangerous condition for firefighters mainly because

- there is not enough oxygen for breathing.
- the heat is extremely intense.
- the smoke is dangerously thick.
- an explosion occurs.

Which of the following is not mentioned as a potential backdraft warning sign?

- windows stained with smoke.
- flames shooting up from the building.
- puffs of smoke leaving the building.
- more intense heat than usual.

To prevent the possibility of a backdraft, a firefighter should

- carry an oxygen tank.
- open a door to allow gases to escape.
- make an opening at the top of the building.
- break a window to release carbon particles.

When compared with a hot, smoldering fire, a fire with visible, high-reaching flames

- has more oxygen available for combustion.
- has more carbon dioxide available for consumption.
- produces more dense gray smoke.
- is more likely to cause a backdraft.

Section 8 of 12

Assessment 2

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
Today, bicycles are elegantly simple machines that are common around the world. Many people ride bicycles for recreation, whereas others use them as a means of transportation. The first bicycle, called a draisienne, was invented in Germany in 1818 by Baron Karl de Drais de Sauerbrun. Because it was made of wood, the draisienne wasn't very durable nor did it have pedals. Riders moved it by pushing their feet against the ground. In 1839, Kirkpatrick Macmillan, a Scottish blacksmith, invented a much better bicycle. Macmillan's machine had tires with iron rims to keep them from getting worn down. He also used foot-operated cranks, similar to pedals, so his bicycle could be ridden at a quick pace. It didn't look much like the modern bicycle, though, because its back wheel was substantially larger than its front wheel. Although Macmillan's bicycles could be ridden easily, they were never produced in large numbers. In 1861, Frenchman Pierre Michaux and his brother Ernest invented a bicycle with an improved crank mechanism. They called their bicycle a vélocipède, but most people called it a "bone shaker" because of the jarring effect of the wood and iron frame. Despite the unflattering nickname, the vélocipède was a hit. After a few years, the Michaux family was making hundreds of the machines annually, mostly for fun-seeking young people. Ten years later, James Starley, an English inventor, made several innovations that revolutionized bicycle design. He made the front wheel many times larger than the back wheel, put a gear on the pedals to make the bicycle more efficient, and lightened the wheels by using wire spokes. Although this bicycle was much lighter and less tiring to ride, it was still clumsy, extremely top-heavy, and ridden mostly for entertainment. It wasn't until 1874 that the first truly modern bicycle appeared on the scene. Invented by another Englishman, H. J. Lawson, the safety bicycle would look familiar to today's cyclists. The safety bicycle had equal-sized wheels, which made it much less prone to toppling over. Lawson also attached a chain to the pedals to drive the rear wheel. By 1893, the safety bicycle had been further improved with air-filled rubber tires, a diamond-shaped frame, and easy braking. With the improvements provided by Lawson, bicycles became extremely popular and useful for transportation. Today, they are built, used, and enjoyed all over the world.

You are going to be asked some questions on the next page. Once you leave this page, you may NOT return to this page.

- ◯ I understand that I may not return to this page after I move on.

Assessment 2 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

There is enough information in this passage to show that

- several people contributed to the development of the modern bicycle.
- only a few vélocipèdes built by the Michaux family are still in existence.
- for most of the nineteenth century, few people rode bicycles just for fun.
- bicycles with wheels of different sizes cannot be ridden easily.

The first person to use a gear system on bicycles was

- H. J. Lawson.
- Kirkpatrick Macmillan.
- Pierre Michaux
- James Starley.

This passage was most likely written in order to

- persuade readers to use bicycles for transportation.
- describe the problems that bicycle manufacturers encounter.
- compare bicycles used for fun with bicycles used for transportation.
- tell readers a little about the history of the bicycle.

Macmillan added iron rims to the tires of his bicycle to

- add weight to the bicycle.
- make the tires last longer.
- make the ride less bumpy.
- make the ride less tiring.

Assessment 3

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
For centuries, time was measured by the position of the sun with the use of sundials. Noon was recognized when the sun was the highest in the sky, and cities would set their clock by this apparent solar time, even though some cities would often be on a slightly different time. Daylight Saving Time (DST), sometimes called summer time, was instituted to make better use of daylight. Thus, clocks are set forward one hour in the spring to move an hour of daylight from the morning to the evening and then set back one hour in the fall to return to normal daylight. Benjamin Franklin first conceived the idea of daylight saving during his tenure as an American delegate in Paris in 1984 and wrote about it extensively in his essay, "An Economical Project." It is said that Franklin awoke early one morning and was surprised to see the sunlight at such an hour. Always the economist, Franklin believed the practice of moving the time could save on the use of candlelight, as candles were expensive at the time. In England, builder William Willett (1857–1915) became a strong supporter for Daylight Saving Time upon noticing blinds of many houses were closed on an early sunny morning. Willet believed everyone, including himself, would appreciate longer hours of light in the evenings. In 1909, Sir Robert Pearce introduced a bill in the House of Commons to make it obligatory to adjust the clocks. A bill was drafted and introduced into Parliament several times but met with great opposition, mostly from farmers. Eventually, in 1925, it was decided that summer time should begin on the day following the third Saturday in April and close after the first Saturday in October. The U.S. Congress passed the Standard Time Act of 1918 to establish standard time and preserve and set Daylight Saving Time across the continent. This act also devised five time zones throughout the United States: Eastern, Central, Mountain, Pacific, and Alaska. The first time zone was set on "the mean astronomical time of the seventy-fifth degree of longitude west from Greenwich" (England). In 1919, this act was repealed. President Roosevelt established year-round Daylight Saving Time (also called War Time) from 1942–1945. However, after this period, each state adopted its own DST, which proved to be disconcerting to television and radio broadcasting and transportation. In 1966, President Lyndon Johnson created the Department of Transportation and signed the Uniform Time Act. As a result, the Department of Transportation was given the responsibility for the time laws. During the oil embargo and energy crisis of the 1970s, President Richard Nixon extended DST through the Daylight Saving Time Energy Act of 1973 to conserve energy further. This law was modified in 1986, and Daylight Saving Time was reset to begin on the first Sunday in April (to spring ahead) and end on the last Sunday in October (to fall back).

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Assessment 3 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

Who first established the idea of DST?

- President Richard Nixon
- Benjamin Franklin
- Sir Robert Pearce
- President Lyndon Johnson

Who opposed the bill that was introduced in the House of Commons in the early 1900s?

- Sir Robert Pearce
- farmers
- television and radio broadcasting companies
- the U.S. Congress

Which of the following statements is true of the U.S. Department of Transportation?

- It was created by President Richard Nixon.
- It set standards for DST throughout the world.
- It constructed the Uniform Time Act.
- It oversees all time laws in the United States.

The Daylight Saving Time Energy Act of 1973 was responsible for

- preserving and setting Daylight Saving Time across the continent.
- instituting five time zones in the United States.
- extending Daylight Saving Time in the interest of energy conservation.
- conserving energy by giving the Department of Transportation authority over time laws.

2. Survey 2 Passages and Comprehension Questions

Assessment 1

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
Greyhound racing is the sixth most popular spectator sport in the United States. Over the last decade, a growing number of racers have been adopted to spend their retirement as household pets, once their racing careers are over. Many people hesitate to adopt a retired racing greyhound because they think only very old dogs are available. Actually, even champion racers only work until they are about three-and-a-half years old. Because greyhounds usually live to be 12 to 15 years old, their retirement is much longer than their racing careers. People worry that a greyhound will be more nervous and active than other breeds and will need a large space to run. These are false impressions. Greyhounds have naturally sweet, mild dispositions, and while they love to run, they are sprinters rather than distance runners and are sufficiently exercised with a few daily laps around a fenced-in backyard. Greyhounds do not make good watchdogs, but they are very good with children, get along well with other dogs (and usually cats as well), and are affectionate and loyal. They are intelligent, well-behaved dogs, usually housebroken in only a few days. A retired racing greyhound is a wonderful pet for almost anyone.

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Assessment 1 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

Based on the tone of the passage, the author's main purpose is to

- ○ teach prospective owners how to transform their racing greyhound into a good pet.
- ○ show how the greyhound's nature makes it equally good as racer and pet.
- ○ encourage people to adopt retired racing greyhounds.
- ○ objectively present the pros and cons of adopting a racing greyhound.

According to the passage, adopting a greyhound is a good idea for people who

- ○ do not have children.
- ○ live in apartments.
- ○ do not usually like dogs.
- ○ already have another dog or a cat.

One drawback of adopting a greyhound is that

- ○ greyhounds are not good with children.
- ○ greyhounds are old when they retire from racing.
- ○ the greyhound's sensitivity makes it temperamental.
- ○ greyhounds are not good watch dogs.

Which of the following is implied by the passage?

- ○ The public is more aware of greyhounds than they used to be.
- ○ Greyhounds are more competitive than other dogs.
- ○ Greyhound racing should not be allowed.
- ○ People who own pet rabbits should not adopt greyhounds.

Assessment 2

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
The human body can tolerate only a small range of temperature, especially when the person is engaged in vigorous activity. Heat reactions usually occur when large amounts of water and/or salt are lost through excessive sweating following strenuous exercise. When the body becomes overheated and cannot eliminate this excess heat, heat exhaustion and heat stroke are possible. Heat exhaustion is generally characterized by clammy skin, fatigue, nausea, dizziness, profuse perspiration, and sometimes fainting, resulting from an inadequate intake of water and the loss of fluids. First aid treatment for this condition includes having the victim lie down, raising the feet 8 to 12 inches, applying cool, wet cloths to the skin, and giving the victim sips of salt water (1 teaspoon per glass, half a glass every 15 minutes) over a 1-hour period. Heat stroke is much more serious; it is an immediate life-threatening situation. The characteristics of heat stroke are a high body temperature (which may reach 106° F or more); a rapid pulse; hot, dry skin; and a blocked sweating mechanism. Victims of this condition may be unconscious, and first-aid measures should be directed at quickly cooling the body. The victim should be placed in a tub of cold water or repeatedly sponged with cool water until his or her temperature is sufficiently lowered. Fans or air conditioners will also help with the cooling process. Care should be taken, however, not to over-chill the victim once the temperature is below 102° F.

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Assessment 2 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

The most immediate concern of a person tending to a victim of heat stroke should be to

- get salt into the victim's body.
- raise the victim's feet.
- lower the victim's pulse.
- lower the victim's temperature.

Which of the following is a symptom of heat exhaustion?

- unconsciousness
- profuse sweating
- hot, dry skin
- a weak pulse

Heat stroke is more serious than heat exhaustion because heat stroke victims

- do not sweat.
- have no salt in their bodies.
- cannot take in water.
- have frequent fainting spells.

Symptoms such as nausea and dizziness in a heat exhaustion victim indicate that the person most likely needs to

- be immediately taken to a hospital.
- be given more salt water.
- be immersed in a tub of water.
- sweat more.

Assessment 3

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
Milton Hershey was born near the small village of Derry Church, Pennsylvania, in 1857. It was a modest beginning that did not foretell his later popularity. Milton only attended school through the fourth grade; at that point, he was apprenticed to a printer in a nearby town. Fortunately for all chocolate lovers, Milton did not excel as a printer. After a while, he left the printing business and was apprenticed to a Lancaster, Pennsylvania candy maker. It was apparent he had found his calling in life, and at the age of eighteen, he opened his own candy store in Philadelphia. In spite of his talents as a candy maker, the shop failed after six years. It may come as a surprise to current Milton Hershey fans, but his first candy success came with the manufacture of caramel. After the failure of his Philadelphia store, Milton headed for Denver, where he learned the art of making caramels. There he took a job with a local manufacturer who insisted on using fresh milk in making his caramels; Milton saw that this made the caramels especially tasty. After a time in Denver, Milton once again attempted to open his own candy-making businesses, in Chicago, New Orleans, and New York City. Finally, in 1886, he went to Lancaster, Pennsylvania, where he raised the money necessary to try again. This company—the Lancaster Caramel Company—established Milton's reputation as a master candy maker. In 1893, Milton attended the Chicago International Exposition, where he saw a display of German chocolate-making implements. Captivated by the equipment, he purchased it for his Lancaster candy factory and began producing chocolate, which he used for coating his caramels. By the next year, production had grown to include cocoa, sweet chocolate, and baking chocolate. The Hershey Chocolate company was born in 1894 as a subsidiary of the Lancaster Caramel Company. Six years later, Milton sold the caramel company, but retained the rights, and the equipment, to make chocolate. He believed that a large market of chocolate consumers was waiting for someone to produce reasonably priced candy. He was right. Milton Hershey returned to the village where he had been born, in the heart of dairy country, and opened his chocolate manufacturing plant. With access to all the fresh milk he needed, he began producing the finest milk chocolate. The plant that opened in a small Pennsylvania village in 1905 is today the largest chocolate factory in the world. The confections created at this facility are favorites around the world. The area where the factory is located is now known as Hershey, Pennsylvania. Within the first decades of its existence, the town of Hershey thrived, as did the chocolate business. A bank, a school, churches, a department store, even a park and a trolley system all appeared in short order; the town soon even had a zoo. Today, a visit to the area reveals the Hershey Medical Center, Milton Hershey School, and Hershey's Chocolate World—a theme park where visitors are greeted by a giant Reeses Peanut Butter Cup. All of these things— and a huge number of happy chocolate lovers—were made possible because a caramel maker visited the Chicago Exposition of 1893!

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Assessment 3 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

According to the information contained in the passage, the reader can infer which of the following?

- Chocolate is popular in every country in the world.
- Reeses Peanut Butter Cups are manufactured by the Hershey Chocolate Company.
- Chocolate had never been manufactured in the United States before Milton Hershey did it.
- The Hershey Chocolate Company now makes more money from Hershey's Chocolate World than from th...

The writer's main purpose in this passage is to

- recount the founding of the Hershey Chocolate Company.
- describe the process of manufacturing chocolate.
- compare the popularity of chocolate to other candies.
- explain how apprenticeships work.

According to the passage, Milton Hershey sold his caramel company in

- 1894
- 1900
- 1904
- 1905

The mention of the Chicago International Exposition of 1893 in the passage indicates that

- the exposition in Chicago is held once every three years.
- the theme of the exposition of 1893 was "Food from Around the World."
- the exposition contained displays from a variety of countries.
- the site of the exposition is now a branch of the Hershey Chocolate Company.

3. Survey 3 Passages and Comprehension Questions

Section 6 of 12

Assessment 1

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
By using tiny probes as neural prostheses, scientists may be able to restore nerve function in quadriplegics and make the blind see or the deaf hear. Thanks to advanced techniques, a single, small, implanted probe can stimulate individual neurons electrically or chemically and then record responses. Preliminary results suggest that the microprobe telemetry systems can be permanently implanted and replace damaged or missing nerves. The tissue-compatible microprobes represent an advance over the typical aluminum wire electrodes used in studies of the cortex and other brain structures. Researchers accumulate much data using traditional electrodes, but there is a question of how much damage they cause to the nervous system. Microprobes, which are about as thin as a human hair, cause minimal damage and disruption of neurons when inserted into the brain. In addition to recording nervous-system impulses, the microprobes have minuscule channels that open the way for delivery of drugs, cellular growth factors, neurotransmitters, and other neuroactive compounds to a single neuron or to groups of neurons. Also, patients who lack certain biochemicals could receive doses via prostheses. The probes can have up to four channels, each with its own recording/stimulating electrode.

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Assessment 1 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

One similar feature of microprobes and wire electrodes is

- a minimal disturbance of neurons.
- the density of the material.
- the capacity for multiple leads.
- their ability to generate information.

Which of the following best expresses the main idea of the passage?

- Microprobes require further techno-logical advances before they can be used in humans.
- Wire electrodes are antiquated as a means for delivering neuroactive compounds to the brain.
- Microprobes have great potential to help counteract neural damage.
- Technology now exists that may enable repair of the nervous system.

All of the following are mentioned in the passage as potential uses for prostheses except

- transportation of medication.
- induction of physical movement.
- transportation of growth factor.
- removal of biochemicals from the cortex.

The initial function of microprobe channels is to

- create pathways.
- disrupt neurons.
- replace ribbon cables.
- study the brain.

Assessment 2

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
The lives of the Ancient Greeks revolved around eris, a concept by which they defined the universe. They believed that the world existed in a condition of opposites. If there was good, then there was evil, if there was love, then there was hatred; joy, then sorrow; war then peace; and so on. The Greeks believed that good eris occurred when one held a balanced outlook on life and coped with problems as they arose. It was a kind of ease of living that came from trying to bring together the great opposing forces in nature. Bad eris was evident in the violent conditions that ruled men's lives. Although these things were found in nature and sometimes could not be controlled, it was believed that bad eris occurred when one ignored a problem, letting it grow larger until it destroyed not only that person, but his family as well. The Ancient Greeks saw eris as a goddess: Eris, the Goddess of Discord, better known as Trouble. One myth that expresses this concept of bad eris deals with the marriage of King Peleus and the river goddess Thetis. Zeus, the supreme ruler, learns that Thetis would bear a child strong enough to destroy its father. Not wanting to father his own ruin, Zeus convinces Thetis to marry a human, a mortal whose child could never challenge the gods. He promises her, among other things, the greatest wedding in all of Heaven and Earth and allows the couple to invite whomever they please. This is one of the first mixed marriages of Greek Mythology and the lesson learned from it still applies today. They do invite everyone . . . except Eris, the Goddess of Discord. In other words, instead of facing the problems brought on by a mixed marriage, they turn their backs on them. They refused to deal directly with their problems and the result is tragic. In her fury, Eris arrives, ruins the wedding, causes a jealous feud between the three major goddesses over a golden apple, and sets in place the conditions that lead to the Trojan War. The war would take place 20 years in the future, but it would result in the death of the only child of the bride and groom, Achilles. Eris would destroy the parents' hopes for their future, leaving the couple with no legitimate heirs to the throne. Hence, when we are told, "If you don't invite trouble, trouble comes," it means that if we don't deal with our problems, our problems will deal with us . . . with a vengeance! It is easy to see why the Greeks considered many of their myths learning myths, for this one teaches us the best way to defeat that which can destroy us.

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Assessment 2 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

According to the passage, the ancient Greeks believed that the concept of eris defined the universe

- as a hostile, violent place.
- as a condition of opposites.
- as a series of problems.
- as a mixture of gods and man.

It can be inferred that Zeus married Thetis off because

- he needed to buy the loyalty of a great king of mankind.
- he feared the gods would create bad eris by competing over her.
- he feared the Trojan War would be fought over her.
- he feared having an affair with her and, subsequently, a child by her.

It can also be inferred that Zeus did not fear a child sired by King Peleus because

- he knew that the child could not climb Mt. Olympus.
- he knew that the child would be killed in the Trojan War.
- he knew that no matter how strong a mortal child was, he couldn't overthrow an immortal god.
- he knew that Thetis would always love him above everyone else

According to the passage, Achilles

- defeated Zeus during the Trojan War.
- dies during the Trojan War.
- was born 20 years after the war because of the disruption Eris caused at the wedding.
- was the illegitimate son of Peleus.

Assessment 3

This section is going to ask you to undergo a brief assessment. Follow the directions below.

You are going to read a short passage below. Take as much time as you need to read the entire thing.

Passage Begins Here:
An upsurge of new research suggests that animals have a much higher level of brainpower than previously thought. If animals do have intelligence, how do scientists measure it? Before defining animals' intelligence, scientists defined what is not intelligence. Instinct is not intelligence. It is a skill programmed into an animal's brain by its genetic heritage. Rote conditioning is also not intelligence. Tricks can be learned by repetition, but no real thinking is involved. Cuing, in which animals learn to do or not to do certain things by following outside signals, does not demonstrate intelligence. Scientists believe that insight, the ability to use tools, and communication using human language are all effective measures of the mental ability of animals. When judging animal intelligence, scientists look for insight, which they define as a flash of sudden understanding. When a young gorilla could not reach fruit from a tree, she noticed crates scattered about the lawn near the tree. She piled the crates into a pyramid, then climbed on them to reach her reward. The gorilla's insight allowed her to solve a new problem without trial and error. The ability to use tools is also an important sign of intelligence. Crows use sticks to pry peanuts out of cracks. The crow exhibits intelligence by showing it has learned what a stick can do. Likewise, otters use rocks to crack open crab shells in order to get at the meat. In a series of complex moves, chimpanzees have been known to use sticks and stalks in order to get at a favorite snack— termites. To make and use a termite tool, a chimp first selects just the right stalk or twig. He trims and shapes the stick, then finds the entrance to a termite mound. While inserting the stick carefully into the entrance, the chimpanzee turns it skillfully to fit the inner tunnels. The chimp attracts the insects by shaking the twig. Then it pulls the tool out without scraping off any termites. Finally, he uses his lips to skim the termites into his mouth. Many animals have learned to communicate using human language. Some primates have learned hundreds of words in sign language. One chimp can recognize and correctly use more than 250 abstract symbols on a keyboard. These symbols represent human words. An amazing parrot can distinguish five objects of two different types. He can understand the difference between the number, color, and kind of object. The ability to classify is a basic thinking skill. He seems to use language to express his needs and emotions. When ill and taken to the animal hospital for his first overnight stay, this parrot turned to go. "Come here!" he cried to a scientist who works with him. "I love you. I'm sorry. Wanna go back?" The research on animal intelligence raises important questions. If animals are smarter than once thought, would that change the way humans interact with them? Would humans stop hunting them for sport or survival? Would animals still be used for food, clothing, or medical experimentation? Finding the answer to these tough questions makes a difficult puzzle even for a large-brained, problem-solving species like our own.

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Assessment 3 Continued

DO NOT GO BACK TO THE PREVIOUS PAGE. This assessment is designed to test your reading comprehension, so do your best!

Crows use sticks to pry peanuts out of cracks. Which of the following is the kind of intelligence or conditioning the situation describes?

- rote learning
- tools
- communication
- instinct

The concluding paragraph of this passage infers which of the following?

- There is no definitive line between those animals with intelligence and those without.
- Animals are being given opportunities to display their intelligence.
- Research showing higher animal intelligence may fuel debate on ethics and cruelty.
- Animals are capable of untrained thought well beyond mere instinct.

According to the passage, which of the following is true about animals communicating through the use of human language?

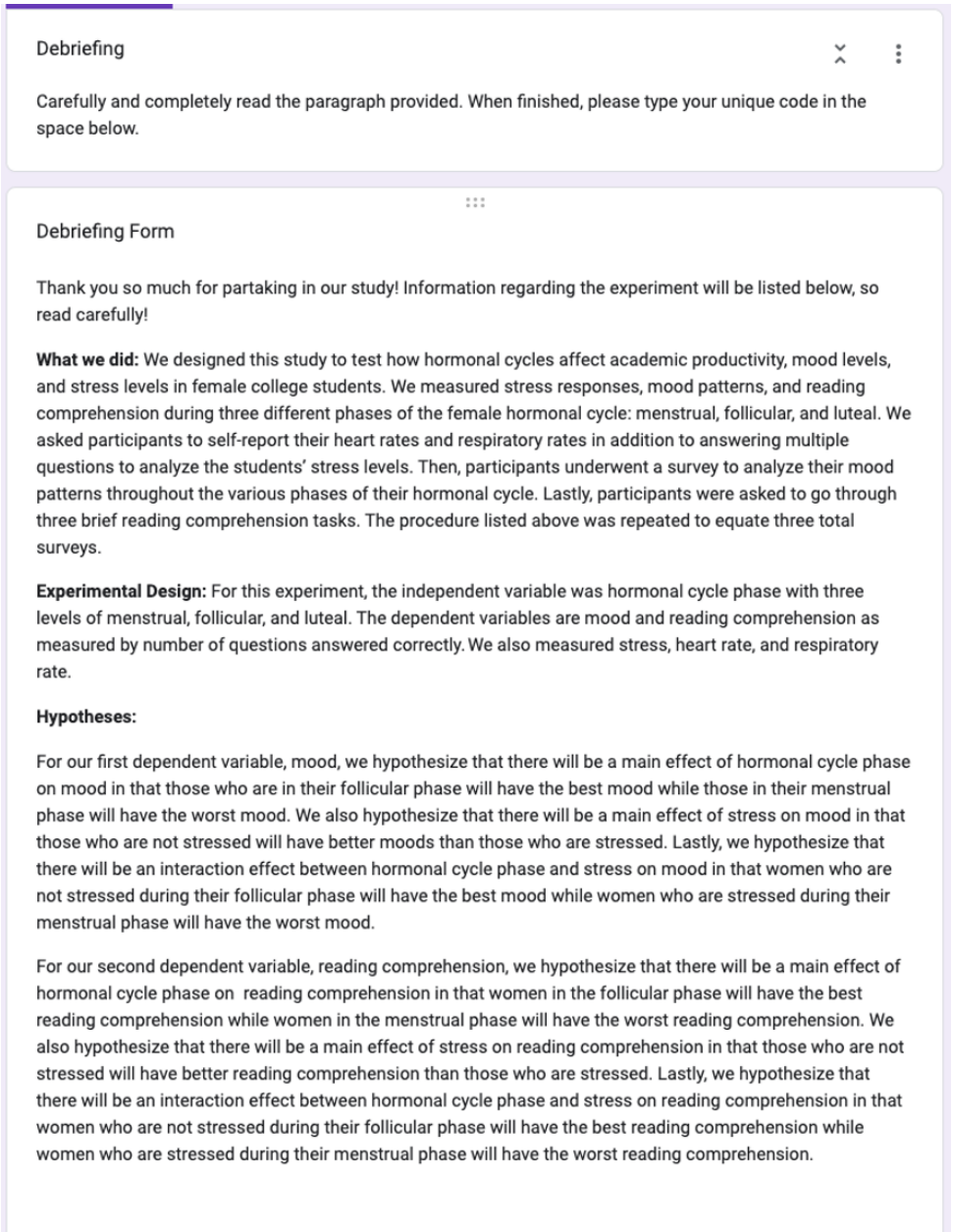
- Parrots can imitate or repeat a sound.
- Dolphins click and whistle.
- Crows screech warnings to other crows.
- Chimpanzees and gorillas have been trained to use sign language or geometric shapes that stand for wo...

Which of the following is not a sign of animal intelligence?

- shows insight
- cues
- uses tools
- makes a plan

Appendix F: Debriefing Form

This is the form that was provided to each participant after they completed all three surveys. It contained information regarding how I conducted my study and what I was hoping to find out from my data.



Debriefing

Carefully and completely read the paragraph provided. When finished, please type your unique code in the space below.

Debriefing Form

Thank you so much for partaking in our study! Information regarding the experiment will be listed below, so read carefully!

What we did: We designed this study to test how hormonal cycles affect academic productivity, mood levels, and stress levels in female college students. We measured stress responses, mood patterns, and reading comprehension during three different phases of the female hormonal cycle: menstrual, follicular, and luteal. We asked participants to self-report their heart rates and respiratory rates in addition to answering multiple questions to analyze the students' stress levels. Then, participants underwent a survey to analyze their mood patterns throughout the various phases of their hormonal cycle. Lastly, participants were asked to go through three brief reading comprehension tasks. The procedure listed above was repeated to equate three total surveys.

Experimental Design: For this experiment, the independent variable was hormonal cycle phase with three levels of menstrual, follicular, and luteal. The dependent variables are mood and reading comprehension as measured by number of questions answered correctly. We also measured stress, heart rate, and respiratory rate.

Hypotheses:

For our first dependent variable, mood, we hypothesize that there will be a main effect of hormonal cycle phase on mood in that those who are in their follicular phase will have the best mood while those in their menstrual phase will have the worst mood. We also hypothesize that there will be a main effect of stress on mood in that those who are not stressed will have better moods than those who are stressed. Lastly, we hypothesize that there will be an interaction effect between hormonal cycle phase and stress on mood in that women who are not stressed during their follicular phase will have the best mood while women who are stressed during their menstrual phase will have the worst mood.

For our second dependent variable, reading comprehension, we hypothesize that there will be a main effect of hormonal cycle phase on reading comprehension in that women in the follicular phase will have the best reading comprehension while women in the menstrual phase will have the worst reading comprehension. We also hypothesize that there will be a main effect of stress on reading comprehension in that those who are not stressed will have better reading comprehension than those who are stressed. Lastly, we hypothesize that there will be an interaction effect between hormonal cycle phase and stress on reading comprehension in that women who are not stressed during their follicular phase will have the best reading comprehension while women who are stressed during their menstrual phase will have the worst reading comprehension.

Finally, we from the research team would like to extend a congratulatory thanks for participating in our study. We recognize that without your participation in this study, we could not have completed our study on the effects of female hormonal cycles and stress on academic productivity, mood, and reading comprehension. Thank you for your contribution and feel free to reach out with any questions about this study.

Researcher Contact Information:

- Kaitlin Medina: kmedina001@regis.edu (970) 390-1855
- Dr. Amanda Miller: amiller@regis.edu (303) 964-5348

In the space below, please DO NOT sign your name. We would like you to sign with a unique code that consists of: 1) your birth year and 2) the last four digits of your Student ID number.

For example, if your birth year is 2002 and your Student ID number is 1234567, then your unique code would be 20024567.

Short answer text