INCORPORATING MOBILE LEARNING
IN THE
DESIGN OF CURRICULUM
FOR
ANATOMY AND PHYSIOLOGY
by
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A curricular thesis submitted to
Sonoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF ARTS
in
Education

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ABSTRACT

Purpose of the Study:

Mobile technologies are becoming the new norm for the computing needs of society and as such students should be interacting with this form of technology in their classroom curriculum. This work examines the design of curriculum, for a senior level high school elective course Anatomy and Physiology, to integrate the use of mobile devices. Areas of emphasis are on the ways in which student use of mobile devices are assessed, how mobile devices afford the opportunity for an increase in collaboration in the classroom, and how mobile devices support student-centered learning.

Procedure:

To determine the quality of curriculum that was designed the content validity panel was asked to evaluate one of the five units of study. Colleagues were invited to observe one of the activities in a classroom and provide feedback. Finally extensive field notes were taken that included student comments as well as personal reflections of experiences in engaging students with mobile learning as part of my regular teaching position. Data collected was used to enhance five units of study that comprise the semester of curriculum completed for this work.

Findings:

Mobile learning was found to be engaging to students in a way that enhanced their learning without altering the content of the curriculum. In addition to this, it was found that mobile learning does indeed foster a more collaborative classroom that provides opportunities to include more student-centered learning.

Conclusions:

Now is the time for mobile learning to be incorporated into the classroom curriculum. Educators can successfully integrate the use of mobile devices into their curriculum without taking away from the content of their subject matter.

Chair: _________________________
Signature

MA Program: Education
Sonoma State University Date: ____________
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This work has truly become a labor of love, since beginning the educational Masters program at Sonoma State University I have known that I was interested in composing a thesis. Since that time I have had many inspirations and have compiled some of my best work as an educator in designing curriculum for the sciences. This work has fortified my future career goal to be an educational researcher and writer. If it were not for the support of many none of this would be possible.

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A big thank you goes out to my thesis committee, especially the chair Dr. Perry Marker. If it wasn’t for all of your feedback my work would be no where, I thank you for asking all the questions you did of me so that I could really see what my data was telling me. Dr. Perry your feedback was priceless and I am honored to have worked with such a scholar. Dr. Jessica Parker I would like to thank you for your support throughout the program, your coursework encouraged me to step beyond my beliefs and take a new approach to education. Ms. Lee Boyes I thank you for all of your feedback and willingness to talk no matter how much you had going on, you always made me and my work feel like a priority.

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<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Introduction to the Study</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Background Context</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Description of the Study</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Significance of the Study</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Support for the Study</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Definitions of Terms</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Limitations</td>
<td>7</td>
</tr>
<tr>
<td>II.</td>
<td>Review of Related Literature</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>History of Incorporating New Technologies into Curriculum</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>M-learning as an Evolution of E-Learning</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Defining M-Learning</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>The Need to Focus on the Design of Curriculum</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>M-Learning Fostering a Collaborative Environment</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>M-Learning Provides Opportunities for Student-Centered Learning</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>The Role of Assessment in M-Learning</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Conclusion</td>
<td>24</td>
</tr>
<tr>
<td>III.</td>
<td>Methodology</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Designing M-Learning Curriculum</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Resources Used in the Study</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Description of the Classroom</td>
<td>30</td>
</tr>
</tbody>
</table>
Procedures........................................................................................................31

IV. Findings ........................................................................................................34
   Introduction....................................................................................................34
   Demographics and Description of the Sample.................................34
   Data Collection............................................................................................35
   Discussion of Content Validity Panel Findings.................................36
   Discussion of Findings from Field Notes..............................................43
   Discussion of Findings from Colleague Observation.......................54
   Conclusion....................................................................................................58

V. Conclusion......................................................................................................61
   Introduction....................................................................................................61
   Major Findings............................................................................................62
   Future Curriculum.......................................................................................66
   Suggestions for Implementing M-Learning........................................67
   Next Steps for Research............................................................................69
   Possible Obstacles and Ways to Overcome Them..............................69
   Conclusion....................................................................................................70
   Appendix A – Curriculum........................................................................72
   Appendix B – Assessments in M-learning Curriculum....................216
   Appendix C – List of Educators.................................................................218
   Appendix D – Lung Capacity Data ............................................................220
   Appendix E – Human Subjects Protocol Approval............................222
   References....................................................................................................224
Chapter One: Introduction to the Study

Background Context

From meager beginnings with binder paper taped to the back of a bedroom door, with stuffed animals lined up much like students in row upon row ready to learn, I have always known that being an educator was my passion. Upon graduating from Lakehead University in Ontario, Canada with a degree in Education as well as an Honors degree in Biology I quickly began blazing a trail for my very own version of the American dream. I was fortunate to start teaching in a middle school in Minnesota where I designed curriculum for 6th, 7th, and 8th grade science classes. While in this position, I had the opportunity to collaborate with the school’s social science teacher in the capacity of co-curriculum coordinator, where we collaboratively designed school-wide thematic units encompassing state standards as well as the scope and sequence standards for the school’s charter. After two years, I headed west, settling in Northern California. I have been in the same district for the past 5 years and have recently taken on a new position teaching Biology, and Anatomy and Physiology. I have designed curriculum for a total of fourteen courses over the past seven years, and in this time I have had many successes and have gained confidence in being able to outline what the pertinent pieces of the puzzle are in designing curriculum. Now I aim to incorporate mobile learning (m-learning) into the design of curriculum.

Each time I work on creating new curriculum, I find myself reflecting on the diversity of students who will fill my classroom. Socio-economic status, gender, race, ethnicity, age, and learning abilities are all taken into consideration when I design
curriculum. Also included in the design process is my philosophy of education: I have always believed that “education is not a process of putting the learner under control, but one of putting the learner in control of his or her learning” (Wong & Wong, 2001, p. 210) in order to foster a successful learning environment.

The curriculum designed for this work is for an Anatomy and Physiology course that is comprised of junior and senior level high school students. I am in a new classroom and on a new campus. Although I have been provided with lecture notes, supplemental materials, and assessments, I am in the process of repackaging the curriculum to incorporate m-learning. I desire for students to see their personal digital devices as a means to compliment and enhance their learning experience inside the classroom, but this means going against the grain since the school sends messages that oppose the idea of using personal digital devices on campus. The parent/student handbook (2012) contains the following passage regarding the usage of these personal digital devices:

Cell phones may never be used or in sight during class time anywhere on campus. A student who leaves the classroom for restroom privileges may not use cell phones; he or she will be assigned a Saturday School and the cell phone will be confiscated. If a cell phone is on or recognizably “rings, buzzes,” etc., or if a student leaves class to respond to a cell phone, it will result in the cell phone being confiscated. A student who refuses a staff member’s request to comply with this policy may be suspended. (Parent Student Handbook, 2012, p. 18)

When reading the school’s policy on cell phone usage, I am left wondering why the school takes such a stance. Why do schools take a negative view on personal digital devices and portray them as something not to be utilized in the classroom? Is there potential for what many see as a toy to be used as tool? If educators decide that they are willing to take their curriculum to the next level and begin incorporating m-devices, what
should they keep in mind when designing such curriculum? This leads to many more questions about the task of transforming current curriculum into one that integrates m-learning in it. How does an educator assess the student usage of m-devices in the classroom? Can m-devices allow students to have more ownership over their learning through student-centered activities? Is it possible to harness these m-devices to allow for a more collaborative classroom environment? Before addressing these other questions, educators must begin by taking a step back and ask what role do m-devices currently have in their classroom?

As I enter my 7th year in the profession, I am noticing that the use of personal digital devices in the classroom is on the rise. This trend parallels what I see outside of the classroom in society, where smartphones, tablets, and music listening devices seem to be carried around virtually all of the time. With the infinite capabilities for communication and collaboration it is time for schools to re-evaluate their opinions on whether or not there is a place for m-learning in the classroom.

Description of the Study

The focus of this study will be on how I incorporated m-learning into the design of the second semester of a yearlong high school senior level elective science course: Anatomy and Physiology. The discussion will include ways in which students used the personal digital devices that they brought to school to facilitate learning. The goal is to have m-learning be seamlessly woven into the classroom experience in order to allow students begin to experience the potential benefits of using such devices in the process of learning.
The curriculum will consist of 5 units of study focusing on the circulatory system, the respiratory system, the senses, the nervous system, and finally the endocrine system. The focus of this curriculum will include collaborating using mobile devices (m-devices), student-centered learning with m-devices, and an examination of the role that assessment plays in the student use of m-devices.

**Significance of Study**

The age of the Internet and the ability to be constantly connected to a plethora of information has changed the landscape of how and where we use this information. When educators design curriculum, are they preparing their students for a digitally saturated world? Although there are many challenges in the educational world, with the advent of the common core, and strings tightening on already stretched budgets, there are still opportunities to innovate. Educators need to consider if there is a place in their classroom for m-learning.

Many students bring a personal digital device with them to school every day. If students have them, why not incorporate m-learning into the curriculum? What is great about these personal digital devices is that they give students the opportunity to step into a role where they are the expert and can teach others. Educators need to evolve from the mentality that learning is a one-way flow of information from teacher to student. As educators know, there is something empowering about being able to teach others. With demands on standardization and testing there is little room for a more authentic learning environment of exploration in the sciences, perhaps m-learning can fill that void.
With the influx of digital media into our everyday lives, it seems apparent that educators of all subject matter need to redefine literacy to incorporate some form of digital media. This curriculum will add to the resources that teachers have to assist them in effective ways of developing m-learning to highlight their subject matter. Even though this curriculum will be specific to the field of science, one aim of this study is to have a process and set of guidelines for incorporating m-learning into curriculum that can be applied across subject areas.

M-learning should enhance the classroom experience and not distract from learning. With the current stance that some schools take on the use of personal digital devices, it can only be assumed that they are of the opinion that m-learning does not have a place in the curriculum. Ideally this work demonstrates through the design of curriculum that there is a place for m-learning and that personal digital devices are an integral component in the future of education.

One of the struggles in the sciences is to have experiments that authentically replicate the scientific method, specifically the analysis of data. It is difficult, if not impossible, for trends to emerge when students rarely share data with one another or try to analyze only their own data. With the use of m-devices, students can share data with the rest of the class in order to analyze a larger data set from which they can draw conclusions. Not only can m-devices be used in the sharing of data, but they can be used in the collection of data as well with the use of applications (apps) and the ability to record audio, still pictures, and video. Not all students are artistically talented and have the ability to draw specimens under a slide to accurately represent what they see with their eyes; m-devices can give students a truly accurate account of what was seen in lab.
Such usage of m-devices in the science classroom can benefit the field of science by allowing students to have a more accurate data set to analyze, much like scientists in the field do.

**Support for the Study**

Since m-learning is a relatively new area of interest in the educational world, it has been difficult to find much information guiding this research. Interestingly enough, what has surfaced repeatedly is the notion that “there is still a scarcity in studies on curriculum design of m-learning” (Abdullah & Sirij, 2010, p. 1638). Koszalka and Ntloedibe-Kuswani’s (2010) work examining the safe and disruptive use of mobile technologies noted that “the educational applications of m-technologies are still poorly understood, as is what constitutes good m-learning” (p. 139). Such ideas inspire this work to move forward and attempt to define what m-learning is and how to best implement it in the design of curriculum. Koszalka and Ntloedibe-Kuswani’s (2010) also suggested that “like m-learning itself, educational research on m-learning needs to develop further.

Having students use their own m-devices in the classroom can foster a more genuine connection to the classroom environment as students become active participants in their learning, instead of sitting back and waiting to be fed the next concept. There is a desire to find a way to use personal digital devices in the classroom curriculum to enhance student ownership of their learning, similar to what Cuban (1990) was focusing on when he examined the use of computers in the classroom and acknowledged that “educators and parents are expressing intense interest in such instructional reforms as
cooperative learning, and greater student participation in classroom tasks” (p. 3). Since m-learning has evolved from electronic learning (e-learning) it is only natural that educators take the ways in which they have utilized e-learning, and apply them to the process of m-learning.

**Definition of Terms**

Engagement – used to describe the performance of students who demonstrate, “focus and attention, actively participating in the learning process, and being motivated to carry on an academic task through to completion” (Brunvand & Byrd, 2001, p. 33).

Mobile Device (m-device) – handheld electronic devices that have the ability to connect to the Internet and run applications (apps); including smartphones, ipods, and tablets.

**Limitations**

The curriculum being designed for this thesis is limited to a senior level elective science course to be implemented in a public high school in Northern California where class sizes range from 28-32 students. Since the curriculum will only be presented to a panel of 3 educators there are limitations to the scope of feedback that will be received with suggestions for improvement.

This work is also limited by the fact that it is the design of a single semester of a yearlong course that will not be piloted. In education there is not always time given to test-drive a lesson, much like people would with a car before making the decision to purchase it. Any time an educator has an opportunity to re-teach a lesson there are
always ways to improve upon what was originally planned, since this is not happening
with the curriculum it is limited.

One of the greatest limitations can be seen in the sheer fact that the sample
population is a classroom where all students carry personal digital devices to school with
them every day, which most likely does not represent the norm in senior level high school
elective science courses.
Chapter Two: Review of Related Literature

Introduction

If the goal of education is to prepare today’s youth for tomorrow’s world, what skills do educators need to ensure students have? What will the future of society, industry, and business look like? Educators need to start by looking at where they are today with the usage of digital technologies in their classroom curriculum and begin to dissect the skills that students need to have in order to be successful in a landscape that is digitally saturated.

More and more educators are encouraged to include a variety of digital technologies in their classroom curriculum. Such changes are leading to a transformation of familiar ways of learning as society is slowly stepping away from the printed tangible text to the binary digital text. Here lies an opportunity to drive curriculum forward as digital technologies introduce altered structures for learning where there can be a seamless blend of the old and the new. The connection to what happens outside the classroom to what happens within is needed now more so than ever. When we feel connected to something there is inherently more value in it. As we leave the classroom and go about our lives we are constantly connected to one device more so than any other: our personal digital devices, be it smartphone or tablet. These handheld devices are quickly becoming much more than something to simply make a call on as all our computing needs are now accessible virtually any time and any place with such mobile technologies.

Many students bring mobile devices (m-devices) with them to class every day. Just what are they using them for? Is there potential for students to be using these m-
devices for learning in the classroom curriculum? Although some educators are beginning to incorporate the use of mobile learning (m-learning) into their curriculum, resistance remains among some educators, administrators, and school districts to incorporate m-learning in the classroom.

Collegeboard.org lists 6 of the top 10 occupations with the most job openings for Bachelor’s degree graduates from 2008-2018 as including some form of computer technology. More and more companies are encouraging workers to bring their own device to complete work on, known as Bring Your Own Device (BYOD). Interestingly enough TechRepublic’s survey on zdnet.com reports that by the end of 2013 62% of companies will allow BYOD. How will companies ensure that these devices will be used for business and not just as a distraction to their employees? What does this mean for future graduates who are in schools now where m-devices are banned in the classroom?

When preparing students for what lays ahead educators must take a look at their current curriculum and consider the possibility of incorporating m-learning. In order to accomplish this, educators need to look at the past experiences of incorporating various types of new technologies and learn how they can apply lessons learned and be effective at integrating m-learning. Just as educators encourage students not to give up and continue to persevere through a seemingly daunting process, educators must remind themselves of the same as they continue to strive for students that are best prepared for their increasingly mobile futures.

This chapter begins by taking a step back and reviewing the history of incorporating new technologies in the classroom curriculum in order to bring to the light the fact that classrooms have gone through similar shifts in pedagogical design. The
discussion then progresses to how m-learning is seen as a natural evolution from
electronic learning (e-learning), leading to a discussion of what m-learning looks like in
the classroom curriculum. Of utmost importance is the need to focus on the design of
curriculum itself that centers on: demonstrating how m-learning fosters a collaborative
environment, how m-learning allows for the incorporation of more student-centered
learning, and finally various approaches to the assessment of m-learning.

**History of Incorporating New Technologies into Curriculum**

Educators who have attempted to incorporate new technology into their
classroom have most likely met their fair share of struggles as “most reforms foundered
on the rocks of flawed implementation” (Cuban, 1988, p. 343). This legacy should not
prevent educators from attempting to incorporate another new form of technology in the
classroom curriculum. When educators are in front of their students imparting
knowledge to them they are often seen as an expert, the one with all the answers. When
teaching specific content, this can be achieved with great success and confidence can
easily be seen in an educator who has years of experience and passion for their subject
matter. For the most part, the content of many subjects has not changed to the same
degree that digital technology has in the past few decades. It seems there is always a
device awaiting an update. The nature of m-devices constantly being upgraded can leave
educators feeling as though it is not worth it to be continually trying to be confident in
their abilities with m-learning when the technology is ever-improving.

One can’t help but question why, when it comes to digital technologies, there is
such a disconnect between our daily lives outside the classroom when “devices are
reshaping users’ daily lives in different ways” (El-Hussein & Cronje, 2010, p. 12). Although it does take time for technology outside of the classroom to be incorporated into classrooms “computer-based technology has failed to impact education in any significant way” (Ingram, 1994, p. 113). Why is this? On a daily basis digital technologies are relied upon for business and pleasure, but not in classrooms, even though student use of digital technologies results in greater student achievement and “enhance[s] their self-confidence and motivation to do well in school” (Cuban et al., 2001, p. 823).

There are still many inconsistencies in the integration of such technology from classroom to classroom since “access to equipment and software seldom led to widespread teacher and student use” (Cuban et al., 2001, p. 813). Keeping this in mind, it’s not surprising that there is a lack of literature discussing the incorporation of digital technology. With such little guidance on how to move forward with technology integration, educators can easily transition their focus to other aspects of teaching and learning.

Cohen et al. stated “the design, adoption, and implementation of new technologies have had a long history that invites little optimism” (as cited in Cuban et al., 2001, p. 816). Digital technology is going to continue to shape our lives and as educators move forward they can no longer wait until there is a significant literature base to begin implementation of m-learning and alter the idea that “in American education, practice has always been up to a century and even more behind theory” (Bayles, 1966, p. 72).
M-learning as an Evolution of E-Learning

Along with the introduction of digital technology in the classroom has come new terminology to describe this form of learning. E-learning is used to describe the use of electronic devices such as radios, televisions, and computers. These devices have changed the landscape of the classroom as they brought with them more resources for students to learn from. Reading about the lunar landing of 1969 is one thing, but to watch a video of the event and see the astronauts leap along the surface of the moon enriches the experience for the viewer. Taking this a step further, students could begin discussing online with their peers the implications and historical significance of such an event. This is one example in which “technology can increase the effectiveness of the human teacher” (Ingram, 1994, p. 120). E-learning has the potential to bring the event to life for the students, therefore further engaging them in the experience.

The incorporation of e-learning in the classroom has not only changed the environment for students but for educators as well. They can now begin to think about how these technologies “might be combined in different ways to accomplish pedagogical objectives, to overcome obstacles, and to provide new opportunities” (Woolsey & Bellamy, 1997, p. 388). Educators are able to blend the old with the new while redefining the best practices of teaching and learning when it comes to incorporating digital technologies. Woolsey and Bellamy (1997) remind educators that, “computer technologies are flexible systems that can be molded and developed for a wide range of objectives” (p. 385). E-learning is not about choosing which tool to use and molding the learning to it; it is about first defining what the objective for learning is and then going to the tool box and seeing what fits. In order to accomplish this, educators must have a
myriad of resources available, just as Ingram (1994) advocated for the idea that “pre-service and in-service teachers will be prepared to integrate technology into all aspects of K-12 curriculum” (p. 118). Although this doesn’t seem to be the case, as among school districts there is a “division between digital haves and digital have-nots known as the digital divide” (Jandric, 2012, p. 65). Some schools have the latest in digital technologies to best incorporate e-learning, and others are simply struggling to get any form of digital technology up and running in their classrooms. Of course it is not always just about the access to equipment. Cuban et al. (2001) note that more importantly educators must “find time to integrate computers and other technologies into their classroom routines” (p. 828).

E-learning has seen its fair share of struggles when it comes to blending into the classroom curriculum. Access to equipment, teacher training, and the time it takes to introduce something new have in many ways inhibited the success of e-learning. Educators need to now take a look at how e-learning is changing and begin to redefine how digital technologies should be a part of the classroom curriculum. If educators step outside their classrooms to see the evolution of digital technologies it does not take long to notice the printed computer maps being replaced with GPS software on a tablet, the once easy to lose boarding passes are now safely stowed away in smartphones, and even the credit card machine may become obsolete as applications (apps) are taking over, the trend is clear that digital technology is going mobile.

But what does this mean for the classrooms that are still struggling to effectively incorporate the use of not-so-mobile technologies? Just as society has transformed its digital nature, it is time for educators to recognize that “mobile learning, also called m-
learning, is seen as a the natural evolution of e-learning” (Martin et al., 2012, p. 46). It is easy for educators to at first step back and argue that e-learning was not an instant success nor was it easily blended into the curriculum so why try something that evolved from it? M-learning is similar to e-learning, and Hassan et al. (2012) claim “mobile learning is a natural flowering of e-learning” (p. 23). E-learning allows students to take their education to a new level with the use of digital technologies and the Internet, which is the foundation for m-learning, which furthers this progress by allowing students to integrate their learning virtually, anywhere and anytime for a variety of purposes, with the use of apps. M-learning provides a new landscape in education where students can take digital technologies with them and allow their learning to flourish inside and outside of the classroom.

Defining M-Learning

Although m-learning has evolved from e-learning educators must remember that “the research is in its infancy” (Koszalka & Ntloedibe-Kuswani, 2010, p. 151). There is much to be learned from the experimentation of introducing m-learning into the classroom curriculum. This will continue to be the case since “like m-learning itself, educational research on m-learning needs to develop further” (Litchfield as cited in Koszalka & Ntloedibe-Kuswani, 2010, p. 153). Educators need to be open to the very idea that m-learning has a place in their classroom curriculum. An epistemological shift in one’s pedagogy usually comes from a solid background of research demonstrating the affordances of utilizing such a form of learning. Abdullah and Siraj (2010) bring to light the obstacle in the integration of m-learning as there is “still a scarcity in studies on
The newness of m-learning positions educators in a place of having to carve their own path as “it seems that there is no detailed methodology or approach of designing mobile learning content” (Hassan et al., 2012, p. 24).

Educators must remember that the age of digital technology is not going away; now is the time to take advantage of the opportunity for students to see the m-devices that they carry around with them as much more. Although students currently have a variety of uses for their m-devices, educators must question if students see the potential in learning from them in the classroom. In the future will the norm be a classroom curriculum that utilizes these m-devices or will the current status of teachers asking students to put them away stagnate this opportunity?

As with any new shift in theory comes obstacles that educators must overcome, front and center would have to be the shift from students simply using m-devices for updating social media to utilizing their m-device in classroom learning as well. “M-learning, however, can also be seen as disruptive learning” (Stead as quoted in Koszalka & Ntloedibe-Kuswani, 2010, p. 142). Which is why for students there needs to be a clear line between the time and the place for using their m-device in the classroom. This rethinking on the purpose of the m-device by the students will take time and training, however it is essential if educators want to effectively incorporate distraction free m-learning in their classroom curriculum. Educators are on the edge of a fundamental change in the way digital technologies are being used in the classroom even though “few people have regarded mobile learning as a core pedagogical activity” (El-Hussein & Cronje, 2010, p. 12). Now is the time to further develop a “philosophy of mobile
learning that relies on Dewey’s insights into democracy and education” (El-Hussein & Cronje, 2010, p. 13). A more collaborative learning experience for students where they are interacting with curriculum in such a way that comes naturally to them is needed.

There is much work to be done as “the educational applications of m-technologies are still poorly understood, as is what constitutes good m-learning” (Koszalka & Ntloedibe-Kuswani, 2010, p. 139). This should not deter educators from driving their curriculum forward to better align with the technological standards of society. It is easy to focus on the “limitations of mobile devices’ capabilities” (Hassan et al., 2012, p. 25). What if educators were to find themselves in a classroom with students who have m-devices in their pockets? Deciding to take a chance on the idea that “mobile learning is a supported teaching technique that can be presented in conjunction with other teaching methods” (Hassan et al., 2012, p. 23). The more educators take advantage of the opportunities students are providing for m-learning by simply bringing their m-devices to class allows for students to utilize the function of apps in a myriad of ways, connect to one another by communicating online as well as sharing information in real time enriching the learning experience.

The Need to Focus on the Design of Curriculum

When educators are preparing for yet another fresh start to the school year, copious amounts of time are spent designing curriculum. Although not every minute of instructional time can be accounted for each educator works with a framework to guide learning as they build on students’ prior knowledge and expand on the content for their subject matter. The most significant curriculum can be designed once the educator
knows their students’ strengths, weaknesses, and individual abilities. This, of course, only comes with time spent in the classroom getting to know students. Just as educators begin to appreciate the individual skills each student carries with them as they enter the classroom, today they must also look physically at what students are bringing with them. Allowing students the power to drive the curriculum by utilizing their m-devices and giving them chances to explore what they are innately interested in working with agrees with Westera’s (2011) work where web technologies are classified as being “firmly grounded in constructivism, exploration-based learning, and inquiry based learning” (p.203).

This does not mean that educators should throw out everything they know about teaching and learning and start from scratch with the focus on m-learning; it means that there needs to be a reframing of the ways in which educators view m-devices. When incorporating new technologies into the classroom Cuban at al. (2001) noted the importance of using “sustained rather than altered existing patterns of teaching practice” (p. 813). Meaning that instead of attempting to alter the curriculum to fit the usage of the m-device, educators need to look at ways that the m-device can be incorporated into existing curriculum. El Hussein and Cronje (2010) stated that, “mobile learning opens our minds to the possibility of a radically new paradigm and encourages us to abandon the constraints of our habitual ways of thinking, learning, communicating, designing, and reacting” (p. 14). Which is where education needs to continue to proceed, to a place where students are asked to move beyond their current abilities.

The myriad of functions that m-learning provides in the classroom can easily seem overwhelming, but what educators must remember is to keep it simple, use what
you need and forget about the rest when getting started. Just as students learn to read one word at a time and progressively work their way up to sentences, educators must be content with starting small and gradually building on the m-learning in their classroom. Again, educators must remember that the adoption of m-learning in a classroom is a gradual change, like introducing any new skill small steps at first can lead to big changes and not feel discouraged because “it has been a challenge to develop learning material for mobile delivery” (Martin et al., 2012, p.47). M-learning is in its infancy, and “curriculum design is one of the major issues which hinders implementation of any new technology based initiative in education” (Abdullah & Siraj, 2010, p. 1638).

**M-learning Fostering a Collaborative Environment**

When designing curriculum, educators often define goals they have for the students as individuals and the class as a whole. When it comes to the scientific method being taught in the classroom, these goals are often aimed at observation and interpretation of data. In the sciences, when the process of experimentation is being employed, traditionally observations are made of an individual’s data or perhaps of a small group of students’ data. With such a small sample size, it can be difficult if not impossible to discover trends and patterns, which is also a poor example of how observations of data are made in laboratories by scientists. Logistically, there are new ways that educators can allow examination of all the student data in the class.

Although there are a variety of ways to achieve this, completing it in real time is one ideal solution so that an immediate discussion can begin. Woolsey and Bellamy (1997) claim that, “sharing observations is a powerful approach to learning” (p. 389).
Sharing of observations can easily be achieved through the use of m-devices by uploading data to a central location for all to access. This mirrors Jeng et al.’s (2010) work that discusses how students can rely on others for data collection and sharing though m-learning that “facilitate[s] collaboration and support[s] some of the social practices associated with learning” (p. 7). Having the skills to be able to effectively work well with one another is vital to a myriad of careers since employees often work in teams where they must rely on one another in order to accomplish tasks.

Not only can m-learning increase the opportunities to collaborate, but “mobile learning devices also have the capacity to enhance a learner’s sense of individuality” (El-Hussein & Cronje, 2010, p. 19). When it comes to m-devices, not all students share the same level of expertise; like in any subject, there is a spectrum of abilities present. Those who are more tech savvy should be acknowledged as individuals with a strength who can then assist other students and the teacher. Due to the nature of m-learning and the accessibility of m-devices, “collaborative and cooperative learning are generally the first method chosen in mobile learning environments” (Jeng et al., 2010, p. 6). Educators should remember that m-learning is not applicable to each and every aspect of the classroom curriculum.

**M-learning Provides Opportunities for Student-Centered Learning**

Teacher-centered learning “refers to teachers controlling what is taught, when, and under what conditions” (Cuban, 2007, p. 3). Student-centered learning is where “students are given increased agency in their own learning experiences” (Luehmann & Frink, 2009, p. 282). The incorporation of m-learning leans towards a more student-
centered learning environment allows “students to talk to one another more, to give students more control over their learning, and to define new roles for themselves” (Woolsey & Bellamy, 1997, p. 398). Allowing students to use their own m-devices in the classroom opens up a new dynamic for learning.

Traditionally m-devices are seen as distractions and not to be used during class time. Telling a student that they cannot use something that they are constantly engaging with virtually everywhere except for the classroom is an invitation for students to hide such behavior. However, if students began to see the value in utilizing their m-devices in the classroom, their relationship with them might change. There might gradually be a shift in the need to always check the m-device as soon as any sound is made alerting them that they have a new e-mail, or that someone commented on their social media status, or that someone is trying to instant message them. This obsession and lack of a healthy relationship with m-devices is one of the reasons why educators might need to consider Franklin Bobbit’s idea brought to light in Bayles’ (1966) work that it is useful to “teach the child to do better what he is going to do anyway” (p. 73). If students are going to rely so heavily on their m-devices why would educators not take advantage of the opportunity to teach them how to make the most of it?

In the past, new technologies such as “film and radio, were reformers’ ways of making early 20th century classrooms child-centered” (Cuban, 1990, p. 4). However, simply bringing these new technologies into the classroom is not enough. What is more important is what educators are doing with the m-devices that students are bringing with them. Cuban (1990) reported that “child-centered progressives wanted more student involvement, active learning, informal relationships between teachers and students, and
connections to the larger world outside the classroom” (p. 4). All of which can be accomplished with the aid of m-learning. When students are engaging with their m-devices in a structured way the role of the teacher is altered to more of a coach who facilitates opportunities for learning.

The Role of Assessment in M-Learning

Educators still continue to discuss what effective assessment is even though “assessment first emerged in America in the 1840’s” (Buzzetto-More & Alade, 2006, p. 252). One might think that by this time educators would be comfortable assessing any new form of student work. The challenge with assessing m-learning is that the technology is not like any other addition to the curriculum, it allows for a myriad of functions which then in turn opens up to various ways to evaluate students. With the influx of new technologies into the classroom educators are now asking “how should the success of e-learning be evaluated?” (Holsapple & Lee-Post, 2006, p. 68).

When introducing any new skill set into the classroom curriculum, it is vital to have a solid assessment in order to evaluate the success of such a form of learning. When introducing new technologies in the classroom Sluijsmans et al. (2006) suggested that, “the design of the assessment should be the first step” (p. 48). Martell and Calderon, as cited in Buzzetto-More and Alade (2006) suggested that, “the assessment process begins with the identification of learning goals and measurable objectives” (p. 253). Educators should not solely base student performance on m-assessment alone as Sluijsmans et al. (2006) research reminded educators that it is ideal when “data from several assessments are used to make decisions about a learner’s performance” (p. 46). Rahmat (2008) said
“assessment is an on-going process” (p. 2). When assessing m-learning, educators cannot simply look at one aspect of the integration of m-learning, there needs to be an ongoing approach to assessing a variety of student uses of m-learning to determine whether or not it improves the learning experience. It is pertinent that educators begin to examine the role that assessment plays in m-learning since “m-learning is likely to become far more a normal part of practice in the years to come” (Ellaway & Masters, 2008, p. 469).

Peer assessment has been a part of the classroom curriculum for some time and according to Al-Smadi (2010) “has gained importance from its emphasis on the importance of making the student an important part of the assessment process” (p. 5). What is interesting is that Sluijsmans et al. (2006) advocated for peer assessment “especially in e-learning” where “learners can play a valuable part” (p. 62). Students need to be given a set of guidelines to follow in order to get the most out of the process of assessment. One efficient way to demonstrate to students what is required of them when assessing the work of their peers in an m-learning environment is the use of a rubric. Nordseth et al. (2010) focused on the use of rubrics to assist in the process of peer assessment in an e-learning environment and noted “the best results were registered with the use of rubrics where the students were presented with clearly defined criteria for expected performance” (p. 337). Most notably, “the overall result was more time spent studying the subject matter so that the students obtained more knowledge and better understanding” (Nordseth et al., 2010, p. 335) of the content.

When incorporating a new form of assessment in the classroom educators must remember that it “is difficult and requires new teacher roles” (Sluijsmans et al., 2006, p.
There must be patience with the process. Not only do educators need to be reminded of the rationale behind incorporating m-learning in the classroom, “implementing innovative approaches like personalized learning on mobile devices requires us to remind students of the pedagogical justification for this new way of doing things” (Nedungadi & Raman, 2012, p. 660). If teachers don’t explain to students the reasons behind the shifts in their learning environment, students will be less likely to buy into this new form of learning and assessment of their work. In time there will be a set of guidelines describing the best practices for assessment in m-learning. This work begins to demonstrate the ways in which one can assess the student use of m-learning with a focus on peer assessment and the use of rubrics.

**Conclusion**

As educators step forward and continue to refine their classroom curriculum it is important to keep in mind that “students seem constantly plugged in, wired, and connected to one device or another” (Considine, 2009, p. 65). The influx of m-devices present in the classroom is not always easy to deal with; however, Woolsey and Bellamy (1997) informed educators that, “technology is a change agent and that change is often uncomfortable” (p. 398). Educators need to look beyond the initial distraction of m-devices and begin to examine how they may be able to incorporate m-learning into their classroom curriculum. Instead of focusing on the mistakes and misuse of e-learning in the classroom, educators need to take a fresh look at the possibilities that m-learning affords for student success.
To begin, there needs to be more of a focus on the design of curriculum to support m-learning as “the use of information technologies and e-learning strategies can provide an efficient and effective means of assessing teaching and learning effectiveness” (Bennett as cited in Buzzetto-More & Alade, 2006, p. 251). In conjunction with the design of curriculum is the assessment of m-learning: educators need to simultaneously develop both simultaneously in order to end up with a solid curriculum focusing on the use of m-devices in the classroom. Buzzetto-More and Alade (2006) shed light on the idea that “e-learning should encourage the rethinking of curriculum, e-learning, and technology, and explain that e-assessment is flexible and supports the assessment of higher order thinking, social skills, and group work” (p. 256). Which is similar to Sluijsmans et al. (2006) work where e-learning is described as a “dynamic collaborative environment in which learners can interact, engage in critical thinking, share ideas, defend and challenge each other’s assumptions, and reflect on the learning material” (p. 45). With all of the affordances of m-learning it is bound to become a part of the new standard in the process of teaching and learning.

With a lack of research apparent to any new structure for learning in the field of education, it is understandable that educators have apprehensions surrounding the incorporation of m-learning into their curriculum. Educators need to be willing to risk the possibility of entering seemingly uncharted territory in order to transform their work into the future of learning. This work serves to continue the conversation among educators to consider the idea that “the mobile device has the potential to aide the teaching and learning experience” (Martin et al., 2009, p. 51).
Chapter Three: Methodology

Introduction

Whenever educators are working to improve their practice it is important to reflect on the journey they have taken. The idea of electronic learning (e-learning) where students use computers to drive the curriculum forward has slowly developed in various classrooms. With the addition of the Internet educators are finding various new ways to incorporate e-learning into their classroom curriculum. However lately the trend in society has been toward the mobile aspect of digital technologies, and as a result many students are bringing their own electronic devices to class. This influx of mobile devices (m-devices) is beginning to inspire educators to look beyond the distraction that m-devices bring to the classroom and see if there is a way to effectively incorporate the use of mobile learning (m-learning) in the classroom curriculum.

The curriculum for this work was designed for an Anatomy and Physiology course that has a prerequisite of the completion of Biology with a B or better for both semesters in the previous academic year. Anatomy and Physiology is described in the student handbook as follows:

This laboratory course is intended for students who wish to expand their knowledge of the structure and function of the human body. This course will be especially valuable for students wishing to continue in various health careers after high school. Participation in all aspects of this course, including field trips, dissections, and CPR training is mandatory. This course qualifies for credit by exam for Anatomy 140 at the local junior college. This course meets the subject area “d” requirement for the UC/CSU approved course list. (Course Catalogue, 2012-2013, p. 22)

Although the complete curriculum included in the study was not be piloted, a current teaching position was used to inspire this thesis and some of the activities included in the curriculum. In addition, a content validity panel along with feedback
from colleagues was used to further guide the development of the m-learning curriculum. Finally, a discussion of the procedures used to finalize the curriculum is included.

**Designing M-Learning Curriculum**

When one takes the time to look around the local coffee shop, the line at the grocery store, and even in our homes, a pattern emerges where there are more and more screens becoming omnipresent in our everyday lives. Most recently society has seen an influx of handheld devices entering the market place. Smartphones and tablets are quickly becoming somewhat of an appendage as we find ourselves constantly connected to these personal digital devices. When educators think about the future of classrooms and where they will be in ten, twenty, and even fifty years from now, it is easy to come to the conclusion that digital technologies will soon begin to dramatically reshape the current ways of teaching and learning in the classroom. Although many schools have policies in place about the usage of digital technologies, some educators view personal digital devices as a distraction to student learning.

The potential to influence the classroom by allowing students the ability to collaborate on their learning through their m-devices, have the ability to take ownership over their classroom through student-centered learning, and assess the student use of m-devices in their learning will be the pillars of this curriculum study. This work will contribute to the research that is evolving around the best practices associated with m-learning.
Resources Used in the Study

The initial resource used in this study is the work of the previous science teacher who recently retired leaving his course notes and lecture schedule. The school has adopted Marieb’s 2001 edition of Human Anatomy and Physiology as the course textbook. In conjunction with these resources, California state standards (2008) under the Biology/Life Science framework standards 9 a-i and standards 10 a-f are included. Along with this the Next Generation Science Standards HS-LS1-2 and HS-LS1-3 are covered.

With the design of any new curriculum comes evaluation of the curriculum itself. In order to determine the usefulness of incorporating m-learning into the classroom curriculum a content validity panel will be asked to assess and provide feedback on one of the five units included. The content validity panel consists of three educators who can be classified as adept in curriculum design, Anatomy and Physiology content, and in the use of digital technologies in the classroom. Each of the panel members was identified through numerous conversations with highly qualified colleagues. The panel was asked to respond to the following prompts in regards to a single unit of the curriculum:

1.) Does this unit contain student-centered learning activities using m-devices that are engaging to students?
2.) Is the assessment of the student use of m-devices clear and appropriate?
3.) Does the use of m-learning foster collaboration among students?
4.) Is the content of the curriculum negatively or positively impacted by the use of m-learning?
5.) Should any changes be made to the content of the unit to adjust for the use of m-learning?
6.) Any suggestions on how to improve the unit?

The feedback gained from the content validity panel will be analyzed and used to further develop the individual units.
In addition, colleagues including two administrators, one teacher, and one student teacher were asked to observe a lesson that includes the use of an online polling website. The colleagues were asked to respond to the following prompts during the class time in order to determine what educators outside of the regular classroom see happening.

1.) Discuss what you observed in the classroom with respect to the student use of mobile technology.
2.) What are your thoughts on student use of mobile technology in the classroom (beyond what you saw today)?
3.) Discuss your experience with mobile technology in the classroom.
4.) Any other thoughts?

The feedback gained from the observation by colleagues was helpful in refining and improving the ways in which the specific task, of using an online polling website, was utilized.

Even though the curriculum will not be piloted, there was some degree of student feedback used in the study since certain activities were implemented in a previous position as an Anatomy and Physiology teacher. As the semester progressed, it was important to document the reactions of students to the use of m-learning in the classroom curriculum as the school policy states that personal digital devices are not to be used in the classroom unless instructed by a teacher. Opening up the curriculum in such a way potentially changes the pedagogical practice of curriculum design, ideally expanding the best practices that are associated with the process of designing curriculum for m-learning. A discussion of the sample population of students’ comments will follow, as I am using their experiences in the classroom to support this work.
Description of the Classroom

Since designing this curriculum is a part of a regular position as a high school science teacher the school and classroom was used to provide feedback to further develop the curriculum to include m-learning. The classroom is located in a semi-rural region in Northern California with a population of approximately 58,000 and is one of two high schools in the city. Below is demographic information taken from the 2011-2012 School Accountability Report Card (SARC). The SARC is a yearly report that is made public to allow the community to be informed of the demographics, student achievement, and the general environment of schools.

Table 1.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>School Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Enrollment</td>
<td>1,317</td>
</tr>
<tr>
<td>Graduation Rate</td>
<td>96%</td>
</tr>
<tr>
<td>African American</td>
<td>1.9%</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>0.8%</td>
</tr>
<tr>
<td>Asian</td>
<td>1.4%</td>
</tr>
<tr>
<td>Filipino</td>
<td>0.7%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>20.4%</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>0.5%</td>
</tr>
<tr>
<td>White</td>
<td>73.9%</td>
</tr>
<tr>
<td>Socio-Economically Disadvantaged</td>
<td>28.2%</td>
</tr>
<tr>
<td>English Learners</td>
<td>14.8%</td>
</tr>
<tr>
<td>Students with Disabilities</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

Anatomy and Physiology is a course that has been offered on campus for just over a decade, ranging from two to three sections each year, with a maximum of 32 students per section. Currently there are 2 sections, each with 29 students. The second section
was used to provide support for the development of the m-learning curriculum. Located below is demographic information for the second section that had various m-learning activities integrated into the classroom curriculum.

Table 2.

*Sample population for 2nd period Anatomy and Physiology.*

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Anatomy and Physiology Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juniors</td>
<td>34.5% females, 10.3% males</td>
</tr>
<tr>
<td>Seniors</td>
<td>41.4% females, 13.8% males</td>
</tr>
<tr>
<td>African American</td>
<td>3.4%</td>
</tr>
<tr>
<td>Asian Indian</td>
<td>3.4%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>10.4%</td>
</tr>
<tr>
<td>White</td>
<td>82.8%</td>
</tr>
<tr>
<td>Socio-Economically Disadvantaged</td>
<td>20.7%</td>
</tr>
<tr>
<td>English Learners</td>
<td>13.8%</td>
</tr>
<tr>
<td>Students with Disabilities</td>
<td>3.4%</td>
</tr>
</tbody>
</table>

Anatomy and Physiology is a senior level elective science course in the department with an almost 50/50 mix of juniors and seniors. The majority of the class was composed of white females. The students in Anatomy and Physiology primarily fall into one of two categories for why they have chosen this elective course: plan on going into the medical field, or not interested in the medical field, but highly interested in understanding how the human body operates.

**Procedures**

The m-learning curriculum began with an outline of the five units that were covered in one semester, included in this was the learning objectives for each system of the body. This information was used to roughly sketch out the amount of time that was
needed for each unit. Overestimating the amount of time necessary is best in order to provide time for a variety of extenuating circumstances that may arise.

Once the content of the curriculum is described, the m-learning was then integrated through various activities in order to utilize the m-devices students bring to class. When designing m-learning, it is important to remember that it is not about making the curriculum fit to the m-devices, it is about allowing the m-devices fit the curriculum. The m-devices were used in a variety of ways in each of the units as described in Appendix A.

Some examples of the ways to integrate m-learning into the science classroom was through the use of applications (apps) to collect data during experiments. The m-devices were also used to share the data that was collected with the class, allowing students to analyze a set of data for trends much like scientists do. An online polling website was used in a variety of ways throughout the units, including accessing the background knowledge of students, as a tool to initiate the discussion surrounding the analysis of data, and to gain feedback from students. The functionality of m-devices allows users to access e-mail and compose messages, which was included in the curriculum, replacing the traditional paper and pencil method of quizzing students mid-unit. Finally, due to the ability to access the Internet students were using their m-devices to conduct research on a topic of their choosing, which was later presented in a variety of formats.

As the semester progressed, feedback was taken from the content validity panel, observations of colleagues, as well as field notes highlighting personal experiences when integrating m-learning activities. As feedback was collected, it was continually used to
further advance the development of the curriculum for Anatomy and Physiology that focuses on the student use of m-devices.
Chapter Four: Findings

Introduction

Mobile devices (m-devices) are being seen more and more in the pockets of high school students. The time has come for educators to ask themselves: what role does mobile learning (m-learning) have in their classroom curriculum? Is it possible to harness students’ m-devices when designing curriculum to allow for a more collaborative environment? Can the use of m-devices provide opportunities for more student-centered learning giving students more ownership over their learning? How does an educator assess the student usage of m-devices in the classroom? Finally, what should educators keep in mind when designing curriculum that includes the use of m-devices?

This chapter begins with a description of the sample population that was used as an audience for the curriculum. Next is a description of the ways in which data was collected, from field notes to colleague observations to a review of one unit by a content validity panel. Following this is a discussion of how each of the components of data collected was used to further refine the m-learning as the semester progressed. Finally, the most significant aspects of designing m-learning curriculum are discussed.

Demographics and Description of the Sample

This chapter will focus on the use of m-devices in the classroom through the analysis of data collected over an academic year in an elective Anatomy and Physiology course. The course may be taken upon completion of both physical science and biology. The high school is located in a town in Northern California with a population of 58,921 (according to www.city-data.com). The school has a student population of 1,317 with a
96% graduation rate and is one of two public high schools in the district. The student body is predominantly White (73.9%) with 20.4% of the population being Hispanic or Latino. In total 26.9% (354) of students are receiving free/reduced price meals. The school’s population consists of 72 (5.5%) English learners; with 65 (4.9%) consisting of Spanish speakers, 3 (0.2%) consisting of German speakers, and 4 (0.3%) consisting of speakers of other languages (according to www.ed-data.k12.ca.us). The class that was used in this work was an almost 50/50 combination of juniors and seniors with the majority of students (75.9%) being female. The majority of the class is White (82.8%), 10.4% Hispanic or Latino, and 3.4% both Asian Indian and African American. Twenty percent of the class is defined as being socio-economically disadvantaged and 13.8% are English learners, with 3.4% identified as having a disability. The refinement of the completed curriculum for the second semester included in Appendix A was guided by: feedback from a content validity panel, colleagues observing the student use of m-devices in the classroom, as well as an accumulation of field notes that include comments from students when m-learning activities were completed.

**Data Collection**

During the second semester of a yearlong course, field notes were taken weekly with monthly reflective follow-ups that allowed for a more thoughtful examination of what was observed when students were engaging with m-learning. Field notes were collected in a number of ways, from simply scratching down information on a post-it note to typing up observations on an m-device (a convenient way to capture data quickly). After the smaller pieces of data were collected, they were assembled in a document and
periodically returned to and reflective comments were added to gain more from the experiences of students. Attempting to understand what the data was saying was vital to the refinement of the completed curriculum and essential to effectively designing curriculum that incorporates meaningful m-learning.

Pertinent to the process of data collection was the use of student comments during the introduction of m-learning in the curriculum. Since the students are the audience for the use of m-devices, it was essential to utilize their feedback to contribute to the finalization of the curriculum. The rationale for using student comments was to gain an insight into the lens that students bring to the table in an effort to gain an understanding of how students interpret the use of m-learning in the curriculum.

Colleague observations were collected to gather outsider perspectives on how m-learning is presented by educators and how students respond, engage, and function in this new learning environment. Two administrators, one teacher, and one student teacher observed the use of an online polling website in the classroom where students used their m-device to text in responses to a variety of questions. Polling websites allows one to ask an audience a question to which they can respond in real time via text message. Responses can be open-ended or responders can choose from pre-determined responses. The responses were then viewed on a computer and projected onto a screen for the entire class to view.

**Discussion of Content Validity Panel Findings**

The content validity panel consisted of three educators who are seen by their peers as exemplary in their fields: one in the usage of digital technologies in the
classroom, one in the content of Anatomy and Physiology, and one in the design of curriculum itself. The panel was selected through discussions with colleagues and personal experience with the selected panel members. The panel was chosen based on the experience, reputation, and passion, not only for the process of learning, but for their subject matter as well. The panel was asked to review one of five units of curriculum for this work guided by a series of questions. The content validity panel was helpful in providing alternate lenses in the evaluation of the unit itself while simultaneously providing useful insight to further improve the m-learning curriculum.

**Student–centered learning.** First the panel was asked, “Does this unit contain student-centered learning activities using m-devices that are engaging to students?” All panel members agreed that it did. Various comments highlighted that it is important to have a mixture of student-centered activities that are modeled after one another while continuing to differentiate the structure of the activities in order to maintain engagement. This is important to keep in mind with m-devices being used, since when students are asked to complete the same task over and over again with little variation, they can easily lose interest. Students need to be continually challenged with meaningful activities. The tech educator commented that, “when the students perceive value, it can correlate to more engagement” resulting in a better chance of successfully incorporating m-learning into the curriculum. This is especially important when it comes to the use of m-learning in the classroom curriculum: if students are not engaged, they literally have infinite ways to distract themselves with their m-devices.

Throughout the curriculum, students are asked to complete a variety of mini-research projects where they choose which medical condition they are interested in
learning more about. In the circulatory unit, students’ final work was presented in a public service announcement that was made using m-devices (see Appendix A, p. 107). This type of student-centered learning allows for the opportunity to choose what it is they will be learning about. These mini-research projects involve the use of m-devices in a variety of ways, depending on the specific unit, in order to keep the activities alluring to students. By nature, m-learning is engaging to students, but as educators we need to remember that we must keep the activities continually appealing, instead of repetitive, and that different activities will have varying degrees of success with different populations of students. When first introducing m-learning into the curriculum it is vital to test out several activities to find what works best for your content and your students. It is important to continually look for new ways to incorporate m-learning to further enhance student learning.

Assessment of m-device usage. Secondly the panel was asked, “Is the assessment of the student use of m-devices clear and appropriate?” This proved to be the area of biggest need. With the introduction of any new learning modality in the classroom educators must assess effectiveness and determine whether or not it is worth continuing. M-devices are unlike any other piece of equipment that has been introduced into the classroom. Educators are constantly asking their students to bring supplies into the classroom to enhance their learning, such as calculators, paper, and colored pencils, but never before have educators harnessed the very device that students bring into the classroom on their own. The ways in which m-learning is assessed is pertinent to the success of the usage of the m-device itself (Abdullah & Siraj, 2010, p.1641). The panel was informative in recommending the need to have clarity for the students’ sake on
expectations of use. M-devices are by nature multi-functional, and as such, the
assessment needs to be as well. The curriculum educator stated that, “you are assessing
students in their use of m-devices at many different times throughout the unit,” which
lead to the realization that students need to have specific guidelines on what the
expectations are when it comes to the use of m-devices in the classroom. As a result
rubrics were designed for m-device usage when watching videos, when researching
medical conditions associated with specific systems of the body, and when using
applications (apps) (see Appendix A, p. 81, 82, 115). It is important to be transparent
with expectations of students in order to increase the usefulness of m-devices in
classroom activities. Even though students have most likely completed similar tasks with
m-devices on their own, they had not done so in a structured educational setting.
Altering the context will ideally change the ways in which students see their m-device.
Ideally students will gain an appreciation for the ways in which their m-device can assist
in learning and lessen the distraction that can come with taking what was once banned
and bringing it to center stage. Educators need to be specific with each m-learning task
by describing what the expectations are along with how the students will be assessed
before beginning activities. For example, the app usage rubric (see Appendix A, p. 115)
was given to students and reviewed upon several occasions when students were given
time in class to take practice quizzes and use virtual flash cards. The rubric allowed
students to clearly understand what it mean to stay on task by having it spelled out in the
rubric. When beginning this m-learning activity for the first time it was important to
model for student how one shows what it looks like to engage with the app, as outlined in
the rubric. It was also useful to post this rubric on a large screen in the front of the class
as students were completing the activity, while I walked around the room to monitor student work. These rubrics proved to be useful in attaining the desired behavior of students while using their m-devices in the classroom. Although it can be difficult to constantly monitor everyone’s device, what is needed is buy-in from the students. Just like with electronic learning (e-learning) students will eventually misuse the device in some way. What is important as an educator is to limit these opportunities through strong engagement.

**M-learning fostering collaboration.** Thirdly the panel was asked, “Does the use of m-learning foster collaboration among students?” All panel members were in agreement that m-learning does indeed foster collaboration. The tech educator mentioned first and foremost that, “the wikispace and the apps definitely foster collaboration.”

What was interesting was the fact that the content panel member noted that some of the activities that included m-learning, such as the use of apps in the lab, were already collaborative in nature. When it comes to apps, students are relying on one another to test their sense of hearing and to collect data (see Appendix A, p. 145). This sort of collaboration does take place a lot in science classrooms when experiments are being conducted. When m-learning is introduced to this already collaborative setting, students have to further work together to ensure that they are properly using their m-devices to collect the data, which means the ways in which they assist one another is altered. It is as if there is a layering of collaboration with the use of m-devices where students are working together in new ways that are not simply orchestrated by the teacher. The ability to work well with peers is something that does not come easily to all students as they often take their personal connections into consideration when working with others. It is
the role of educators to remind students that collaboration is about being able to work well with any number of individuals, no matter what your personal opinions are, and that the goal of collaboration is to be successful in completing a task together. The introduction of m-learning in the curriculum opens up a new level of collaboration where students feel more comfortable with the tasks they are being asked to complete as they are using something they are already familiar with as observed in the classroom setting.

**M-learning’s impact on content.** Next the panel was asked, “Is the content of the curriculum negatively or positively impacted by the use of m-learning?” It was unanimously agreed upon that with the introduction of m-learning, there is a positive impact on the curriculum. The panel saw m-learning as a natural progression in the usage of digital technologies in the classroom, mirroring what is seen in society’s transition from desktop to handheld. The panel did mention that the only possible negative impact they could see was in the misuse of the m-devices. Like any other tool that is being utilized students will find a way to somehow misuse m-devices; even a piece of paper can easily be turned into a paper airplane, or worse yet, crumbled into tiny pieces and spit through a straw. The point is not to let what may go wrong prevent educators from incorporating m-learning into their curriculum. Students need to be taught how to properly use their m-device in the classroom without abusing it; hence, ensuring a solid structure is in place when utilizing these m-devices is vital. In a science lab setting, there are multiple times when students are using experimentation to better comprehend concepts. The content educator was quick to mention that, “the content is positively impacted by the use of the color blindness and hearing test apps,” (see Appendix A, p. 145) much like traditional instrumentation has done for students studying the sciences.
The positive feedback of the content validity panel encourages the use of more apps when conducting experiments.

In addition, the panel was asked, “Should any changes be made to the content of the unit to adjust for the use of m-learning?” To which they all replied no. It was reassuring to have the outside perspective of experts advocating that the incorporation of m-learning does not take away from the content of the curriculum. Introducing anything new into the curriculum can be challenging for educators. It can be difficult to change what has been successful in the past when there is so much unknown surrounding m-learning. Educators are on the verge of a dramatic shift in the dynamic of classrooms and their relationship to new mobile technologies. Now is the time to plan, experiment, reflect, and share with one another in order to make the most of the opportunities that students bring to the classroom with their m-devices as it is “a format that is engaging” to the students, as noted by the curriculum educator.

**Suggestions to improve curriculum.** Finally the content validity panel was asked if there were, “Any suggestions on how to improve the unit?” A variety of suggestions were made on how students can present information for a research project. Most notably was the use of an infographic that was added to the curriculum to explain a medical condition of the respiratory system (see Appendix A, p. 122). The tech educator also focused on preventing students from using their m-devices to cheat off one another. If there is more than one section of the course, or for students who are absent, than there must be more than one prompt to be used when using m-devices to submit quiz answers. The content educator brought up a good point in regards to students using their m-devices for research and ensuring that “they have a solid background in how to distinguish
reputable online resources.” This is important no matter what electronic device is being used to access the Internet. Ideally, by the time students reach a senior level course they come prepared already knowing how to do so; if not, it is a great opportunity to either design a mini-lesson around critiquing websites for accurate information, or better yet, rely on colleagues to assist with such a lesson. Many librarians and tech savvy educators would be more than willing to share what they have when it comes to teaching students how to discriminate websites for their quality.

The content validity panel was assembled as a resource to evaluate the quality of one of the five units of m-learning curriculum. The panel was insightful in bringing up the need for clarity when assessing the student use of m-devices in the classroom. From their responses rubrics were designed to allow for transparency of expectations in order to maintain a productive learning environment. The panel was encouraging with regards to their feedback on the quality and feasibility of implementing this new form of learning in a science classroom.

**Discussion of Findings from Field Notes**

Introducing m-learning in the second semester was beneficial as students had a clear understanding of what classroom expectations were when it came to m-devices from the first semester. Since students carry these devices with them everyday, parameters were put in place as to what constitutes the proper usage of m-devices in the classroom. Students were allowed to listen to music when they were given time to start their homework in class, as long as it was not a distraction to them or to anyone else. For many it was a good way to lessen distractions of what was going on around them. One
student commented, “it allows me to concentrate better.” When students had their m-device out during lecture or other class time, they were directed to put it away. Since having a high level of respect is pertinent to the success of any learning environment, when students were defiant in the rules associated with their m-device, they were promptly reminded of what was appropriate and what was not. What was interesting was that some students would pull their m-device out and have it sitting on their desk while they were working, but not touch it at all. It seemed to be almost like a security blanket, as if they just liked having it around, comforted in knowing it was there. One student commented, “I forgot my phone today and I feel lost without it.”

Educators can attempt to break down the walls of the classroom with their students so that they view learning as more than just what happens inside four walls. A wikispace was used in the classroom that included the daily agenda, copies of handouts, a calendar with homework assignments and upcoming tests, along with links to clips that were watched in class to reinforce concepts. The wikispace was also used to upload and share data that was collected from experiments. One of the benefits of the wikispace is that students can access it through their m-device. When talking to a student after an absence and asking about the process of using their m-device to access missed information, they commented, “I love it; it’s so convenient.” Having the ability to catch up on classwork and ensure that students are completing the correct homework is valuable to be able to do virtually any time at any place via their m-device. It is moments like these that reinforce how students are willing to see their m-device as an extension of the classroom and aid in their learning. If students see the convenience of using their m-
device for classroom activities, it makes sense that educators need to continue to incorporate such technologies in their curriculum.

**Scientific method.** In any science class, students are encouraged to further their understanding of the scientific method. One of the most important steps in the scientific method is the analysis of data collected. It has always been a struggle as more often than not students are asked to analyze a small set of data, perhaps only their own. This is not the best-case scenario as students are not able to draw conclusions and discuss trends. In the scientific community the best research is done on a large number of specimens. M-devices allow students to be able to share their data anonymously with everyone in the class and one student commented, “I like being able to compare my data to others.” With each experiment, the first question students would ask is whether or not their data was normal. Being able to see the entire set of class data gave students a better understanding of the spectrum of results. Each student was assigned an ID number that they would reference to the column to input their data; this allowed students to analyze the data, not the person.

After all the data was submitted, it was projected on the screen for everyone to see and evaluate (see Appendix D, p. 227). The first time analyzing such a large data set, students were thoroughly guided in what steps they needed to take to draw conclusions and discover trends. After subsequent times in sharing data, there was more ownership on the students to properly draw conclusions from the data that was collected.

The first time included a bit of a learning curve in that some students had never used their m-device in such a way before, while some students seemed to be right at home. It was encouraging to see how quickly students were willing to ask for assistance
when they were struggling. Educators know that asking for help can be difficult for students, and using m-devices in this manner allowed students to collaborate in a positive way with one another. It was encouraging to see the students who were more tech savvy with their m-device gaining confidence in their abilities as well as a new role in the class as the go to person for assistance. One student noted that they were “glad James¹ was there to help us out.” As an educator, it is always pleasant to see a shift in power as different students are being given the opportunity to shine. Some of the most tech savvy students hadn’t experienced this before in class. It was thrilling that the opportunity for these students, who thus far had had little success in class, to rise to the top was afforded by the use of m-devices.

When conducting experiments in any science classroom, there is a high degree of collaboration that takes place among students. In Anatomy and Physiology there is often one subject being tested, one subject completing the testing, and one subject recording the results. As a group, students are often given little time to begin making sense of the data collected, and are most often asked to complete this work individually. M-learning allows students to share data with the entire class as it is being collected. As data was uploaded, students had the opportunity to immediately discuss in their groups what they saw. While doing so, a student commented, “I feel more science-y discussing a big set of data like this.” It was such a powerful moment to have students conduct an analysis of a large set of data and discuss the trends they saw.

After some time, a class-wide conversation ensued where students were able to dig deep into the data that was presented. Scientists rarely work independently and often

¹ Student name changed.
take into consideration the opinions of others when coming to a final conclusion. The quality of conversation that took place while discussing the large set of data was a powerful moment for the students to further their learning, not only making connections to the content, but also in their understanding of the scientific method. This opportunity was afforded by the use of m-devices. Hearing students comment that “it’s interesting to see the differences in males and females” while analyzing the data is not something they were able to complete before utilizing their m-devices in such a way. This example of analysis was used as a springboard to further understand the inner workings of the human body; it opened up the conversation to the differences in the physiology of males and females and how these seemingly small internal differences can lead to larger outward differences in performance. For students, it was not easy to comprehend that so much of what we see physically on the outside is predetermined by what is happening physiologically on the inside. It is important for students to appreciate the complexity and functioning of the structures of the human body in an introductory Anatomy and Physiology course.

When utilizing m-learning in the classroom curriculum, attention was paid to the relationship the students had with their m-devices. For example, when using apps in a laboratory experiment where students were testing their hearing and vision, they were instantly engaged as they immediately got down to work (see Appendix A, p. 144). Sometimes the use of equipment in experiments can be daunting and students lose interest as there is much time spent learning how to use the equipment as opposed to gathering information from it.
One of the most successful uses of m-learning in the curriculum was the use of apps in laboratory experiments. With each lab report write-up, students completed as part of working through the scientific method they were asked to share what their favorite part of the lab was. Eight-five percent of students listed that using the app in the experiment was the best part, suggesting that students are not only interested in the use of the apps, but also enjoy the use of m-learning in the classroom. Students quickly demonstrated a willingness to use their m-devices in a novel way in their learning.

Since students are continually struggling with best practices when it comes to preparing for test taking, the use of apps also helped when it came specifically to labeling diagrams for a unit test. Students were directed to download free apps (see Appendix A, p. 172) that included flashcards and quizzes of content and were given time as a warm-up in class to review the previous days material. This style of m-learning incorporation opened them up to the idea of thinking about studying like training for an athletic event: doing a little each day will yield better results than only training once for a longer period of time. All too often students see studying for a test as something that happens at a desk with a pile of papers and a textbook in front of them the night before. The juniors and seniors commented on just how busy their lives had become with a course load of AP classes, applying for college, jobs, and graduation. What they didn’t realize was that there were pockets of time in their day when they could sneak in some studying. A few minutes on the way to school, waiting at the dentist, or during commercial breaks of their favorite television show adds up quickly and better prepares students for the memorization that comes with learning specific structures that comprise organs and organ systems. During the majority of the day students have their phone with them, so why not
take advantage of the opportunity of m-learning outside of the classroom as well?

Several students commented after the next test that these little pockets of time spent on their m-device really helped with getting all the information straight.

**Student-centered learning.** When introducing student-centered learning utilizing m-devices in the classroom beginning with something simple, such as a mini-research project, is ideal. Starting small to see how students react to the use of m-learning in the classroom is important to see if they can focus on the task at hand and not be distracted by the fact that they are using devices that are traditionally asked to be put away. In this sturdy, students were asked to research a medical condition of one of the special senses (see Appendix A, p. 148). To ensure that there were no repeats, students wrote on the board what condition and special sense they were researching. It was a nice way to get variety in the research the students were completing. Students worked in pairs so that they were able to collaborate and assist one another. Having the freedom to choose what they would be researching allowed for more enthusiasm in getting started. Students were given a set of guidelines for researching and for the way in which the information would be reported. While students began their research in the classroom using m-devices, they were frequently observed enjoying being able choose what they would be learning. One student mentioned, “I like having more freedom; I hate being so limited,” reinforcing the importance of including student-centered learning, where students are given an opportunity to make their own choices in learning while using m-devices. On the other hand, some students struggled with the lack of structure. Another student said, “I want to make sure I am doing it right because I don’t want to fail,” suggesting that some students are not used to being given such freedom in the classroom.
Although some students enjoy the freedom that comes from student-centered learning, educators must remember that some students will struggle with these kinds of activities. Like any new activity being implemented in the classroom, educators need to provide the guidance that students require while making sure that they are still being pushed just beyond their comfort zone in order to grow as a student.

**Affordances of utilizing m-devices.** Anatomy and Physiology by nature has content that is very visual. When students are learning about the inner workings of the human body, it is pertinent to understand the structure and location of various organs. Educators stress the importance of learning though coloring diagrams along with drawing to scale different organ systems. Students were asked to focus on primary structures of an organ in a diagram to get started, and then gradually build on that knowledge by adding in secondary structures. Since the class textbook was college level, students could just label everything, yet it was difficult for them to make sense of the diagram of a heart with a myriad of secondary and tertiary structures. Having an example of the diagram labeled and colored only with primary structures for students to reference on the front board was successful. Often students would look at the example and comment that “the example makes more sense” to them then the textbook diagram. Some students would even take a picture of the example and continue to reference it as they were working at their desks along with their textbooks. The convenience of being able to write and color with one hand while holding the m-device in the other was an advantage for students to be able to complete work. Another observation with regards to taking pictures was when students would forget their textbook, they would take a picture of another student’s page and go back to their desk and work from it. It was interesting to see that they had no
issue with working off such a small screen. Sometimes adults neglect to think about the differences in which they view m-devices to the ways in which students view them.

Lastly in regards to taking pictures, students began to ask, “Can I use my phone to take a picture of the homework board?” Perhaps this is just another way in which students are finding their own path to allowing m-devices to assist them in their learning. Traditionally students were directed to copy homework down in some sort of planner. This, however, is only one piece of the puzzle; even more important is making sure that they go home and actually check their planner. This is where homework fell apart for some students, as they would not remember to check their planner or even know where it was. M-devices are not something that we need to remind students to check, as rarely do they not know where their m-device is. In this situation the constant connection to the m-device is an advantage as students are more often than not always aware of the location of their m-device.

**Student engagement with m-devices.** To begin, it was assumed that students would be engaged in using their m-devices largely because doing so was going against the grain of the school’s policy. However, the researcher was interested to see if the engagement would be sustained or if the use of m-devices would become humdrum once the initial titillation wore off. The researcher was surprised to see that the use of m-devices afforded them the opportunity to take their learning in a new direction. It was pleasantly surprising to see how students were treating their m-devices in a different way, seeing the m-devices in a new light, as much more than a distraction from what was going on in the classroom. Students were making suggestions on new ways to use their m-devices in the classroom, such as building into an assignment the requirement that
students present on an endocrine gland of their choice, involving the audience through use of m-learning (see Appendix A, p. 188). Students had the opportunity to utilize their m-device in a way that they thought would make the most of learning about a medical condition. This responsibility of the student to determine how to use m-devices in the classroom encourages them to continually look for new ways to allow m-learning to assist in their understanding of content.

The students themselves had many positive comments when it came to their opinions on the use of m-learning. For the most part, all students were engaged in the process of utilizing m-learning in the classroom; however, one student did comment, in reference to the uploading of data after an experiment for analysis, “I feel like it would have been easier on a computer.” Although the use of m-learning in the classroom is somewhat of a novel idea and is quickly being introduced more and more, the aforementioned student brings up a valid point that not all students are receptive to the use of m-devices. Some students may have recently gotten their m-device and are still learning how to navigate the device themselves, or they may just prefer to use a computer to a hand-held device. Either way, with the introduction of any new device into the classroom, educators must continually evaluate student engagement and continue to adjust accordingly. A solid m-learning lesson will come from fine-tuning a few minor details, just like educators do with all lessons, making sure that all aspects of the lesson is best suited to the students they currently find in their classroom.

When observing students in the classroom during lunch or breaks, it was noticed that there was a constant use of their m-device. Even when students were sitting beside one another, having a conversation, they could do so while simultaneously engaging with
their m-device. It was compelling to note that students can adapt to the notion that there is a time and a place for their m-device in the classroom, even though they write the rules for m-device use outside of the classroom. Educators concerns that it will be difficult for students to transition between being free to use m-devices at their own discretion outside of the classroom to having limitations on their m-device in the classroom have been shown to be irrelevant. This work demonstrates that with reinforcement of expectations, students can properly use m-devices in the classroom without abusing them. Constant reminders and high expectations surrounding proper usage is what worked the best to ensure students stayed on task when using m-devices in the classroom. Repeatedly students would comment, “don’t worry I’m not texting” suggesting that they cared about letting others know they were not off task. Comments of the like demonstrate that students had a clear understanding of expectations surrounding appropriate usage of m-devices. This kind of rapport is possible in the classroom and essential to the effective use of m-learning in the classroom curriculum.

Through gathering field notes while testing m-learning activities in the classroom much was learned. It was encouraging to see how m-learning provided a change in the dynamic of power in the classroom, as students who were more tech savvy had the opportunity to shine. Being able to share data with the class brings the curriculum more to a real world experience, where scientists are collaborating and discussing trends, trying to determine what the data is telling them. Recording comments from students and then later reflecting on these comments allowed for an understanding of how students view their m-devices. It is beneficial to note that they can understand the idea of a time and a place and use their m-device properly in an educational setting. Without input from
students and personal field notes, the curriculum would not be as rich. Taking the time to record what is being observed as m-learning activities are being implemented allowed for reflection to take place on how to improve upon this new form of learning.

**Discussion of Findings from Colleague Observation**

The school’s principal and one of the assistant principals, each having 5 years and 3 years respectively in an administrative role, were present for the observation. The administrators were important to have as a part of the observation of the usage of m-devices in the classroom curriculum since the school’s policy does not advocate for the use of m-learning. The social science teacher present was in his second year of teaching World History as well as an online learning credit recovery course; this educator was chosen as he expressed a genuine interest in the work being done with m-devices in the classroom and has a reputation at the school for being an effective innovator who continues to bring content alive for students. The student teacher was in her last semester of university course work and was observing as well as teaching in several other science classrooms on campus. Being interested in the content of Anatomy and Physiology, the student teacher had previously spent a two-week period in the classroom observing and assisting with experiments. Since the students responded well to the presence of another adult in the room, and the student teacher was curious about the myriad of ways in which digital technologies, specifically m-learning, could be integrated into future classrooms, she was a good fit to observe and provide feedback. Also, gaining an understanding of what incoming teachers thought of the use of m-devices in the classroom was of interest to the researcher.
It was encouraging how honest students were with one another when using an online polling website as one student responded, “only one person spoke” when evaluating a poster presentation. When using the website as a tool to evaluate presentations of their peers, there were open-ended questions as well as multiple-choice prompts. Students did not hesitate to make note of presentations where students simply read off a piece of paper as oppose to presenting the information in a well-informed manner. Such a constructive critique is often not seen when students are asked verbally to reflect on the presentation itself. This quality of instant peer feedback would not be possible without the use of m-devices. The ability to share opinions with one another can be powerful when dealing with issues that students may find difficult to discuss, such as whether or not they would donate their bodies to science. Asking students to share in an anonymous manner takes the pressure off when sharing personal opinions that others may disagree with. When discussing cadavers and donating bodies to science, student opinions ranged from yes, to no, to maybe. Being able to see the opinions of all students was a great starting point to an authentic conversation about the role that cadavers play in the scientific community. When an educator is aware of the opinions of students or prior knowledge that they bring to the classroom, this can allow for a richer learning experience for all. M-learning can make the sharing of opinions and knowledge faster and easier.

The use of online polling websites can also drive student-centered learning forward as one student was interested in “learning how the police get involved with cadavers” when prompted to share something they were interested in gaining more knowledge about. Perhaps several students are interested in similar topics and will self-
select groups based on curiosity and not based solely on the friends they have in class. Polling websites allows educators to gather information from students in a number of ways to enhance the classroom curriculum.

Each of the colleague observers noted that during the presentations, students had their m-device out on their desks, yet were not using them. Students only picked up their m-devices when asked to respond to one of the prompts after each of the presentations. The student teacher commented “students voted, then were respectful and put their phones down.” This acceptance by students that there is a time and a place for their m-device is not achieved over night. It takes time for them to understand that there are expectations when it comes to the use of m-devices in the classroom, especially since when outside of the classroom they are free to be constantly connected. A strong rapport with students allows such a structure in the classroom where m-learning can be effectively integrated into the curriculum without taking over and becoming a distraction thus taking away from learning.

Most notably, several colleagues discussed how the use of m-learning in the classroom changed the role of assessment. The principal noted that “when students are given the chance to react to literature or other student work, they often rise to the occasion.” Having peers assess each other’s work often increases the accountability of students as they are no longer only being assessed by the teacher. This style of peer review is beneficial in assisting students in beginning to assess their own work more thoroughly before presenting. Students seemed to enjoy the process of being able to share what they thought were strengths and what needed more work in the presentations they witnessed.
All of the colleagues agreed that the use of m-learning is an important part of the future of classrooms, which is interesting since current school policy is against m-devices. The assistant principal mentioned that “using technology is a critical piece of enhancing student engagement.” The social science teacher believes that “the use of mobile technology in the classroom is a powerful resource for fostering student engagement.” Administrators are in a difficult position as they see there is potential for this emerging form of technology, but are somewhat resistant at the same time. The principal repeatedly commented that m-learning is only “effective when harnessed properly.” Since educators are still in the process of defining effective use of m-devices in the classroom curriculum, it can be difficult to gain support. This is why educators who are incorporating m-learning into their curriculum they also need to invite colleagues to observe how effective m-devices can be in student learning.

Although the use of m-learning in the classroom opposes the school’s policy, it was interesting to note that all colleagues mentioned that the use of m-devices engaged students in learning. The principal mentioned the importance of sustained engagement. An explanation for students by the educator of why m-learning is being used is important, and when students are aware of the reasons behind such activities with m-devices, they are more likely to be invested. Whenever new content is being presented to students, it is pertinent to the learning process to understand what ideas students bring to the table. Another effective use of polling websites in the curriculum is in the ability to access prior knowledge from students (see Appendix A, p. 124). It can often be difficult to access prior knowledge in a quick and meaningful way where all students gain the feeling of being heard. The use of an online polling website allows all students ideas not only to be
shared with the teacher but with the rest of the class as well and as a springboard for an engaging introduction to a new topic in the curriculum.

All colleagues agreed that m-learning could be utilized as an effective tool in the classroom curriculum. As we look around in society and see how frequently people are constantly connected to their m-devices, it’s only natural that educators be conscience of the potential distraction the use of m-devices can have in the classroom. Educators must take into consideration what they are using the m-learning to accomplish and continue to reinforce the expectations they have for students. Giving students the opportunity to rise to the occasion and use their m-devices for learning in the classroom curriculum is essential as we transition to an ever-increasing mobile society.

Having colleagues come in and observe m-learning in action was useful in seeing how the use of m-devices can enrich classroom conversations. The use of an online polling website allowed all voices to be heard when a question was asked. This can be useful in a myriad of ways and allows for an increase in engagement, as oppose to classroom conversations where few voices are heard. It was powerful to have observers notice that students can have their m-devices on their desks and not be distracted by them. The more colleagues that observe the use of m-learning in the classroom, the better the chances of school-wide implementation of this new form of learning, and the better chance of improved use of m-devices in the classroom.

**Conclusion**

Evident throughout the process of data collection and analysis was strong engagement that students had with curriculum when interacting with their m-devices.
During the colleague observations, it was noted repeatedly that students would use their m-devices when directed to and then place them on their desks and not be distracted by their presence as the activity was continued. The content validity panel also noted how engaged students would be when using apps during laboratory experimentation. Students were observed to be engaged in using their m-devices, not only to collect data but also to share data collected with the class online. When students are engaged in their learning, there is an increased chance that they will retain more knowledge with a better understanding of concepts.

Throughout the analysis of field notes, content validity panel feedback, and colleague observations, it was clear that m-learning allows for a more collaborative environment. As students use their m-device to conduct experiments, upload data to facilitate analysis, and complete mini-research projects by accessing information on the Internet and designing presentations, they continually rely on one another to be successful in completing the task at hand.

Of great significance to this work is the relationship that m-learning has to content. It was demonstrated by the content validity panel that using m-devices did not alter the content of the curriculum. This idea should be omnipresent when educators are discussing integrating m-learning into their curriculum, if more educators were aware of this, it is predicted that more of them would be willing to begin using m-devices in their classroom. Incorporating m-learning into the curriculum should not be seen as merely adding something else to the overflowing plate, m-learning should be seen as a new plate where educators are serving up the same content in a new way.
The use of m-devices in the classroom also allowed for students to have more ownership in their learning through the incorporation of student-centered learning activities where students were making choices about what they would be learning. When students have the opportunity to make choices, they engage even more in the content of the classroom curriculum, providing a richer understanding of material. One of the unintended consequences of incorporating m-learning in the curriculum was the shift in the learning environment that allowed for excellence to be seen in another skill set. Those students who were more tech savvy than others were given the opportunity to be seen in a new light, which could not be accomplished without the inclusion of m-learning.
Chapter Five: Conclusion

Introduction

As educators continue to develop and improve their classroom curriculum they are constantly looking for what the next phase of education will be. Educators are preparing students for their future endeavors, whether it is post secondary education or directly entering the workforce. Many of the cues guiding educators today deal primarily with the integration of digital technologies in the classroom. Electronic learning (e-learning) has been implemented with varying degrees of success in the past, and just as computers have evolved from stationary desktop computers to mobile handheld devices, so has the form of learning associated with such devices. Mobile learning (m-learning) is in its infancy, and as educators begin to see a greater number of students bringing mobile devices (m-devices) into the classroom, the more opportunities there are to integrate this latest form of technology. No matter what field students chose as their career path, they can bet that they will be working with digital technology, most likely with m-devices. Since one of the roles of education is to prepare students for what lays ahead, it seems reasonable for classrooms to see an influx of m-learning in curriculum.

This work demonstrates that if m-learning is incorporated into classroom curriculum there is an increase in student engagement with learning. Throughout the process of testing out activities, and inviting an outsider’s perspective with a content validity panel, colleague observations, and feedback from students, one clear thread tied all of these observations together: m-devices increase the engagement of students. Even though students already use their m-devices outside of the classroom for a variety of
reasons, once they were invited to use them in the classroom as part of the curriculum, the dynamic began to shift in the ways in which the m-devices were handled. Less and less were m-devices seen as a distraction as students began to understand the idea of there being a time and a place for usage. Prior to this, students were not asked to use their m-devices in the classroom and m-devices did function as a distraction in class. Once students experienced m-learning by accessing information online, collecting and sharing data with the class, preparing for tests, the result was in an appreciation for how these devices could enhance learning.

Introducing m-learning into the curriculum does not mean that it is a time for educators to throw out their current curriculum and start from scratch. The introduction of m-learning in the curriculum should be a slow and steady process to allow educators and students time to adapt to this new form of learning. The feedback collected suggested that the content for Anatomy and Physiology, the subject for which the curriculum was designed, was not altered. This suggests that m-learning has a place in secondary school classrooms without diminishing the quality of education that is already present. M-learning is more about enhancing the content in a way that is more engaging to students while simultaneously preparing them for an ever increasing mobile society.

**Major Findings**

Upon completion of the analysis of data collected for this work, it was found that engagement is one of the strongest components of m-learning curriculum. Along with this, the need for strong assessment surfaced across data sets. M-learning also demonstrated that collaboration is easily achieved when using m-devices in the
classroom. Finally, it is noteworthy to mention that when students are engaging with m-learning, the content of the curriculum is not altered. This section will focus on the significance, implications, and reasons for the aforementioned findings.

Whenever educators are working with students, it is important to have strong engagement in order to develop a positive learning environment. When students are engaged in their learning, they are more likely to absorb and retain information that is being presented to them. One of the reasons why students are so engaged with m-devices is the simple fact that it is their own personal device. When students are using a device that they are comfortable with, they are more likely to have a better sense of security in how to operate the device as opposed to other equipment that they are not familiar with. When students are in a position where they are the expert when it comes to the device being used in the classroom, it can result in a shift in power from the traditional classroom setting where the teachers are the ones imparting all of the knowledge. M-devices can flip the classroom and allow students to be experts. Having an altered dynamic can lower the affective filter of students, and thus provide an environment that allows for more learning by increasing the engagement of students in the content being presented.

Key to the success of any endeavor is a solid assessment. When it comes to m-learning, it can be difficult to know where to begin with the assessment of student usage of m-devices due to the minimal amount of literature on the subject. When students are aware of how they will be assessed in the classroom, there is a greater chance that they will rise to the occasion and meet the expectations of the teacher. This can be difficult when dealing with assessing the usage of the very device that students bring with them to
class; the m-device that has little to no restrictions on usage of outside of the classroom. When strong assessments are used with m-learning curriculum, there is more buy-in from students to use their m-devices in learning. Along with assessment comes the opportunity to improve activities that are implemented in the classroom, depending on the results. If an m-learning activity is not as successful as anticipated, adjustments can be made in order to improve the learning experience for users. The lack of research on the assessment in student usage of m-devices implies that this is the next step for research to take. Educators need to be willing to add to the literature allowing for best practices to arise from their work. Since m-learning is relatively a new field in the educational world, it is expected that the literature pool is rather shallow at this time. Ideally, with time, more and more will be available to educators as they continue to design curriculum that incorporates the use of m-devices in their classroom.

Part of teaching beyond content is a skill set that provides students the necessary tools to be successful no matter what area of the workforce they find themselves in. At the top of the list is the ability to collaborate. M-devices afforded more opportunities for students to collaborate in the classroom while engaging with content. As students begin to enter the workforce, they will find a myriad of ways in which they will need to collaborate with colleagues, and one can reasonably assume that this will take place with m-devices. New technologies are increasingly focusing on the functionality of multiple users. An example can be seen in open source digital technologies where multiple users can alter software at the same time. Since working together is working better, it makes sense that when engaging in m-learning, students should work collaboratively.
M-learning takes collaboration to a new level. Traditionally, a group of students using a traditional piece of lab equipment might find that no one is an expert on the equipment, which can be daunting and can stall the group from beginning to work together. However, if everyone steps into the ring as an expert on their own device, it can allow for a more comfortable setting where students are more likely to hit the ground running. When students are working with m-devices, they are familiar with the technology, thus lowering their affective filter as evidenced by there being less of a hesitation to ask for help when doing projects with m-devices. Students hesitate to ask for assistance in a situation when they are out of their comfort zone because it subconsciously makes them vulnerable in that they are opening themselves up to showing others that they do not have the answers. Much of what happens in a classroom is dependent on the comfort of the students. If they feel safe and protected, they are much more likely to put themselves out on a limb and see what happens. M-devices give the students a sense of support in the familiar, thus opening them up to being pushed beyond their comfort zone in an area to progress their learning to new heights.

Arguments can be made that when there is an addition to the curriculum something must be taken out in order to make room for it. This is not the case with m-learning, it is not about altering the content, it is about presenting content and allowing students to interact with the curriculum in a new way. The fear that teachers have about shaking the foundation of their courses, the content, is not an issue as no longer do they need to worry that incorporating m-learning will alter the content of their curriculum.

M-learning is about taking content and reframing it. The picture is still the same but the ways in which it is held together are altered. M-learning, much like the frame of a
painting illuminates the piece of art and allows you to focus on the image. It can highlight certain aspects of the piece, and although there are many frames, there are also many ways of using m-learning in the classroom. What is important at this stage is to experiment with different activities and determine what is the best fit for the content and for the group of students that are in current classrooms. Just like activities are tweaked as educators get to know their students, m-learning should be viewed in the same way. This is an opportunity to have curriculum be continually blossoming as oppose to stagnating, which happens when there is little to no change year after year with curriculum that is being presented to students.

**Future Curriculum**

As digital technologies continue to advance and become more mobile, one can only predict that the same will be seen with the digital technologies that are being integrated into classroom curricula. When educators are engaging with m-devices in their every day lives, it seems reasonable to assume that they will begin to see more connections between m-device usage and the very curriculum they present to students on a daily basis. With the increase in society’s use of m-devices it is only natural that more and more students will continue bringing these devices to class.

The increase in students bringing m-devices to class will lead to an increase in educators being able to take advantage of the opportunity to incorporate m-learning in their curriculum. As educators step away from banning m-devices and begin to encourage the use of this new form of technology in learning, there will be a shift in the ways in which students view their m-devices. M-devices will be seen as a multi-
functional tool to expand the learning experience, ideally bringing with this a form of etiquette surrounding the proper usage of m-devices, not only in the classroom but outside of it as well. For some, it is acceptable to be constantly connected to m-devices, even when engaging in conversation with others, but others find this behavior disrespectful.

Along with m-learning in the classroom curriculum, there will be an increase in university and college preparatory programs for teachers including m-learning in their programs. In the future, curriculum design courses will focus on m-learning in content areas, as there will be a greater need for educators to be proficient in including such a form of learning in their curriculum. Perhaps even entire courses will focus on m-learning across disciplines and grade levels as more research is completed, adding to the literature. The more educators begin to research m-learning, the better the process will become as best practices will be defined on how to effectively incorporate m-learning into classroom curriculum, and in time, m-learning will be common place in the secondary school curriculum across disciplines.

**Suggestions for Implementing M-Learning**

With the integration of a new form of learning in the classroom curriculum educators can easily become overwhelmed and abandon the opportunity to enhance the learning experience for students. Starting simple and setting realistic expectations can help alleviate some of the stress that may accompany such a transition in the curriculum. Students will adapt to this m-learning curriculum and may be overwhelmed at first with the initial excitement of being able to use something that was once banned in class.
Educators should not bite off more than they can chew, and instead be comfortable with setting a realistic pace for m-learning integration into curriculum.

Educators should also take the time to share their work with colleagues. Even though not all educators will agree with incorporating m-device usage in the classroom, many educators are interested in what colleagues are doing with m-devices. Having a cohort of colleagues to bounce ideas off of is beneficial. Key to the process is also being open to inspiration, not only from colleagues, but from students as well. As m-learning was incorporated into the classroom, students began to make suggestions of the different ways they thought their m-device could be used. Oftentimes students are aware of more capabilities with m-devices, and educators need to take their suggestions into consideration as they continue to refine and improve their m-learning curriculum. Paying attention to the new ways in which society and business are utilizing m-devices can also inspire ways in which m-devices can be integrated into the curriculum.

Finally, educators need to be clear and consistent with the expectations surrounding proper usage of m-devices in the classroom. Students may have difficulty at first transitioning between being continually told not to use their m-device in the classroom to all of a sudden being asked to pull them out. Having strong classroom management skills with transparency surrounding proper usage is essential to a smooth transition into m-learning curriculum. Modeling for students the idea of a time and a place can be a powerful message, so that they can see first hand that a healthy balance can be achieved between reliance on m-devices and the ability step away and focus on something else without being distracted.
Next Steps for Research

Throughout this work it became clear that there is a lack of research on the integration of m-learning. As such, more educators need to evaluate the possibility of designing m-learning curriculum. As more educators continue to do so, they should share successes and failures and continue to add to the field of research devoted to the implementation of m-learning in classroom curriculum.

Other aspects of student usage of m-devices beyond collaboration and student-centered learning need to be examined. Critical to any aspect of student usage would be the assessment of m-learning. With time, more structure will present itself as to the steps to take when an educator is interested in re-designing their curriculum to include m-learning. Once there is more research available, educators can begin to examine the differences in m-learning among subject areas and grade levels. Also, researchers could gain insight into the effectiveness of m-learning by comparing classrooms with m-learning to those that do not incorporate m-learning.

Future researchers need to be open to piloting m-learning curriculum in a variety of subject areas across grade levels. The more literature that is available to educators, the better the process of incorporating m-learning into the curriculum will be. This, of course, will take time and should not inhibit educators from testing out different ways to utilize m-devices in their current curriculum.

Possible Obstacles and Ways to Overcome Them

When educators begin to introduce m-learning into their classroom curriculum, the excitement by students may initially overcome them and proper usage may be a
struggle. In some situations students will have an increased sense of engagement as they naturally gravitate toward the usage of their m-devices. In order to overcome the issue of improper usage and m-devices being seen as a distraction in the classroom, educators must have a solid set of guidelines for students to follow when engaging in m-learning. Being transparent with expectations eliminates the chances of students abusing their m-devices and not using them for their intended purpose in the classroom.

Although educators may not have support from all colleagues, it is important to have a few players on their side. Administrators can be strong allies when making such changes to the learning structure in the classroom curriculum. Having an open dialogue with administration can be a good place to start for getting support. Inviting administrators into the classroom to witness firsthand what m-learning looks like in your classroom is a powerful way to get them on board. Some colleagues may be on the same page and willing to support you right away, while others may see no value in m-learning and deem it to be a waste of time. No matter what, it is important for educators to do their homework and take the time to research m-learning and determine in what ways it can fit into their current curriculum.

**Conclusion**

If educators find themselves in a classroom where the majority of students bring m-devices with them, they need to consider if this situation is worth taking advantage of and consider incorporating m-learning into their classroom curriculum. This is not simply achieved by asking students to begin using their m-devices, what needs to happen in order for a successful implementation of m-learning is curriculum development. The
success of utilizing m-devices in the classroom will come after educators take the time to thoughtfully develop curriculum for mobile learning. Some may see it as a risk, while others may see it as a great gift to be able to work with students in such a way that is engaging and allows for an increase in student-centered learning along with fostering a more collaborative learning environment where students are given the opportunity to take their learning to new levels as they begin to prepare for what lays next in our digitally saturated world.
APPENDIX A
Introduction

The following curriculum consists of 5 units of study for an Anatomy and Physiology senior level science course. The units are intended for the second semester of a yearlong course including: the circulatory system, the respiratory system, the special senses, the nervous system, and the endocrine system. Prior to this students would have learned about the integumentary system, the skeletal system, the muscular system, the digestive and urinary systems, and the reproductive system in the first semester of the course. This curriculum focuses on the integration of mobile learning (m-learning) in the classroom. M-learning utilizes a variety of mobile devices that students bring to class with them in order to access information, share data, communicate with one another, and stay connected to the curriculum. M-learning is a new platform of communicating that has become ever present in today’s society, and as such is starting to take root in educational settings. As we move forward m-learning will become evermore present in industry and as such students will be expected to easily transition their work to mobile devices such as tablets, smartphones, and personal digital assistants (PDAs).

This curriculum allows students to interact with m-learning on a daily basis (see Appendix B). For example, students text in responses to a variety of prompts in order to facilitate classroom discussions allowing all voices to be heard, students also use their mobile device (m-device) to access information on the Internet much like they would if they were working on a traditional desktop computer. The use of applications (apps) is also relied on in the curriculum to test subjects during laboratory experiments, as well as to prepare for tests. These are just a few of the myriad of ways in which students are
relying on their m-devices to interact with content.

The goal for this curriculum is to provide a framework for educators who are interested in incorporating m-learning in their classroom. Although the curriculum is specific to Anatomy and Physiology the ways in which m-learning are incorporated can be applied to a variety of subject matters. Ideally even educators who are not interested in incorporating m-learning will be inspired by this work to reconsider the possibilities that m-learning has for increasing student achievement.

Any educator that decides to implement this curriculum or parts of this curriculum should take into consideration that fact that it was designed for a classroom where all students bring m-devices to class every day. Adaptations can be made if this is not the case, and it is suggested that at least half of the student body have m-devices with them and possibly work in pairs to complete tasks. Another factor was that the student body this curriculum was designed for were senior level students that understood clearly and responded well to the proper usage of m-devices in the classroom. The reason why the curriculum was designed for the second semester was deliberate so that a significant amount of time could be spent training students on what was appropriate and what was not with respect to their m-devices. Ideally in the future not as much time will be needed reinforcing such etiquette. If proper usage of m-devices is an issue in your classroom it is suggested that perhaps scaling back on the m-learning at first may make the transition easier for students as gradually scaffolding more m-learning into the curriculum may work better. What is important is to do what is best for the population of students found in the classroom and keep an open mind as such transitions can lead to small frustrations at first, but with time the success of the students will make it worth while. Be open to the
fact that students themselves will begin to make suggestions on how they can utilize their
m-device to assist in their learning in the classroom. Take advantage of these
opportunities as often students have insight to m-learning possibilities that educators may
not see.

Although this curriculum focuses on the integration of m-learning and the
assessment of student use of their m-devices, also included in this curriculum are a
myriad of traditional assessments. M-learning assessments include the use of rubrics for
a variety of purposes in order to have transparency on what expectations are of students
when they are engaging with their m-devices. Some assessments include simply
completing a task such as uploading data or texting in responses, similar to a participation
assessment. With this form of assessment what works best is to be in constant
communication with students in order to provide them with feedback in an informal way.
When students are asked to submit a quiz through their m-device the assessment is
similar to what an educator would outline for a paper copy of the same assignment. Also
included in the curriculum to assess student performance are more traditional assessments
such as unit tests and laboratory reports where each question is assigned a specific point
value and simply added up at the end for an overall grade for the assignment.

As with any curriculum educators are expected to take inspiration from what is
available and adapt it to best suit the needs of the students in their classroom. Ideally
there is some part of this curriculum that encourages educators to incorporate m-learning
into their curriculum in order to demonstrate to students how the very m-devices that they
carry in their pockets everyday affords them the opportunity to engage with content in a
new and exciting way.
Circulatory Unit Timeline

Objectives:
- Students gain an understanding of the anatomy and physiology of: cardiovascular system and the lymphatic system
- Students comprehend the relationship between the structure and function of the components of each of the cardiovascular system and lymphatic organs. Form fits function.
- Students have the opportunity to test in lab their cardiovascular function.
- Students analyze class data to draw conclusions and engage in a class discussion about trends in the data.
- Students utilize mobile technologies (m-tech) on a daily basis for a variety of purposes.

Day One:

Flow through the heart – Khan Academy Video
http://www.youtube.com/watch?v=7XaftdE_h60

*Students will be directed to watch the above video on their mobile device individually as an introduction to the new unit.*

Heart Diagram – students will be given a blank copy of the heart diagram to label and color specific structures.

Intro to the Circulatory System Notes – notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

Homework – heart model chart (refer to textbook if needed) Complete the function, blood from, and blood to columns. The materials list will be used the next day in class.

Day Two:

Correct homework.

Heart Physiology Notes - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

Heart Model Activity – students will be working in small groups to make a
physical model of a heart with all of the listed structures. Students will bring in their own materials to represent each of the structures in the heart. Students may not use the same material for more than one structure. Students are given time to discuss within groups what materials they have around the home that can be brought in to make the models (recyclable materials are strongly suggested).
**Homework** – bring in supplies needed to make heart model

**Day Three:**

**Heart Model Activity** – students will spend the majority of the class time working on the heart models.

**Heart Model De-Brief** - [www.polleverywhere.com](http://www.polleverywhere.com)

> Students are asked to respond to the following prompts. How are things going so far making your models? Biggest challenge? Feelings about moving forward?

> This will give students a chance to reflect on the process of making a model and be able to begin thinking about what they need to do to continue moving forward.

**Homework** – review notes: intro to the circulatory system & heart physiology

**Day Four:**

**Cardiac Muscle Fibers Notes** - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds. Students expected to draw the mini-diagrams as they are included in the notes included.

**Heart Model Activity** – last day to work on in class

**Partner Challenge (Blood Flow Through the Body)** – students are to work in partners for this activity where they are asked to e-mail in the flow of blood through the heart, lungs, and body. Responses will be e-mailed in and completed on m-devices.

**Homework** – complete heart models (if not finished in class)

**Day Five:**

**Cardiovascular System Lab Activity** – student will collect all data for the activity during class time. M-devices will be used to upload data to the class wikispace as well as a timer while collecting data.

**Homework** – complete the write-up for the lab activity (analysis of data)
Day Six:

**Discuss Homework** – major conclusions and trends from cardiovascular system lab activity.

**Cardiovascular Disorders Activity** – *students will use their m-device to research cardiovascular disorders that were discussed in a previous class lecture and make a public service announcement on their m-device.*

**Homework** – work on Cardiovascular Disorders Activity

Day Seven:

**Lymphatic System Notes** - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

**Lymphatic System Diagrams** – label diagrams of the lymphatic system

**Cardiovascular Disorders Activity** – *continue working on*

**Homework** – post link to Cardiovascular Disorder PSA on class wikispaces

Day Eight:

**Present Cardiovascular Disorder PSAs** – [www.polleverywhere.com](http://www.polleverywhere.com)

*Students will respond to prompts evaluating the PSAs that are viewed in class. Prompts can assess the effectiveness of the messages that are being sent through the PSAs.*

**Circulatory System Test Review** – discussion will ensue on best practices for preparing for unit test, students will be made aware of the test date prior to this review.

**Homework** – study!

Day Nine:

**Circulatory System Test**

**Circulatory System Test Feedback** [www.polleverywhere.com](http://www.polleverywhere.com)

*Students will be asked to provide feedback regarding the test, the test review, and what they would do differently if they could complete the unit all over again. What was the best activity to assist with the comprehension of content?*
## Circulatory Unit M-Learning Rubrics

### Watching Videos

**RUBRIC**

<table>
<thead>
<tr>
<th>Follows Along</th>
<th>Comprehension</th>
<th>Respects Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student is on the correct video and is actively taking quality notes of major concepts while watching.</td>
<td>Student is on the correct video and usually appears to be actively taking notes of major concepts while watching.</td>
<td>Student listens quietly, does not interrupt others, and stays on assigned task until everyone is finished.</td>
</tr>
<tr>
<td>Student is on the wrong video OR is clearly not participating in the activity.</td>
<td>Student is on the correct video and seems to be taking notes. May have a little trouble recalling major concepts.</td>
<td>Student listens quietly and does not interrupt others.</td>
</tr>
<tr>
<td>Student understands most of the video and accurately answers 2 questions related to the major concepts.</td>
<td>Student understands some parts of the video and accurately answers 1 question related to the major concepts.</td>
<td>Student interrupts once or twice, but comments are relevant. Stays in assigned place without distracting movements.</td>
</tr>
<tr>
<td>Student has trouble understanding or remembering most parts of the video.</td>
<td>Student interrupts often by whispering, making comments or noises that distract others OR moves around in ways that distract others.</td>
<td></td>
</tr>
</tbody>
</table>
# Cardiovascular Disorders

## RUBRIC

<table>
<thead>
<tr>
<th>Sources-Quality</th>
<th>Students include 4 or more high quality sources from the Internet.</th>
<th>Students include 3 high quality sources from the Internet.</th>
<th>Students include 2-3 sources from the Internet but some of are questionable quality.</th>
<th>Students include fewer than 2 sources from the Internet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources-Citation</td>
<td>Information in all source citations is correct and the format assigned.</td>
<td>Information in all source citations is correct but there are minor errors in formatting.</td>
<td>Information in almost all source citations is correct AND there are minor errors in formatting.</td>
<td>The information is often incorrect OR there are major errors in formatting.</td>
</tr>
<tr>
<td>Brainstorming-Problems</td>
<td>Students identify more than 4 reasonable, insightful barriers/problems that need to change.</td>
<td>Students identify at least 4 reasonable, insightful barriers/problems that need to change.</td>
<td>Students identify at least 3 reasonable, insightful barriers/problems that need to change.</td>
<td>Students identify fewer than 3 reasonable, insightful barriers/problems that need to change.</td>
</tr>
<tr>
<td>Brainstorming-Solutions</td>
<td>Students identify more than 4 reasonable, insightful possible solutions/strategies to encourage change.</td>
<td>Students identify at least 4 reasonable, insightful possible solutions/strategies to encourage change.</td>
<td>Students identify at least 3 reasonable, insightful possible solutions/strategies to encourage change.</td>
<td>Students identify fewer than 3 reasonable, insightful possible solutions/strategies to encourage change.</td>
</tr>
<tr>
<td>Campaign/Product</td>
<td>Students create an original, accurate and interesting PSA that adequately addresses the issue.</td>
<td>Students create an accurate PSA that adequately addresses the issue.</td>
<td>Students create an accurate PSA but it does not adequately address the issue.</td>
<td>The PSA is not accurate.</td>
</tr>
<tr>
<td>Use of M-Tech</td>
<td>Students appropriately used the m-tech during class time.</td>
<td>Students were rarely off task with the use of their m-tech.</td>
<td>Students were continually off task with the use of their m-tech.</td>
<td>Students did not use their m-tech for the intended task.</td>
</tr>
</tbody>
</table>
Gross anatomy of the heart, page 697.

COLOR
- MYOCARDIUM
- VISCERAL PERICARDIUM
- INTERVENTRICULAR SEPTUM
- PULMONARY SEMILUNAR VALVE
- AORTIC SEMILUNAR VALVE
- MITRAL VALVE
- TRICUSPID VALVE
Circulatory System = Cardiovascular System + Lymphatic System

**Cardiovascular System**
- heart, blood vessels, and blood
- deliver oxygen & nutrients to all cells in the body
- remove wastes
  - kidneys – remove urine
  - lungs – remove carbon dioxide

**Lymphatic System**
- lymphatic vessels, lymph (fluid), and lymphatic tissue (immune response)
- connection to the cardiovascular system

CARDIOVASCULAR SYSTEM

**Blood Vessels and Flow**
- deliver nutrients, remove wastes, & have unique functions

**Artery**
- rapid transit passageway, pressure reservoir, travels away from the heart

**Arteriole**
- diameter changes to regulate blood flow & pressure
- epinephrine (hormone): sympathetic nervous system

**Capillary**
- site of nutrient & waste exchange
- smallest blood vessel

**Venule**
- returns blood from capillaries to the veins

**Vein**
- returns blood to the heart
- serves as a volume reservoir
- requires valves to prevent backflow

\[ (A \rightarrow a \rightarrow c \rightarrow v \rightarrow V) \]
Blood Cells

Plasma
- fluid containing water, ions, metabolites, & plasma protein

Fibrinogen
- soluble fiber that can become insoluble fibrin during the clotting process

Formed Elements
- red blood cells (carry oxygen)
- white blood cells (fight infection)
- platelets (clotting)

Circuits of Blood Flow

Systemic Circuit
- delivers blood under HIGH pressure to the entire body
- left ventricle of the heart

Pulmonary Circuit
- delivers blood under LOW pressure to the lungs
- right ventricle of the heart
Anterior View of the Heart

- thick bundles of cardiac muscle twisted and whorled into ring-like arrangements
- layer that contracts
- reinforced internally with dense, fibrous connective tissue
- “skeleton of the heart”

Coronary Circulation
- the heart is nourished by its own blood supply, not the blood it is pumping

Heart Chambers

Receiving Chambers:
- ↓↓ oxygen blood from body
- ↑↑ oxygen blood from lungs

Pumping Chambers:
- ↓↓ oxygen blood to lungs
- ↑↑ oxygen blood to body
The Heart – Supply tissues with Oxygen

A - Brachiocephalic Artery – supplies head, neck, and arms with oxygen

B – Common Carotid Artery – supplies brain, head, and neck with oxygen

C – Subclavian Artery – supplies arms with oxygen

**Pulmonary Circulation**
- carry blood to the lungs for gas exchange and return to the heart

**Pulmonary Arteries**
- carry blood to the lungs
- oxygen is picked up and carbon dioxide is unloaded

**Pulmonary Veins**
- oxygen rich blood from the lungs is returned to the heart

**Systemic Circulation**
- supplies body tissues with oxygen rich blood
- oxygen rich blood is pumped out of the heart via the aorta
- oxygen poor blood returns to the heart though the vena cava
- blood then goes to PULMONARY CIRCULATION
Valves – blood flow in one direction

Atrioventricular Valves
- located between the atria and ventricles

Semilunar Valves
- located at the exit area of the ventricles
<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Blood From</th>
<th>Blood To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aorta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Atrium</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Right Ventricle</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Superior Vena Cava</td>
<td></td>
<td></td>
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<tr>
<td>Inferior Vena Cava</td>
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<tr>
<td>Left Pulmonary Artery</td>
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<tr>
<td>Right Pulmonary Artery</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Left Atrium</td>
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<td></td>
<td></td>
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<tr>
<td>Left Ventricle</td>
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<tr>
<td>Left Pulmonary Vein</td>
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<td></td>
</tr>
<tr>
<td>Right Pulmonary Vein</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Myocardium</td>
<td>❌</td>
<td>❌</td>
<td></td>
</tr>
<tr>
<td>Visceral Pericardium</td>
<td>❌</td>
<td>❌</td>
<td></td>
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<tr>
<td>Interventricular Septum</td>
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<tr>
<td>------------------------</td>
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<td></td>
</tr>
<tr>
<td>Pulmonary Semilunar Valve</td>
<td></td>
<td></td>
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<tr>
<td>Aortic Semilunar Valve</td>
<td></td>
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<tr>
<td>Mitral Valve</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tricuspid Valve</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Materials List:**

- Aorta -
- Atrium -
- Ventricle -
- Vena Cava -
- Pulmonary Artery -
- Pulmonary Vein -
- Myocardium -
- Visceral Pericardium -
- Interventricular Septum -
- Semilunar Valve -
- Atroventricular Valve -
Heart Physiology Notes

Setting the Basic Rhythm
- presence of gap junctions
- activity of the intrinsic conduction system

Action potential initiation by autorhythmic cells
- unstable resting potential: continually depolarize
- pacemaker
- influx of calcium

Sequence of excitation
- sinoatrial (SA) node
- atrioventricular (AV) node
- atrioventricular (AV) Bundle (Bundle of His)
- right & left bundle branches
- purkinje fibers

Irregular Heart Beats
- Arrhythmia = uncoordinated atria and ventricular contractions
- Fibrillation = rapid out-of-phase contractions

Defective SA Node
- ectopic focus (abnormal pacemaker)
- hyperexcitable (too much stimulation)
- heart block

Modifying the Basic Rhythm
- Autonomic Nervous System
  - Sympathetic – cardioacceleratory center
  - Parasympathetic – cardioinhibitory center

Diseased or Damaged Heart
- enlarged R wave = enlarged ventricles
- flattened T wave = cardiac ischemia
- prolonged Q-T interval = ventricular arrhythmias

The Cardiac Cycle
- systole = contraction
- diastole = relaxation

Ventricular Filling (mid-late diastole)
- low pressure in heart
- blood flowing through atria into ventricles
- semilunar valves are closed
Ventricular Systole
- atria relax & ventricles begin to contract
- AV valves close
- semilunar valves are forced open
- blood leaves via aorta & pulmonary artery

Isometric Relaxation: Early Diastole
- ventricles relax
- semilunar valves close
- atria begin to fill with blood

Heart Sounds
- lub-dup
- lub = AV valves close (beginning of systole)
- dup = semilunar valves close (beginning of diastole)
- murmurs are unusual heart sounds

Cardiac Output
- amount of blood pumped out by each ventricle in 1 minute
- stroke volume = amount of blood pumped out by a ventricle with each beat
- adult blood volume = 5 L

Regulation of Stroke Volume
- stroke volume = EDV – ESV
- EDV = end diastolic volume
- ESV = end systolic volume
- Each ventricle pumps about 60% of the blood in its chambers with each heartbeat

Preload: Degree of Stretch
- cross-bridging of actin & myosin
- more stretch = more force
- depends on the amount of blood that is returning to the heart (venous return)

Venous Return
- blood pressure
- valves – prevent backflow
- skeletal muscle pump – squeezes blood
- respiratory pump – change in pressure
- connective tissue – limits expansion of veins

Contractility
- greater calcium influx
- more complete ejection of blood from the heart
  o sympathetic stimulation of the heart
Afterload: Back Pressure
- pressure that must be overcome for the ventricles to eject blood
- pressure on the aortic & pulmonary valves (semilunar)

Regulation of Heart Rate
- Autonomic Nervous System
  - hormones increase the influx of calcium (sympathetic)
  - depression & grief increase the influx of potassium (parasympathetic)
  - baroreceptors = changes in blood pressure

Chemical Regulation
- Hormones
  - Epinephrine (increases heart rate)
  - Thyroxine (increases metabolic rate)
    -- Slower influence on increasing heart rate
- Ions
  - Calcium and potassium levels
  - Too much sodium inhibits calcium influx

Tachycardia = abnormally fast heart rate
- sympathetic nervous system
- drugs
- stress
- heart disease

Bradycardia = abnormally slow heart rate
- low body temperature
- drugs
- parasympathetic nervous system

Congestive Heart Failure
- Coronary Atherosclerosis
  - Clogging of vessels
  - Myocardium weakens
  - Dead heart cells are replaced with scar tissue
  - Ventricles stretch
  - Can result in heart enlarging

Pulmonary Congestion
- left side of the heart fails
- blood is not ejected properly for circulation
- blood vessels in the lungs become engorged

Peripheral Congestion
- right side of the heart fails
- blood stagnates in the organs
**Cardiac Muscle Fibers NOTES**

- cardiac muscle fibers = cardiac muscle cells
- autorhythmic (1%) & contractile (99%)
- striated, short, thick, branched, & interconnected
- 1 or 2 centrally located nuclei
- endomysium – connective tissue that fills intercellular space
- fibers are coiled together forming walls of heart chambers
- plasma membranes of adjacent cardiac fibers interlock

- 25% volume – large mitochondria (high resistance to fatigue)
- remaining volume: myofibrils (actin & myosin), branch extensively

**Stimulation**
- autorhythmic (self excitable)
- stimulate rest of the heart
- contractile muscle fibers (need to be excited)

**Contraction**
- heart contracts as a unit or not at all
- gap junctions tie all cardiac muscle cells together
- ion passage: depolarization wave (contract)
**Contractile Cells**
- influx of sodium (quick)
- influx of calcium (slow)
- cross bridge activation – sliding of myofilaments
  - depolarization wave “contract”
  - as long as calcium enters fibers will contract
- calcium channels close, potassium channels open restoring the resting membrane potential
  - repolarization wave “relax”
- heart requires oxygen for energy (primarily aerobic respiration)
- can use variety of nutrient supplies (glucose, fatty acids, lactic acid)

**Cardiovascular Disorders**
Aneurysm – ballooning of a vessel
Angina – reduced blood flow: chest pain
Arteriosclerosis – loss of elasticity of artery wall
Endocarditis – infection in lining of heart
Hypertension – high blood pressure
Myocardial Infarction – heart attack – blood clot blocks flow
Myocarditis – infection of heart muscle
Stroke – blood supply to brain is stopped or reduced
Today you and your partner will track the flow of blood through the heart, lungs, and body.

You will track one complete cycle: starting in the right atrium and ending in the right atrium.

Be sure to include all structures including: heart chambers, valves, and blood vessels.

Complete on your mobile device and e-mail to me.
Cardiovascular System Lab Activity

Heart Sounds

Two distinct sounds can be heard during each cardiac cycle. These heart sounds are commonly described by the monosyllables “lub” and “dup”; and the sequence is designated lub-dup, pause, lub-dup, pause, and so on. The first heart sound (lub) is associated with closure of the AV valves at the beginning of systole. The second heart sound (dup) occurs as the semilunar valves close and corresponds with the end of systole. Figure 34.1a indicates the timing of heart sounds in the cardiac cycle.

Listen to the recording “Interpreting Heart Sounds” so that you may hear both normal and abnormal heart sounds.

Abnormal heart sounds are called murmurs and often indicate valvular problems. In valves that do not close tightly, closure is followed by a swishing sound due to the backflow of blood (regurgitation). Distinct sounds, often described as high-pitch “screeching,” are associated with the tortuous flow of blood through constricted, or stenosed, valves.

Activity: Auscultating Heart Sounds

In the following procedure, you will auscultate your partner’s heart sounds with an ordinary stethoscope. A number of more sophisticated heart-sound amplification systems are on the market, and your instructor may prefer to use one such if it is available. If so, directions for the use of this apparatus will be provided by the instructor.

1. Obtain a stethoscope and some alcohol swabs. Heart sounds are best auscultated (listened to) if the subject’s outer clothing is removed, so a male subject is preferable.

2. With an alcohol swab, clean the earpieces of the stethoscope. Allow the alcohol to dry. Notice that the earpieces are angled. For comfort and best auscultation, the earpieces should be angled in a forward direction when placed into the ears.

3. Don the stethoscope. Place the diaphragm of the stethoscope on your partner’s thorax, just to the sternal side of the left nipple at the fifth intercostal space, and listen carefully for heart sounds. The first sound will be a longer, louder (more booming) sound than the second, which is short and sharp. After listening for a couple of minutes, try to time the pause between the second sound of one heartbeat and the first sound of the subsequent heartbeat.

How long is this interval? ______________ sec

How does it compare to the interval between the first and second sounds of a single heartbeat?

________________________________________

4. To differentiate individual valve sounds somewhat more precisely, auscultate the heart sounds over specific thoracic regions. Refer to Figure 34.2 for the positioning of the stethoscope.

Figure 34.2 Areas of the thorax where valvular sounds can best be detected.
Figure 34.4 Procedure for measurement of blood pressure. (a) The course of the brachial artery of the arm. Assume a blood pressure of 120/70. (b) The blood pressure cuff is wrapped snugly around the arm just above the elbow and inflated until blood flow into the forearm is stopped and a brachial pulse cannot be felt or heard. (c) The pressure in the cuff is gradually reduced while the examiner listens (auscultates) carefully for sounds (of Korotkoff) in the brachial artery with a stethoscope. The pressure read as the first soft tapping sounds are heard (the first point at which a small amount of blood is spurtting through the constricted artery) is recorded as the systolic pressure. (d) As the pressure is reduced still further, the sounds become louder and more distinct, but when the artery is no longer restricted and blood flows freely, the sounds can no longer be heard. The pressure at which the sounds disappear is routinely recorded as the diastolic pressure.

Blood Pressure at Rest (1 minute)

<table>
<thead>
<tr>
<th></th>
<th>Trial #1</th>
<th>Trial #2</th>
<th>Trial #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting</td>
<td></td>
<td></td>
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<tr>
<td>Standing</td>
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</tbody>
</table>

Blood Pressure after activity (1 minute)

<table>
<thead>
<tr>
<th></th>
<th>Trial #1</th>
<th>Trial #2</th>
<th>Trial #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up &amp; Down (single step)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprint OR Jumping Jacks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit-Ups</td>
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<td></td>
</tr>
</tbody>
</table>
Cardiovascular System Lab Activity Write-Up

After completing the lab activity post results on to the class wikispace.

Respond to the following in paragraph form.

Discuss the general trends that are present in males and females, what do you think accounts for this?

Discuss any patterns that arise as you analyze the data, come up with a rationale for the patterns that you see in the class data set.
Cardiovascular Disorders Activity

Aneurysm – ballooning of a vessel

Angina – reduced blood flow: chest pain

Arteriosclerosis – loss of elasticity of artery wall

Endocarditis – infection in lining of heart

Hypertension – high blood pressure

Myocardial Infarction – heart attack – blood clot blocks flow

Myocarditis – infection of heart muscle

Stroke – blood supply to brain is stopped or reduced

1.) Choose one of the following cardiovascular disorders that you are interested in learning more about.

2.) Students will work in groups of 4.

3.) Each student will find a current event dealing with the cardiovascular disorder to discuss with the class after airing the PSA.

4.) Each student will research and find information to use to educate the public about the cardiovascular disorder through a public service announcement (PSA).

5.) PSAs will be linked to the class wikispace.

Search online to find examples of PSAs if you are interested.
**Lymphatic System NOTES**

- collect tissue fluid that is leaked from the cardiovascular system
- transport fluid (lymph) to veins (retuned to the heart)
- immune response: white blood cells & macrophages
- absorption of fat from small intestine
  - lacteals: specialized lymph capillaries
- capillaries are “blind-ended”, made of endothelial cells that overlap
- anchored to connective tissue (open & close)

**Lymph Nodes (organs)**

- lymph “filters” that destroy pathogens before they are delivered to the blood
  - activate the immune system
    - form white blood cells & phagolytic cells that remove pathogens

**Other Lymphatic System Organs**

**Tonsils**
- remove bacteria entering the digestive & respiratory tracts

**Thymus**
- programs lymphocytes through the production of thymosin (peaks during youth)

**Spleen**
- filters pathogens out of the blood
- destroys damaged/worn out red blood cells
- stores platelets (same as liver)

**Peyer’s Patches**
- “tonsils” of the small intestine
- contains macrophages to destroy pathogens in the digestive tract
Lymphatic System Diagrams

**Figure 21.1** Distribution and special structural features of lymphatic capillaries, page 779.

**Figure 21.2b** The lymphatic system, page 780.
Circulatory System Test

1.) Sketch and label a human heart. Be sure to include the following: right atrium, right ventricle, left atrium, left ventricle, aorta, pulmonary vein, pulmonary artery, superior vena cava, inferior vena cava, semilunar valves (aortic & pulmonary), atrioventricular valves (mitral & tricuspid).

2.) Discuss in a well-composed essay how blood flows though the cardiovascular system including the heart, lungs, and body tissues. Be specific and include each structure the blood will come in contact with as it passes though 1 complete cycle.

3.) Discuss in a well-composed paragraph how heart rate is controlled.

4.) Discuss in a well-composed paragraph the role of the lymphatic system, be sure to include organs discussed in class.
Respiratory Unit Timeline

Objectives:
- Students gain an understanding of the anatomy and physiology of the respiratory system
- Students comprehend the relationship between the structure and function of the components of each of the respiratory system. Form fits function.
- Students have the opportunity to test in lab their respiratory system function.
- Students analyze class data to draw conclusions and engage in a class discussion about trends in the data.
- Students utilize mobile technologies (m-tech) on a daily basis for a variety of purposes.

Day One:

Respiratory System Notes – notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

Anatomy of the Lungs Diagram – students will label and color code the anatomy of the respiratory system.

Respiratory System Application (App) – students will be directed to download the Grade 12 Biology: Respiratory System Application by Michael Lee Education. Students will use the App’s flashcards to review information for 15 minutes.


Day Two:

Physiology of the Respiratory System Notes - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

The Lungs & Pulmonary System: Khan Academy Video

http://www.youtube.com/watch?v=SPGRkexI_es

Students will use their mobile device (m-device) to view independently the preceding video explaining structure and functioning of the pulmonary system and the lungs. Students will stream this video through a free youtube app.

Homework – textbook reading from Human Anatomy and Physiology 5th Ed. Marieb, 2001 p.862 - 867
Day Three:

**Respiratory Lab Activity** – students will conduct an experiment where they will be measuring their lung capacity at rest in different positions as well as after several exercises. After each trial they will use a lung capacity bag to measure lung capacity in liters.

*During this activity students will utilize their m-tech as a timer, as a calculator to determine averages, and to upload data to the class wikispace.*

**Respiratory System App** – students will be directed to spend the final 15 minutes of class reviewing the app quiz: *Structure of the Respiratory System* as a closing activity.

**Homework** – review notes: respiratory system and physiology of the respiratory system

Day Four:

**Respiratory Lab Activity** – students will conduct an experiment where they will be measuring their lung capacity at rest in different positions as well as after several exercises. After each trial they will use a lung capacity bag to measure lung capacity in liters.

*During this activity students will utilize their m-tech as a timer, as a calculator to determine averages, and to upload data to the class wikispace.*

**Respiratory System App** – students will be directed to spend the final 15 minutes of class reviewing the app quiz: *Breathing Mechanics* as a closing activity.

**Homework** – Respiratory Lab Activity Write Up

Day Five:

**Respiratory Lab Activity** – discussion of data

[www.polleverywhere.com](http://www.polleverywhere.com)

*Students will text in their responses to the following prompts, each prompt will be used to facilitate a class discussion, the responses as well as the class data posted on the wikispace will be projected on the white board during the discussion.*
Prompt #1 – What trends did you see in the data at rest? Discuss either males or females.
Prompt #2 – What differences did you see in the data at rest when comparing males to females.
Prompt #3 – What trends did you see in the data after exercise? Discuss either males or females.
Prompt #4 – What differences did you see in the data after exercise when comparing males to females?

Medical Conditions of the Respiratory System – Students will research on their m-device different medical conditions of the respiratory system in class. They will also use their m-device to view samples of infographics.

Students will conduct research and present the information in an infographic that will be uploaded on the class wikispace.

Homework – study with Respiratory System App and review notes

Day Six:

Medical Conditions of the Respiratory System – Students will research on their m-device different medical conditions of the respiratory system in class. They will also use their m-device to view samples of infographics.

Students will conduct research and present the information in an infographic that will be uploaded on the class wikispace.

Respiratory System Quiz – students will use their m-device to e-mail in responses to the quiz.

Homework – finish Medical Conditions of the Respiratory System Infographic
Respiratory Unit M-Learning Rubrics

App Use: Flashcards & Quiz Practice

RUBRIC

<table>
<thead>
<tr>
<th>Stays on task</th>
<th>Student completes the quiz flashcards for the entire time allotted.</th>
<th>Student completes the quiz flashcards almost all (80% or more) of the allotted time.</th>
<th>Student completes the quiz flashcards some (50% or more) of the allotted time.</th>
<th>Student wastes a lot of allotted time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tries to understand</td>
<td>Student actively engages in the quiz and flashcards and puts forth 100% effort to comprehend all material.</td>
<td>Student actively engages in the quiz and flashcards and puts forth some effort to comprehend all material.</td>
<td>Student actively engages in the quiz and flashcards and puts forth little effort to comprehend material.</td>
<td>Student does not pay attention to the quiz or flashcards.</td>
</tr>
<tr>
<td>Respects others</td>
<td>Student is quiet and does not distract others.</td>
<td>Student is quiet, moves around once or twice but does not distract others.</td>
<td>Student makes 1-2 comments or noises when working with the app, but stays in place.</td>
<td>Student reads loudly, makes repeated comments or noises OR fidgets and moves about often, distracting others.</td>
</tr>
</tbody>
</table>

Watching Videos

RUBRIC

<table>
<thead>
<tr>
<th>Follows Along</th>
<th>Student is on the correct video and is actively taking quality notes of major concepts while watching.</th>
<th>Student is on the correct video and usually appears to be actively taking notes of major concepts while watching.</th>
<th>Student is on the correct video and seems to be taking notes. May have a little trouble recalling major concepts.</th>
<th>Student is on the wrong video OR is clearly not participating in the activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehension</td>
<td>Student seems to understand entire video and accurately answers 3 questions related to the major concepts.</td>
<td>Student understands most of the video and accurately answers 2 questions related to the major concepts.</td>
<td>Student understands some parts of the video and accurately answers 1 question related to the major concepts.</td>
<td>Student has trouble understanding or remembering most parts of the video.</td>
</tr>
<tr>
<td>Respects Others</td>
<td>Student listens quietly, does not interrupt others, and stays on assigned task until everyone is finished.</td>
<td>Student listens quietly and does not interrupt others.</td>
<td>Student interrupts once or twice, but comments are relevant. Stays in assigned place without distracting movements.</td>
<td>Student interrupts often by whispering, making comments or noises that distract others OR moves around in ways that distract others.</td>
</tr>
<tr>
<td>Medical Conditions of the Respiratory System</td>
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<tr>
<td>---------------------------------------------</td>
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</tr>
<tr>
<td>RUBRIC</td>
<td></td>
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</tr>
</tbody>
</table>

| Sources                                      | Careful and accurate records are kept to document the source of 95-100% of the facts and graphics in the infographic. | Careful and accurate records are kept to document the source of 94-85% of the facts and graphics in the infographic. | Careful and accurate records are kept to document the source of 84-75% of the facts and graphics in the infographic. | Sources are not documented accurately or are not kept on many facts and graphics. |
| Knowledge Gained                             | All students in the group can accurately answer all questions related to facts in the infographic and to technical processes used to create the infographic. | All students in the group can accurately answer most questions related to facts in the infographic and to technical processes used to create the infographic. | Most students in the group can accurately answer most questions related to facts in the infographic and to technical processes used to create the infographic. | Several students in the group appear to have little knowledge about the facts or technical processes used in the infographic. |
| Content - Accuracy                           | All facts in the infographic are accurate. | 99-90% of the facts in the infographic are accurate. | 89-80% of the facts in the infographic are accurate. | Fewer than 80% of the facts in the infographic are accurate. |
| Attractiveness & Organization                | The infographic has exceptionally attractive formatting and well-organized information. | The infographic has attractive formatting and well-organized information. | The infographic has well-organized information. | The infographic's formatting and organization of material are confusing to the reader. |
| Spelling & Proofreading                      | No spelling errors remain after one person other than the typist reads and corrects the infographic. | No more than 1 spelling error remains after one person other than the typist reads and corrects the infographic. | No more than 3 spelling errors remain after one person other than the typist reads and corrects the infographic. | Several spelling errors in the infographic. |
| Use of M-Tech                                | Students appropriately used their m-tech for research and to view sample infographics. | Students appropriately used their m-tech for research and to view sample infographics and were rarely off task. | Students were continually off task and rarely completed research or viewed sample infographics. | Students did not use their m-tech for the intended task. |
Respiratory System Notes

- supply oxygen to tissues through the blood stream
- remove carbon dioxide from tissues through the blood stream
- generate ATP (adenosine triphosphate)
  - used as energy source in cellular functions

Anatomy

Nasal Cavity – filters, warms, and moistens incoming air

Pharynx – passageway for food and air

Larynx – air passageway, prevents food from entering the lower respiratory tract

Trachea – air passageway, cleans, warms, and moistens incoming air

Bronchi – primary branching passageway in the lungs

Bronchioles – secondary branching passageway in the lungs (connects to the alveoli)

Alveoli – site of gas exchange between the lungs and blood capillaries
Anatomy of the Lungs

DIAGRAM
Physiology of the Respiratory System

Ventilation
- contraction of the diaphragm draws air into the lungs
- lung volume = capacity of the lungs (can be measured with a spirometer)

Gas Exchange
- oxygen and carbon dioxide are transferred between alveoli and the blood capillaries in body tissues and the lungs

Gas Transport
- OXYGEN
  - Bound to hemoglobin (protein) for transportation
  - Hemoglobin loads up oxygen in the lungs
  - Hemoglobin unloads oxygen in the body tissues
- CARBON DIOXIDE
  - Dissolved in plasma
  - Bound to hemoglobin for transportation
  - Also bound to bicarbonate in plasma for transportation

Control of Respiration
- autonomic nervous system (ANS)
  - medulla and pons in the brain both contain a respiratory center
    - respond to commands (exercise & singing)

Oxygen Levels in Body Tissues
- example of a negative feedback loop
  - Sensor – chemoreceptors (sense the levels of oxygen and carbon dioxide in the tissues)
  - Integrator – respiratory centers in the brain
    - too little oxygen present = increase in air flow
    - too much carbon dioxide present = increase in air flow
  - Effector – diaphragm & intercostal muscles are stimulated resulting in a change in ventilation
**Respiratory Lab Activity**

Calculated averages will be uploaded to the class wikispace.

Lung Capacity at Rest (measured after 2 minutes)

<table>
<thead>
<tr>
<th></th>
<th>Trial #1</th>
<th>Trial #2</th>
<th>Trial #3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing</td>
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</tr>
<tr>
<td>Lying Down</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Lung Capacity after Exercise (measured after 1 minute)

<table>
<thead>
<tr>
<th></th>
<th>Trial #1</th>
<th>Trial #2</th>
<th>Trial #3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climbing Stairs</td>
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<td>Jumping Jacks</td>
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<tr>
<td>Sit-Ups</td>
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</table>
Respiratory Lab Activity

Write Up

1.) Compare your lung capacity at rest: sitting, standing, and lying down. Discuss a rationale for your results.

2.) Compare your lung capacity after 1 minute of exercise (steps, jumping jacks, and sit-ups). Discuss a rationale for your results.

3.) Graph the class data for lung capacity (example below).

4.) Compare the data among females and discuss trends. Explain.

5.) Compare the data among males and discuss trends. Explain.

6.) Compare the female data to the male data and discuss trends. Explain.
Medical Conditions of the Respiratory System

Students will use their mobile device (m-device) to research a medical condition of the respiratory system.

Each student will design an infographic that will be posted on the class wikispace.

Research:
Definition of the medical condition
Symptoms of the medical condition
History of the medical condition
Statistics associated with the medical condition
Medications/Cures for the medical condition
Other information

Use the Infographic App: Lemon-ly as an example to get inspiration for laying out your information.
Respiratory System Quiz

Using your mobile device answer the following questions and e-mail to me.

1.) Discuss in detail the major structures that comprise the respiratory system.
2.) Discuss in detail the physiology of the respiratory system.
Special Senses Unit Timeline

Objectives:
- Students gain an understanding of the anatomy and physiology of: vision, hearing and equilibrium, gustation, and olfaction.
- Students comprehend the relationship between the structure and function of the components of each of the special senses. Form fits function.
- Students have the opportunity to test in lab their own special senses.
- Students analyze class data to draw conclusions and engage in a class discussion about trends in the data.
- Students utilize mobile technologies (m-tech) on a daily basis for a variety of purposes.

Day One:

[http://www.polleverywhere.com](http://www.polleverywhere.com) What do you know about the human sense of taste?

*Opening activity where students respond to the question by texting in their responses – the question is projected up on the whiteboard and students can see the responses in real time. This allows an opportunity for me to get somewhat of a baseline of their knowledge surrounding gustation (sense of taste).*

**Gustation Notes** – notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds. Students are given a copy of the diagram included in the notes and label structures as they are brought up in the lecture. After the lecture is completed students are given time to color all labeled structures.

**Homework** – read pages 561 – 564 (The Olfactory Epithelium and the Sense of Smell) and take notes (textbook Human Anatomy and Physiology 5th Ed. Marieb, 2001.)

Day Two:

**Olfaction Notes** - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds. Students are given a copy of the diagram included in the notes and label structures as they are brought up in the lecture.

**Start Gustation and Olfaction Activity** – students will begin the activity and complete the data collection for the first 3 pages (once students have completed plotting their taste bud distribution they will take a picture of the chart on their data sheet and upload it to the class wiki).
**Homework** – Compare and contrast the data posted on the wiki, be sure to notice trends and discuss the differences and similarities between makes and females

Day Three:

www.polleverywhere.com

Share some observations that you made based on the location of taste receptors.

*Opening activity where students respond to the question by texting in their responses – the question is projected up on the whiteboard and students can see the responses in real time. This allows an opportunity for a class discussion around the data that was collected and the process of analyzing data and noticing trends. The conclusion of the discussion will be drawing conclusions based on the interpretation of data.*

**Finish Gustation and Olfaction Activity** – finish collecting data for the activity and complete packet.

**Homework** – Study! Olfactory quiz next class.

Day Four:

**Olfactory Quiz** – Prompts will be handed out and students will e-mail in their typed responses on their mobile devices.

*Students will be assessed on their quality of answers, and professionalism (appropriate subject on e-mail, and introduction/title in the e-mail, and formatting). Some students may choose to use an alternate program to compose their responses and then send as an attachment.*

**Hearing and Equilibrium Notes** - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds. Students are given a copy of the diagram included in the notes and label structures as they are brought up in the lecture.

**Homework** – think about one of the special senses: olfaction, gustation, hearing and equilibrium, or vision. Which one might you be interested in learning more about with regards to medical conditions (diseases, ailments, etc.)
Day Five:

**Vision Notes** - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds. Students are given a copy of the diagram included in the notes and label structures as they are brought up in the lecture.

**Special Senses Lab** – student will begin working on the lab.

2 apps are needed to complete the lab:

1.) Are you color blind? James Kwan Entertainment
2.) Metronome MarketWall.com

While students are conducting the lab I will be walking around and monitoring the proper use of equipment and offering assistance when it is needed. I will also be paying attention to the use of the mobile device in the lab – is it a distraction?

**Homework** – complete the background information for the Special Senses Lab Report

Day Six:

**Special Senses Lab** – students will complete the data collection for the lab.

While students are conducting the lab I will be walking around and monitoring the proper use of equipment and offering assistance when it is needed. I will also be paying attention to the use of the mobile device in the lab – is it a distraction?

**Homework** – complete the lab report for the Special Senses Lab.

Day Seven:

**Medical Conditions of the …**

Students will research a medical condition that afflicts one of the special senses. Students will spend the majority of the class time researching on their phones. The final product will be due after the unit test. Students have the option of working alone, in partners, or in groups of 3. While students are choosing their medical condition and beginning their research I will be observing and documenting their use of mobile technologies.

**Homework** – study for the unit test
Day Eight:

Special Senses Unit Test

[www.polleverywhere.com] What was the most difficult topic on the test?

A – Gustation
B – Olfaction
C – Hearing & Equilibrium
D – Vision

Opening activity where students respond to the question by texting in their responses – the question is projected up on the whiteboard and students can see the responses in real time. This allows an opportunity for students to share their thoughts on the test and discuss what activities helped them understand concepts, and me to reflect on possible areas for improvement for the future.

Finish Researching Medical Conditions of the… final class time to make sure that all information is included and review the format for the papers (see rubric).

Homework – finish Medical Conditions of the… Assignment
Special Senses M-Learning Rubrics

Medical Conditions of the Special Senses

**RUBRIC**

<table>
<thead>
<tr>
<th>Sources</th>
<th>Careful and accurate records are kept to document the source of 95-100% of the facts and graphics in the brochure.</th>
<th>Careful and accurate records are kept to document the source of 94-85% of the facts and graphics in the brochure.</th>
<th>Careful and accurate records are kept to document the source of 84-75% of the facts and graphics in the brochure.</th>
<th>Sources are not documented accurately or are not kept on many facts and graphics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Gained</td>
<td>All students in the group can accurately answer all questions related to facts in the brochure and to technical processes used to create the brochure.</td>
<td>All students in the group can accurately answer most questions related to facts in the brochure and to technical processes used to create the brochure.</td>
<td>Most students in the group can accurately answer most questions related to facts in the brochure and to technical processes used to create the brochure.</td>
<td>Several students in the group appear to have little knowledge about the facts or technical processes used in the brochure.</td>
</tr>
<tr>
<td>Content - Accuracy</td>
<td>All facts in the brochure are accurate.</td>
<td>99-90% of the facts in the brochure are accurate.</td>
<td>89-80% of the facts in the brochure are accurate.</td>
<td>Fewer than 80% of the facts in the brochure are accurate.</td>
</tr>
<tr>
<td>Attractiveness &amp; Organization</td>
<td>The brochure has exceptionally attractive formatting and well-organized information.</td>
<td>The brochure has attractive formatting and well-organized information.</td>
<td>The brochure has well-organized information.</td>
<td>The brochure’s formatting and organization of material are confusing to the reader.</td>
</tr>
<tr>
<td>Spelling &amp; Proofreading</td>
<td>No spelling errors remain after one person other than the typist reads and corrects the brochure.</td>
<td>No more than 1 spelling error remains after one person other than the typist reads and corrects the brochure.</td>
<td>No more than 3 spelling errors remain after one person other than the typist reads and corrects the brochure.</td>
<td>Several spelling errors in the brochure.</td>
</tr>
<tr>
<td>Use of M-Tech</td>
<td>Students appropriately used their m-tech for research and were on task all of the time.</td>
<td>Students were rarely off task while using their m-tech to complete research.</td>
<td>Students were continually off task while using their m-tech to complete research.</td>
<td>Students did not use their m-tech for the intended task.</td>
</tr>
</tbody>
</table>
Gustation (taste) Notes

*As students take notes the above diagram will be labeled (students have a copy of the diagram and it is drawn on the front board)*

- taste is 80% smell
- gustation happens in the oral cavity (sensory receptor organ)
  --- tongue, palate, cheeks, pharynx, epiglottis
  --- sweet è sugars, salty è metals, sour è acids, bitter è alkaloids, umami (savory) è glutamate

**STRUCTURE**
- 10,000 taste buds
- papillae – functional unit
  --- fungiform: mushroom shaped, primarily located on the tip and sides of tongue
  --- circumvallate: round shaped, arranged in an inverted “V” at the back of the tongue
  --- filiform: slender shaped, located on the palate and cheeks

- each taste bud contains 40-100 epithelial cells that insulate the gustatory cells
- microvilli (gustatory hairs) extend though the taste pore (bathed in salvia)
- taste buds are replaced every 7 to 10 days and can easily be damaged
FUNCTION
- chemicals are dissolved in saliva
- diffuse into taste pore and contact gustatory hairs
- stimulate the release of neurotransmitters (message to the brain)
- gustatory sensory nerve impulses are sent to the: thalamus, parietal lobe (gustatory lobe), hypothalamus
- initiates release of saliva in the mouth and gastric juice in the stomach (mucus and enzymes)
- sensory receptors in the oral cavity
  --- chemoreceptors (chemicals)
  --- thermoreceptors (temperature)
  --- mechanoreceptors (touch & texture)
  --- nocireceptors (pain)
As students take notes the above diagram will be labeled (students have a copy of the diagram and it is drawn on the front board).

**Olfactory Epithelium**
- organ of smell, location on the roof of the nasal cavity
- covers the superior nasal concha in each side of the nasal septum
- contains millions of olfactory receptor cells
- contains olfactory cilia that increase the surface area and are covered by mucus
- mucus dissolves airborne odor molecules

FUN FACT: The typical lifespan of an olfactory neuron is 60 days!
Physiology of Smell
- odors must be volatile (in gaseous state) in order for us to sense them
- chemicals are dissolved in the mucus and then activate olfactory receptors
- glomeruli – location of the filaments of the olfactory nerves, axons with the same type of receptor accumulate
- each glomerulus represents a smell “file” that responds to a specific odor
- nerve impulses travel along the olfactory tracts to: thalamus and to the hypothalamus
- thalamus: smells are interpreted and identified
- hypothalamus: elicits emotional responses to smells
- smells associated with danger (smoke) elicit a sympathetic flight or fight response
- smells associated with appetizing smells elicit a release in saliva and mucus in the digestive system
- smells associated with unpleasant odors elicit protective reflexes such as sneezing or choking
Gustation and Olfactory Activity

Background Information:

The receptors for gustation and olfaction are classified as ________ because they respond to chemicals or volatile substances in solution. Although five relatively specific types of taste receptors have been identified, the olfactory receptors are considered sensitive to a much wider range of chemical sensations. The sense of smell is the least understood of the special senses.

List the different types of taste receptors: _______________________________________

The olfactory __________________ (organ of smell) occupies an area of about 2.5 cm in the roof of each nasal cavity. Since the air entering the human nasal cavity must make a hairpin turn to enter the respiratory passages below, the nasal epithelium is in a rather poor position for performing its function. This is why sniffing, which brings more air into contact with the receptors, intensifies the sense of smell. The specialized receptor cells in the olfactory epithelium are surrounded by supporting cells, nonsensory epithelial cells. The olfactory receptor cells are bipolar neurons whose olfactory hairs (cilia) that extend outward form the epithelium. Impulses from neurons of the olfactory bulbs are conveyed to the olfactory portion of the cortex (uncus).

Draw a simple sketch of the composition of the olfactory epithelium below.
Localization and Anatomy of Taste Buds

The taste buds, specific receptors for gustation, are widely but not uniformly distributed in the oral cavity. Most are located on the dorsal surface of the __________. A few are found on the palate, epiglottis, and inner surface of the __________. The dorsal tongue surface is covered with small projections, or __________, of three major types: slender filiform papillae, and the rounded fungiform and circumvallate papillae. The taste buds are located primarily on the sides of the __________ papillae (arranged in a V formation on the posterior surface of the tongue). The______ papillae look like minute mushrooms and are widely distributed on the tongue.

Use a mirror to examine your tongue. Describe the various papillae types that you see and their location.

Each taste bud consists largely of a globular arrangement of two types of modified epithelial cells: the gustatory, or taste cells, which are the actual receptor cells, and the supporting cells. Several nerve fibers enter each taste bud and supply sensory nerve endings to each of the taste cells. The long __________ (gustatory hairs) of the receptor cells penetrate the epithelial surface through an opening called the __________. When these microvilli contact specific chemicals in the solution the taste cells depolarize. The afferent fibers from the taste buds are carried to the brain via three cranial nerves.

List the three cranial nerves:

Stimulating Taste Buds

1.) With a paper towel, dry the dorsal surface of your tongue.
2.) Immediately place a few sugar crystals in your dried tongue. DO NOT CLOSE YOUR MOUTH.
3.) Have your partner time how long it takes to taste the sugar. Record results.
4.) Why do you think you couldn’t taste the sugar immediately?
Comparing Data

<table>
<thead>
<tr>
<th>Student</th>
<th>Gender</th>
<th>Time to Taste Sugar</th>
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<tbody>
<tr>
<td>A</td>
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</table>

Compare your results with the data in the chart to the left. What conclusions can you make?

---

Plotting Taste Bud Distribution

When taste is tested with pure chemical compounds, most taste sensations can be grouped into one of five basic qualities. What are they?

Although all taste buds are believed to respond in some degree to all five classes of chemical stimuli, each type responds optimally to only one. This characteristic makes it possible to map the tongue to show the relative density of each type of taste bud.

The_________ receptors respond to a number of compounds such as sugars, saccharine, and some amino acids. Some believe that the common factor is the hydroxyl (OH\(^-\)) group.___________ receptors respond to hydrogen ions (H\(^+\)), the acidity of the solution.__________ receptors respond to alkaloids containing nitrogen._______ receptors respond to metallic ions in solution and___________ receptors respond to glutamates.

1.) Prepare to make a taste sensation map of your lab partner’s tongue. Have them record your data here, and record their data in their packet. Collect samples off all compounds, Q-tips, paper towel, and a paper cup.

2.) Before each test the subject should rinse his or her mouth thoroughly with water and lightly dry her or his tongue with a paper towel.

3.) Generously moisten a Q-tip with solution A and touch it to the center, back, tip, and sides of the dorsal surface of the subject’s tongue. DO NOT CONTAMINATE THE SOLUTION.

4.) Rinse and repeat step 3 for each solution.

5.) Draw a tongue and map out what the subject senses below as follows.
Sweet Receptors: O
Bitter Receptors: B
Salt Receptors: +
Sour Receptors: -
Umami Receptors: U

What area of your tongue seems to lack taste receptors?

______________________________________________________________________________

How closely does your localization of the different taste receptors coincide with the information in your textbook?

______________________________________________________________________________

______________________________________________________________________________
Examine the Combined Effects of Smell and Texture on Taste

1.) Obtain a plate with 5 samples of food. DO NOT LET THE SUBJECT SEE THE FOODS BEING TESTED.

2.) Ask the subject to sit with eyes closed and to pinch her or his nostrils shut.

3.) For each test, place a cube of food in the subject’s mouth and ask him or her to identify the food by using the following sequence of activities:
   a. Texture only – nostrils pinched
   b. Chewing only – nostrils pinched
   c. Olfactory – unpinched nostrils

4.) Have your lab partner record your results below.

<table>
<thead>
<tr>
<th>Food</th>
<th>Texture Only</th>
<th>Chewing Only</th>
<th>Olfactory</th>
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Was the sense of smell equally important in all cases? ____________________

Explain why you think that is.
________________________________________________________________________

With what foods did the sense of smell seem to be important? Explain why you think that is.
________________________________________________________________________
1.) What is the organ of smell? What can you tell me about it?
2.) Briefly describe the pathway of our sense of smell from air we inhale to our brain.
3.) Why is it important to have a layer of mucus coating the surface of the olfactory epithelium?

BONUS: What can change our sense of smell? Multiple answers are possible.
Hearing and Equilibrium Notes

*As students take notes the above diagram will be labeled (students have a copy of the diagram and it is drawn on the front board)

- mechanoreceptors are involved in our ability to hear sound vibrations and our balance (movement of fluid)

- ear is divided into 3 major regions
  --- outer/external ear (hearing only)
  --- middle ear (hearing only)
  --- inner ear (hearing and equilibrium)

**EXTERNAL EAR** aka Pinna aka Auricle
- contains elastic cartilage covered in skin

- direct sound waves into the auditory canal

- **auditory canal** extends to the eardrum
  - lined with skin, bearing hairs, sebaceous glands, and ceruminous glands (secrete earwax)
- sound waves travel to the tympanic membrane (aka eardrum)

- eardrum
  --- boundary between external and middle ear
  --- connective tissue covered in skin
  --- vibrations transfer energy to bones in the middle ear

**MIDDLE EAR**
- mucus lined cavity
- tympanic membrane and ossicles (bones)
- auditory tube runs downward and connects with the throat
  --- usually flattened and closed
  --- site of ear infections
- ear popping: equalizing pressure between external and middle ear
- ossicles: malleus (hammer), incus (anvil), stapes (stirrup)
  --- connected by ligaments
- stapes hits the oval window of the cochlea, moving fluid in inner ear, exciting hearing receptors

**INNER EAR aka labyrinth**
- contains 3 subdivision: cochlea, vestibule, semicircular canals

**Cochlea** – (cochlear duct)
  --- snail-like shell in shape
  --- inside is the Organ of Corti – contains hair cells that are covered in a gel-like membrane
  --- responds to high pitched sounds in the outer layer and low pitched sounds in the inner layer
  --- hair cells transmit nerve impulses via the vestibulocochlear nerve to the temporal lobe for integration

**Vestibular Apparatus**
  --- static equilibrium (position of the head with respect to gravity)
  --- otoliths (tiny stones of calcium) orient upwards and activate hair cells
  --- nerve impulse moves along vestibulocochlear nerve to the cerebellum for integration

**Semicircular Canals**
  --- dynamic equilibrium (angular or rotational movement)
  --- hair cells with fluid filled sac – moves in opposite direction of head
  --- nerve impulse moves along vestibulocochlear nerve to cerebellum for integration
*As students take notes the above diagram will be labeled (students have a copy of the diagram and it is drawn on the front board)*

**Nearsighted** = *myopia*
- distant objects appear blurry (near objects appear clear)
- eyeball is too long, lens too strong, cornea too curved

**Farsighted** = *hyperopia*
- near objects appear blurry (distant objects appear clear)
- eyeball too short, “lazy” lens – weakening of muscle

Eye is organized into 3 layers (tunics)
- outer FIBROUS TUNIC: cornea
- middle VASCULAR TUNIC: iris & pupil
- inner SENSORY TUNIC: retina (rods & cones)
Anterior Region of Eye
- focus light waves
- control the amount of light entering the eye

Posterior Region of the Eye
- sensory region
- transduce light energy into a nerve impulse

VISIBLE LIGHT
- wavelength 400-700nm
- travels in packets of energy = photons
- red longest wavelength = lowest energy 700nm
- violet shortest wavelength = highest energy 400nm
- what an object reflects is what we see!

FIBROUS TUNIC
- outermost layer
- composed of dense avascular connective tissue
- 2 regions: sclera & cornea

Sclera – white of the eye
  --- posterior region
  --- anchor site for eye muscles

Cornea – “coarse” focus of light
  -- covers iris & pupil
  --- arrangement of collagen fibers make a crystal clear “window”
  --- anterior region
  --- many nocireceptors

FUN FACT: the cornea is the only tissue that can be replaced with no chance of rejection!
VASCULAR TUNIC aka UVEA
- middle layer
- composed of vascular connective tissue
- 3 regions: choroid, ciliary body, iris

Choroid – contains blood vessels for nourishment
    --- posterior region: absorbs light

Ciliary Body – ring of muscle tissue that encircles the lens
    --- anterior region: shape of lens

Lens – “fine” focus of light
    - adjusts near & far vision

Iris – colored part of the eye
    --- anterior region: layers of smooth muscle
    --- constrict & dilate to allow light through central opening

Pupil – opening that allows light in to the posterior region of the eye

SENSORY TUNIC
- inner most layer
- absorbs light through millions of photoreceptors
- outpocketing of the brain
    è continuous with the optic nerve
    è transmits nerve impulses to the occipital lobe of the brain for integration

Retina – contains photoreceptors (rods & cones)

Rods – activated in dim light
    --- peripheral vision
    --- black & white vision
    --- night blindness = vitamin A deficient

Cones – activated in bright light
    --- visual acuity: sharpness
    --- color vision: red, blue, green receptors
Special Senses Lab

Vision

Demonstrating the Blind Spot:

1.) Hold the cue card 45cm away from your eyes. Close your left eye, and focus your right eye on the X, which should be positioned so that it is directly in line with your right eye. Move the figure slowly toward your face, keeping your right eye focused on the X. When the dot focuses on the blind spot, which lacks photoreceptors, it will disappear.

2.) Record in cm the distance at which the dot disappears. ________________

3.) As the card is moved closer the dot will reappear.

4.) Repeat the test for the left eye, this time closing the right eye and focusing the left eye on the dot. Record the distance at which the X disappears. ________________

Afterimages:

1.) Stare at a bright lightbulb for 5 seconds, and then gently close your eyes for 1 minute.

2.) Have your lab partner record, in sequence of occurrence, what you “saw” after closing your eyes.

______________________________

Visual Acuity:

1.) Stand 20 feet (610cm) away from the Snellen eye chart and cover one yet with a hand. As you read each consecutive line aloud, have your lab partner check for accuracy. If you have glasses complete twice, once with your glasses on and once with your glasses off. GLASSES OFF FIRST!

2.) Have your lab partner record the number of the line with the smallest size letters read correctly.

Visual Acuity, right eye ___________  Visual Acuity, left eye ________________

Astigmatism:

1.) View the chart with your right eye, if all the radiating lines appear equally dark and distinct, there is no distortion of your refracting surfaces. If some of the lines are blurred or appear less dark than others, at least some degree of astigmatism is present. Repeat for your left eye.
2.) Astigmatism present in right eye? _______ Astigmatism present in left eye? _______

Color Blindness:

1.) Download the following free app!
2.) Are you color blind? James Kwan Entertainment
3.) Follow the directions and record your results for each of the 12 prompts.

<table>
<thead>
<tr>
<th>RESULTS</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>12</td>
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</table>

4.) According to the colorblindness test are you colorblind? If so, for what colors?

**Hearing and Equilibrium**

*for this part of the lab you will need to download a metronome app: Metronome MarketWall.com Music. It’s free! Use the 2/4 time signature setting. Ask if you have questions. This will be the “ticking device”.

**Acuity Test**

1.) Plug one ear and sit quietly with eyes closed. Have your partner place the “ticking device” (COVER THE SPEAKER) very close to your unplugged ear. Then have them slowly move it away from your ear until you signal that it is no longer audible. Record the distance in cm at which the ticking is inaudible. Right ear __________ Left ear __________

**Sound Localization**

1.) Close both your eyes and have your partner hold the “ticking device” approximately 30cm from your ear and move it in various directions. (COVER THE SPEAKER). Point in each instance where you think the sound is coming from.
2.) Can the sound be localized equally well at all positions? ______________

3.) What positions was the sound less easily located? ______________

**Barany Test**

1.) Stand with your eyes OPEN and your head down, almost touching your chest. Spin around – to the right – 10 times in 10 seconds, then suddenly stop the rotation.

2.) Have your lab partner immediately look into your eyes and note what they see. Describe your feelings of movement, indicating speed and direction sensation. Record below.

__________________________________________________________________________

**Romberg Test**

1.) Stand in front of the whiteboard and have your partner draw one parallel line on each side of your body. Stand erect, with eyes open and staring straight ahead for 2 minutes while your lab partner observes any movements. Record results.

__________________________________________________________________________

2.) Repeat the test, this time with your eyes closed. Have your lab partner note and record the degree of side-to-side movement.

__________________________________________________________________________

3.) Repeat the test, with your eyes first open and then closed, this time have your shoulder facing the board, so your lab partner can observe front-to-back swaying. Record results.

__________________________________________________________________________

**Role of Vision in Maintaining Balance**

1.) Stand erect with your eyes open. Raise your left foot approximately 1 foot off the floor, and hold there for 1 minute. Have your lab partner record the observations.

__________________________________________________________________________

2.) Rest for a minute, and then repeat the experiment with the same foot raised, but with your eyes closed. Have your lab partner record the observations.

__________________________________________________________________________
Lab Report Format

Title Page (title, name, date conducted, lab partner(s), class, section)
Background Information (see below)
Purpose (statement describing the purpose of this lab – what did you test?)
Materials (bullet point list of everything needed to conduct this lab)
Method (refer to Appendix A)
Observations (compile your observations in an organized fashion)
Conclusion (paragraph describing: what you did, what you found, sources of error 3-4)
Discussion Questions (see below)
Appendix A (attach this packet)

Background Information:
Discuss in detail the anatomy and physiology of the eye. Discuss in detail the anatomy and physiology of the ear.

Discussion Questions:
1.) Draw and label a human eye.
2.) Draw and label a human ear (external, middle, and inner portions).
3.) Referring to the afterimages section – explain the role of rhodopsin and “bleaching of the pigment”.
4.) Explain what is astigmatism is and how it influences your vision.
5.) Explain what color blindness is.
6.) Referring to Sound Localization – the ability to localize the source of a sound depends on 2 things, what are they and how can they be used to explain your results?
7.) Referring to equilibrium – what is nystagmus?
8.) Explain why vision influences your equilibrium (ability to balance)
9.) What was the best part of this experiment?
10.) If you were designing this experiment what would you change in testing vision, hearing, and equilibrium?
Choose one of the special senses to research: olfaction, gustation, vision, or hearing & equilibrium

Final Product: **tri-fold brochure** (similar to the ones you see in the doctors office)

**Research:**
- Definition of the medical condition
- Symptoms of the medical condition
- History of the medical condition
- Statistics associated with the medical condition
- Medications/Cures for the medical condition
- Other information

Be sure to include sources of information.

**Individual** – pamphlet and 1 page paper

**Partners** – pamphlet (per group) and 1.5 page paper (each)

**Groups of 3** – pamphlet (per group) and 2 page paper (each)

Each group must research a different medical condition!

<table>
<thead>
<tr>
<th>Organization</th>
<th>Information is very organized with well-constructed paragraphs.</th>
<th>Information is organized with well-constructed paragraphs.</th>
<th>Information is organized, but paragraphs are not well-constructed.</th>
<th>The information appears to be disorganized.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Information</td>
<td>Information clearly relates to the main topic. It includes several supporting details and/or examples.</td>
<td>Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.</td>
<td>Information clearly relates to the main topic. No details and/or examples are given.</td>
<td>Information has little or nothing to do with the main topic.</td>
</tr>
<tr>
<td>Paragraph Construction</td>
<td>All paragraphs include introductory sentence, explanations or details, and concluding sentence.</td>
<td>Most paragraphs include introductory sentence, explanations or details, and concluding sentence.</td>
<td>Paragraphs included related information but were typically not constructed well.</td>
<td>Paragraphing structure was not clear and sentences were not typically related within the paragraphs.</td>
</tr>
<tr>
<td>Sources</td>
<td>All sources are accurately documented in the desired format.</td>
<td>All sources are accurately documented, but a few are not in the desired format.</td>
<td>All sources are accurately documented, but many are not in the desired format.</td>
<td>Some sources are not accurately documented.</td>
</tr>
</tbody>
</table>
Special Senses Unit Test
Label the following diagrams.
True or False. **T and F will not be graded** (10 points).

1.) ________________ Gustatory hairs are microvilli that extend through the taste pore.

2.) ________________ Transduction is when stimulus energy is converted into a nerve impulse.

3.) ________________ Gastric juice in the stomach is released when food enters the stomach.

4.) ________________ The anterior region of the eye is known for transducing light energy.

5.) ________________ Visible light has a wavelength of 350-750nm.

6.) ________________ The choroid is located in the posterior region of the eye.

7.) ________________ The vascular tunic is continuous with the optic nerve.

8.) ________________ The inner ear is also known as the pinna or auricle.

9.) ________________ The auditory canal is usually closed and flattened, site of ear infections.

10.) ________________ The vestibular apparatus is associated with static equilibrium.
Matching, you know the drill (10 points).

1.) ________________ This structure contains the organ of Corti.

2.) ________________ Most numerous papillae found on the center and edges of the tongue.

3.) ________________ Arrangement of collagen fibers make this structure crystal clear.

4.) ________________ These receptors are associated with peripheral vision.

5.) ________________ These receptors are associated with visual acuity.

6.) ________________ Papillae that are found at the back of the tongue.

7.) ________________ This is the boundary between the middle and external ear.

8.) ________________ This structure contains tiny calcium salts that orient upwards.

9.) ________________ This ring of muscle encircles the lens.

10.) ________________ Modified apocrine glands in the auditory canal secrete this.

<table>
<thead>
<tr>
<th>CERUMEN</th>
<th>CILIARY BODY</th>
<th>CIRCUMVALLATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COCHLEA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONES</td>
<td>CORNEA</td>
<td>EARDRUM</td>
</tr>
<tr>
<td>FUNGIFORM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RODS</td>
<td>VESTIBULAR APPARATUS</td>
<td></td>
</tr>
</tbody>
</table>
Multiple choice (10 points).

1.) These papillae are primarily located on the palate and the inside of the cheeks.
   a. Fungiform
   b. Gustatory
   c. Filiform
   d. Circumvallate
   e. None of the above

2.) All of the following sensory receptors are found in the oral cavity except for
   a. Thermoreceptors
   b. Mechanoreceptors
   c. Nocireceptors
   d. Photoreceptors
   e. Chemoreceptors

3.) Gustatory afferent nerve impulses are sent to the
   a. Thalamus, parietal lobe, frontal lobe
   b. Parietal lobe, frontal lobe, cerebellum
   c. Thalamus, hypothalamus, frontal lobe
   d. Hypothalamus, frontal lobe, cerebellum
   e. Parietal lobe, thalamus, hypothalamus

4.) This layer of the eye is composed of dense avascular tissue
   a. Sensory tunic
   b. Avascular tunic
   c. Fibrous tunic
   d. Uvea
   e. All of the above

5.) All of the following is true about the cornea except for
   a. It is located in the anterior region of the eye
   b. It is the only tissue that can be replaced without rejection
   c. It covers the iris and the pupil
   d. It contains many nocireceptors
   e. It deals with the “fine” focus of light

6.) The vascular tunic contains the following structures
   a. Choroid, ciliary body, lens, iris
   b. Choroid, iris, sclera, cornea
   c. Ciliary body, sclera, cornea, lens
   d. Ciliary body, lens, retina
   e. Choroid, retina, lens, iris
7.) Ear popping is associated with the equalization of pressure between
   a. The middle and inner ear
   b. The inner and external ear
   c. The ossicles
   d. The auditory canal and the middle ear
   e. None of the above

8.) The olfactory tract would probably affect your ability to
   a. See
   b. Hear
   c. Feel pain
   d. Smell
   e. All of the above

9.) Gustatory cells are stimulated by
   a. Movement of otoliths
   b. Stretch
   c. Substances in solution
   d. Photons of light
   e. Pressure

10.) Nearsightedness is more properly called
   a. Myopia
   b. Hyperopia
   c. Presbyopia
   d. Emmetropia
   e. Corneaopia

Response Prompts

Choose 2 of the following and write a well-composed paragraph.

A – Gustation: discuss in detail the structure and function of a taste pore, include the 5 different tastes and what chemical each one recognizes.

B – Olfaction: discuss in detail the structure and function of the olfactory epithelium. How is it that we smell apple pie baking in the oven?

C – Vision: discuss in detail the 3 layers of the human eye.

D – Hearing: discuss in detail the path sound waves take from the outside environment to the brain.
Nervous Unit Timeline

Objectives:
- Students gain an understanding of the anatomy and physiology of the nervous system
- Students comprehend the relationship between the structure and function of the components of the nervous system. Form fits function.
- Students have the opportunity to test in lab their nervous system function.
- Students analyze class data to draw conclusions and engage in a class discussion about trends in the data.
- Students utilize mobile technologies (m-tech) on a daily basis for a variety of purposes.

Day One:

Accessing Background Information
www.polleverywhere.com

Students will be directed to text in their answers to the following prompt:

What is the nervous system?

In order to gain an understanding of what the class knows, thinks, believes to be true about the nervous system. A discussion will ensue with the class that will also pull out what students are interested in learning about the nervous system.

Intro to the Nervous System Notes – notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

Homework – reading from textbook Human Anatomy and Physiology 5th Ed. Marieb, 2001 p.387 - 393

Day Two:

Nervous System Application (app)
Students will be directed to download the free application “Grade 12 Biology: The Nervous System – Michael Lee Education

Students will complete a warm-up exercise where they will answer 20 of the questions that are in the Neurons Quiz portion of the app.
Central Nervous System Notes - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

Central Nervous System Images – students will be given time to label and color code specific structures in the central nervous system that will be the focus of learning for this unit.

Day Three:

Central Nervous System Warm-Up – students will spend the beginning of class working with the Nervous System App again – this time they will be answering 20 questions from the Central Nervous System as a review of material from the last lecture.

Peripheral Nervous System Notes - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

Reflex Arc Cartoon Activity – students will design a cartoon that represents each stage of the reflex arc pathway.

Homework – complete the reflex arc cartoon activity

Day Four:

Peripheral Nervous System Warm-Up – students will spend the beginning of class working with the Nervous System App again – this time they will be answering 20 questions from the Peripheral Nervous System as a review of material from the last lecture.

Reflex Lab Activity – students will begin collecting data as they are testing their reflexes.

Homework – review nervous system notes

Day Five:

Reflex Warm-Up – students will spend the beginning of class working with the Nervous System App again – this time they will be answering 20 questions from the Reflexes section as a review of material from the last lecture.

Reflex Lab Activity – students will finish collecting data as they are testing their reflexes.

Homework – complete the write-up for the reflex lab activity.
# Nervous System M-Learning Rubrics

**App Use: Flashcards & Quiz Practice**

## RUBRIC

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Rubric 1</th>
<th>Rubric 2</th>
<th>Rubric 3</th>
<th>Rubric 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stays on task</strong></td>
<td>Student completes the quiz/flashcards for the entire time allotted.</td>
<td>Student completes the quiz/flashcards almost all (80% or more) of the allotted time.</td>
<td>Student completes the quiz/flashcards some (50% or more) of the allotted time.</td>
<td>Student wastes a lot of allotted time.</td>
</tr>
<tr>
<td><strong>Tries to understand</strong></td>
<td>Student actively engages in the quiz and flashcards and puts forth 100% effort to comprehend all material.</td>
<td>Student actively engages in the quiz and flashcards and puts forth some effort to comprehend all material.</td>
<td>Student actively engages in the quiz and flashcards and puts forth little effort to comprehend material.</td>
<td>Student does not pay attention to the quiz or flashcards.</td>
</tr>
<tr>
<td><strong>Respects others</strong></td>
<td>Student is quiet and does not distract others.</td>
<td>Student is quiet. She moves around once or twice but does not distract others.</td>
<td>Student makes 1-2 comments or noises when working with the app, but stays in place.</td>
<td>Student reads loudly, makes repeated comments or noises or fidgets and moves about often, distracting others.</td>
</tr>
</tbody>
</table>
Introduction to the Nervous System NOTES

3 Main Functions

1.) Sensory Input – monitors changes (stimuli)
2.) Integration – interpretation of stimuli & decision: what happens next?
3.) Motor Output – response: activate effector organs

Divisions of the Nervous System

CNS (central nervous system)
- brain & spinal cord
- integration & command

PNS (peripheral nervous system)
- cranial nerves
- spinal nerves

AFFERENT SENSORY
- “carry toward”
- messages to the CNS

EFFERENT MOTOR
- “carry away”
- messages away from the CNS

SOMATIC
- voluntary transmission

AUTONOMIC
- involuntary transmission

PARASYMPATHETIC
- rest and recover response

SYMPATHETIC
- fight or flight response
Nervous Tissue

Neurons – send electrical signals

Supporting Cells AKA Glial Cells – surround neurons

FUN FACT: ½ mass of brain is composed of glial cells!

Glial Cells

CNS

Astrocytes – attach to capillaries, control chemical environment
Microglia – monitor neuron health
Ependymal – ciliated, move spinal/cranial fluid
Oligodendrocytes – MYELIN SHEATH, wraps around neurons

PNS

Satellite – surround neuron cell body, function unknown
Schwann – MYELIN SHEATH, nerve regeneration

Neuron AKA Nerve Cell

- conduct messages: nerve impulses
- extreme longevity (100 years)
- amitotic – cannot divide
  - exceptions: olfactory (smell) & hippocampus (memory)
- high metabolic rate
  - need continuous supply of oxygen & glucose
  - only survive a few minutes without oxygen
Dendrites
- input region
- change in environment

Axon
- conducting component of the neuron
- generate nerve impulses & transmit them away from the body

Myelin Sheath
- covers axon (protection)
- increases speed of transmission of nerve impulse (x150)
- PNS = Schwann cells
- CNS = Oligodendrocytes

Functions of Neurons
1.) Sensory or Afferent
   - from receptors to CNS

2.) Interneurons or Association
   - between sensory & motor (INTEGRATION)

3.) Motor or Efferent
   - away from CNS to effector organs
Central Nervous System Notes

Brain & Spinal Cord

- made of gray & white matter

Gray Matter

- consists of dendrites, cell bodies, & unmyelinated axons
- location of integration

White Matter

- consists of myelinated axons
  - information transfers over longer distances faster

MYELIN = fatty covering of axons which insulates & speeds up nerve impulse transmission

Cerebrum

Frontal Lobe – control of somatic motor function, planning, personality

Parietal Lobe – somatic sensory input (touch, pressure, temperature, pain)

Occipital Lobe – visual input

Temporal Lobe – auditory input
**Diencephalon**

Thalamus – sensory relay station

Hypothalamus – control of ANS (autonomic nervous system)
  - center for hunger, satiety, thirst, & some emotions

**Brainstem**

Midbrain – somatic control of skeletal muscle

Pons – control of respiration

Medulla Oblongata – control of respiration, heart rate, & blood pressure

**Cerebellum**

  - control of smooth muscle, balance (skeletal muscle), & maintaining body posture
Label and color code the following:

CEREBRUM (frontal lobe, parietal lobe, occipital lobe, temporal lobe)
Label and color code the following:

DIENCEPHALON (thalamus, hypothalamus)
BRAIN STEM (midbrain, pons, medulla oblongata)
CEREBELLUM
Peripheral Nervous System Notes

Cranial & Spinal Nerves

**Sensory** – afferent (towards CNS)

General Senses
- throughout body
- touch
- temperature
- pain
- pressure

Special Senses
- located in the head
- vision
- hearing
- smell
- taste
- equilibrium (balance)

**Motor** – efferent (away from CNS)

Somatic = voluntary
- skeletal muscles

Autonomic = involuntary
- cardiac & smooth muscle

**Sympathetic** – fight or flight response

**Parasympathetic** – rest & recover response
Sensory Receptor Classification

1.) TYPE
   a. Mechanoreceptors – touch, pressure, vibration, stretch, itch
   b. Thermoreceptors – temperature
   c. Photoreceptors – light
   d. Chemoreceptors – chemicals, molecules that are smelled
   e. Nocireceptors – pain

* over stimulation of any receptor results in pain!

2.) LOCATION
   a. Exteroceptors – outside the body
   b. Interoceptors – inside the body
   c. Proprioceptors – inside the body (musculoskeletal organs)

3.) STRUCTURE
   a. Simple – modified dendrites
   b. Complex – sense organs (vision, taste & smell, hearing)

Reflex Arc

1.) sensory receptor – STIMULUS

2.) sensory neuron – AFFECTENT NERVE IMPULSE

3.) integration – INTERNEURONS

4.) motor neuron – EFFERENT NERVE IMPULSE

5.) effector organ - RESPONSE
Reflex Arc Cartoon

Outline the reflex arc pathway.

Brainstorm a specific stimulus and draw a cartoon that demonstrates each step involved in the reflex arc pathway.

Example:

1.) **Stimulus** – walk into a dark room and turn on a light

2.) **Sensory Input** – photoreceptors in eyes pick up light and send a nerve impulse along the optic nerve

3.) **Integration** – nerve impulse travels to the occipital lobe to make sense of message and determine what the response will be

4.) **Motor Output** – nerve impulse travels back along the optic nerve to contract muscles in the iris

5.) **Effector Organ** – iris contracts limiting the amount of light that can come through the pupil
Reflex Arc Lab Activity

**Activity:**

Initiating Stretch Reflexes

1. Test the patellar, or knee-jerk, reflex by seating a subject on the laboratory bench with legs hanging free (or with knees crossed). Tap the patellar ligament sharply with the reflex hammer just below the knee to elicit the knee-jerk response, which assesses the L₂–L₄ level of the spinal cord (Figure 22.4). Test both knees and record your observations.

Which muscles contracted?

What nerve is carrying the afferent and efferent impulses?

2. Test the effect of mental distraction on the patellar reflex by having the subject add a column of three-digit numbers while you test the reflex again. Is the response greater than or less than the first response?

What are your conclusions about the effect of mental distraction on reflex activity?

3. Now test the effect of muscular activity occurring simultaneously in other areas of the body. Have the subject clasp the edge of the laboratory bench and vigorously attempt to pull it upward with both hands. At the same time, test the patellar reflex again. Is the response more or less vigorous than the first response?

4. Fatigue also influences the reflex response. The subject should jog in position until she or he is very fatigued (really fatigued—no slackers). Test the patellar reflex again and record whether it is more or less vigorous than the first response.

Would you say that nervous system activity or muscle function is responsible for the changes you have just observed?

Figure 22.4 Testing the patellar reflex. The examiner supports the subject's knee so that the subject's muscles are relaxed, and then strikes the patellar ligament with the reflex hammer. The proper location may be ascertained by palpation of the patella.

Explain your reasoning.

What is the result?

Does the contraction of the gastrocnemius normally result in the activity you have observed?

Crossed Extensor Reflex The crossed extensor reflex is more complex than the stretch reflex. It consists of a flexor, or withdrawal, reflex followed by extension of the opposite limb.

This reflex is quite obvious when, for example, a stranger suddenly and strongly grips one's arm. The immediate response is to withdraw the clutching arm and push the in-
The reflexes that have been demonstrated so far—the stretch and crossed extensor reflexes—are examples of reflexes in which the reflex pathway is initiated and completed at the spinal cord level.

**Superficial Cord Reflexes** The superficial cord reflexes (abdominal, cremaster, and plantar reflexes) result from pain and temperature changes. They are initiated by stimulation of receptors in the skin and mucosae. The superficial cord reflexes depend both on functional upper-motor pathways and on the cord-level reflex arc. Since only the plantar reflex can be tested conveniently in a laboratory setting, we will use this as our example.

The plantar reflex, an important neurological test, is elicited by stimulating the cutaneous receptors in the sole of the foot. In adults, stimulation of these receptors causes the toes to flex and move closer together. Damage to the pyramidal (or corticospinal) tract, however, produces Babinski's sign, an abnormal response in which the toes flare and the great toe moves in an upward direction. (In newborn infants, Babinski's sign is seen due to incomplete myelination of the nervous system.)

**Activity:**

**Initiating the Plantar Reflex**

Have the subject remove a shoe and lie on the cot or laboratory bench with knees slightly bent and thighs rotated so that the lateral side of the foot rests on the cot. Alternatively, the subject may sit up and rest the lateral surface of the foot on a chair. Draw the handle of the reflex hammer firmly down the lateral side of the exposed sole from the heel to the base of the great toe (Figure 22.6).

**Activity:**

**Initiating the Crossed Extensor Reflex**

The subject should sit with eyes closed and with the dorsum of one hand resting on the laboratory bench. Obtain a sharp pencil and suddenly prick the subject's index finger. What are the results?

---

Did the extensor part of this reflex seem to be slow compared to the other reflexes you have observed?

What are the reasons for this?

---

Is this a normal plantar reflex or Babinski’s sign?
Activity:
Initiating the Ciliospinal Reflex

1. While observing the subject's eyes, gently stroke the skin (or just the hairs) on the left side of the back of the subject's neck, close to the hairline.

What is the reaction of the left pupil? ________________

The reaction of the right pupil? ________________

2. If you see no reaction, repeat the test using a gentle pinch in the same area.

The response you should have noted - pupillary dilation - is consistent with the pupillary changes occurring when the sympathetic nervous system is stimulated. Such a response may also be elicited in a single pupil when more impulses from the sympathetic nervous system reach it for any reason. For example, when the left side of the subject's neck was stimulated, sympathetic impulses to the left iris increased, resulting in the ipsilateral reaction or the left pupil.

On the basis of your observations, would you say that the sympathetic innervation of the two irises is closely integrated?

________ Why or why not? ________________

Reflection Questions:

1.) Design a chart that includes all of the reflexes that you tested in class today that includes a description of the reflex itself (reflex arc pathway) and medical conditions that are associated with each reflex.

2.) p.474 #12

3.) p.474 #13
Reflex Lab Activity

Write-Up

Take all data collected from the Reflex Lab Activity and compile it in an organized fashion. Be sure to include explanations for all results as prompted on the instruction sheet.

Don’t forget about the 3 reflection questions!

Reflex Lab Activity

Write-Up

Take all data collected from the Reflex Lab Activity and compile it in an organized fashion. Be sure to include explanations for all results as prompted on the instruction sheet.

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Reflex Lab Activity

Write-Up

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Don’t forget about the 3 reflection questions!
Endocrine Unit Timeline

Objectives:
- Students gain an understanding of the anatomy and physiology of the endocrine system
- Students comprehend the relationship between the structure and function of the components of the endocrine system. Form fits function.
- Students analyze class data to draw conclusions and engage in a class discussion about trends in the data collected from a reaction time activity (relating to nervous system).
- Students utilize mobile technologies (m-tech) on a daily basis for a variety of purposes.

Day One:

Introduction Video on the Endocrine System:

Khan Academy Video: Intro to the Endocrine System

http://www.youtube.com/watch?v=f_Z1zsR9lFM

Students will begin by individually watching the above video on their m-devices to give them a general overview with detailed diagram of the glands and hormones associated with the endocrine system.

Intro to the Endocrine System Notes – notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.


Day Two:

Endocrine System Application (app)

Students will be directed to download the free application “Biology 30 Unit 2: The Endocrine System – Michael Lee Education

Students will complete a warm-up exercise where they spend 15 minutes reviewing the flash cards in the app.

Endocrine Hormones Day 1 Notes - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.
**Homework** – Endocrine Glands Diagram – students will label, color code, and list hormones that are released from the glands discussed in class today.

**Day Three:**

**Endocrine System Warm-Up** – *students will spend the beginning of class working with the Endocrine System App again – this time they will spend 10 minutes from the flash cards as a review of material.*

**Endocrine Hormones Day 2 Notes** - notes are written on the whiteboard during lecture where the students are continually engaged and adding questions/comments as the lecture proceeds.

**Endocrine Glands Diagram** – students will complete the diagrams that they worked on for homework from the previous day by including the glands and hormones that were discussed in today’s lecture.

**Homework** – Reaction Time Lab Activity Background Information - In preparation for the next day’s lab activity students will complete the background section ONLY of the lab report.

**Day Four:**

**Endocrine System Warm-Up** – *students will spend the beginning of class working with the Endocrine System App again – this time they will spend 15 minutes working through the Quiz: Principle Endocrine Glands.*

**Reaction Time Lab Background Information** – Students will begin by reviewing the background information while a discussion ensues to make sure all students are on the same page before beginning the lab activity.

**Reaction Time Lab Activity** – students will begin working on the lab activity that focuses on another aspect of the workings of the nervous system, as there is not a lab activity that focuses on the endocrine system.

**Homework** – review nervous system notes: to begin preparation for the double unit test focusing on the nervous and endocrine systems.

**Day Five:**

**Endocrine System Warm-Up** – *students will spend the beginning of class working with the Endocrine System App again – this time they will spend 15 minutes working through the Quiz: Hormones of Principle Glands.*
**Reaction Time Lab Activity** – students will finish working on the lab activity that focuses on another aspect of the workings of the nervous system. By the end of class students will have collected all data in order to complete the lab report for homework.

**Homework** – complete the lab report for the Reaction Time Lab Activity

**Day Six:**

**Endocrine System Warm-Up** – *students will spend the beginning of class working with the Endocrine System App again – this time they will spend 15 minutes working through the Quiz: Feedback Homeostasis.*

**Introduction to The Gland Activity** - students will be introduced to the activity and receive rubrics for the research report and presentations in order to get them aware of expectations for the project.

**Homework** - review endocrine notes

**Day Seven:**

**The Gland Activity** – students will have the entire class time to work on their projects, this will give the teacher the opportunity to rotate through the classroom and clarify and questions or concerns students may have with the project. *Mobile devices will be in use during this time for a variety of uses.*

**Homework** - review endocrine notes

**Day Eight:**

**The Gland Activity** - students will have the entire class time to work on their projects, this will give the teacher the opportunity to rotate through the classroom and clarify and questions or concerns students may have with the project. *Mobile devices will be in use during this time for a variety of uses.*

**Homework** - review endocrine notes
Day Nine:

**Nervous Endocrine Study Notes**
- students will copy down information from the NERVENDOTEST Study Notes to begin reviewing for the double unit test
- these notes are a summary and as they are being review students will elaborate on the importance of each point

**Nervous System & Endocrine System Study Guide** – students will begin working on the study guide where they will annotate on each image being sure to include information from notes on the structure and function of key components on the nervous system as well as for the endocrine system.

**Homework** – complete the study guide

Day Ten:

**The Gland Activity Presentations**

**Homework** – study for nervous system & endocrine system unit test

Day Eleven:

**The Gland Activity Presentations**

**Homework** – study for nervous system & endocrine system unit test

Day Twelve:

**The Gland Activity Presentations**

**Homework** – study for nervous system & endocrine system unit test

Day Thirteen:

**Nervous System & Endocrine System Unit Test**
### Endocrine System M-Learning Rubrics

#### Watching Videos

**RUBRIC**

<table>
<thead>
<tr>
<th>Follows Along</th>
<th>Student is on the correct video and is actively taking quality notes of major concepts while watching.</th>
<th>Student is on the correct video and usually appears to be actively taking notes of major concepts while watching.</th>
<th>Student is on the correct video and seems to be taking notes. May have a little trouble recalling major concepts.</th>
<th>Student is on the wrong video OR is clearly not participating in the activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehension</td>
<td>Student seems to understand entire video and accurately answers 3 questions related to the major concepts.</td>
<td>Student seems to understand most of the video and accurately answers 2 questions related to the major concepts.</td>
<td>Student understands some parts of the video and accurately answers 1 question related to the major concepts.</td>
<td>Student has trouble understanding or remembering most parts of the video.</td>
</tr>
<tr>
<td>Respects Others</td>
<td>Student listens quietly, does not interrupt others, and stays on assigned task until everyone is finished.</td>
<td>Student listens quietly and does not interrupt others.</td>
<td>Student interrupts once or twice, but comments are relevant. Stays in assigned place without distracting movements.</td>
<td>Student interrupts often by whispering, making comments or noises that distract others OR moves around in ways that distract others.</td>
</tr>
</tbody>
</table>

#### App Use: Flashcards & Quiz Practice

**RUBRIC**

<table>
<thead>
<tr>
<th>Stays on task</th>
<th>Student completes the quiz/flashcards for the entire time allotted.</th>
<th>Student completes the quiz/flashcards almost all (80% or more) of the allotted time.</th>
<th>Student completes the quiz/flashcards some (50% or more) of the allotted time.</th>
<th>Student wastes a lot of allotted time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tries to understand</td>
<td>Student actively engages in the quiz and flashcards and puts forth 100% effort to comprehend all material.</td>
<td>Student actively engages in the quiz and flashcards and puts forth some effort to comprehend all material.</td>
<td>Student actively engages in the quiz and flashcards and puts forth little effort to comprehend material.</td>
<td>Student does not pay attention to the quiz or flashcards.</td>
</tr>
<tr>
<td>Respects others</td>
<td>Student is quiet and does not distract others.</td>
<td>Student is quiet. She moves around once or twice but does not distract others.</td>
<td>Student makes 1-2 comments or noises when working with the app, but stays in place.</td>
<td>Student reads loudly, makes repeated comments or noises OR fidgets and moves about often, distracting others.</td>
</tr>
</tbody>
</table>
Endocrine System: Introduction to Hormones NOTES

**Function:** to secrete hormones = chemical messengers that coordinate & direct target cells, tissues, & organs.

**Endocrine Glands**
- secrete hormones directly into the bloodstream

**Exocrine Glands**
- secrete a substance through a duct
  - sweat
  - salivary
  - lacrimal (tears)

**Hormonal Control**
- negative feedback loop
- drop in hormone level triggers a chemical reaction to increase secretion

1.) blood level of hormone falls
2.) brain gets message & sends out hormone to stimulate gland
3.) gland stimulates the release of more hormone
4.) blood level of hormone continues to increase, then brain inhibits the stimulation of gland

- controlled by the sympathetic & parasympathetic nervous systems *

Example = stress
- causes adrenal medulla to release adrenaline (epinephrine)
Endocrine Hormones Part One NOTES

Pituitary Gland
- tiny, grape sized
- located at the base of the brain
- connected to the hypothalamus
- “Master Gland”
- divided into an anterior & posterior portion (based on hormone release)

Anterior Posterior

TSH – thyroid stimulating hormone (stimulates the release of thyroxine)

FSH – follicle stimulating hormone (stimulates the ovaries & testes)

LH – luteinizing hormone (stimulates the release of estrogen & testosterone)

ACTH – adrenocorticotrophic hormone (stimulates the adrenal cortex)

GH – growth hormone (stimulates growth and repair of body tissues)

PRL – prolactin (develops breast tissue, stimulates milk production in the mammary glands)

Posterior Pituitary

ADH – antidiuretic hormone OR vasopressin (stimulates kidneys to concentrate urine, to preserve the amount of water in the body)

Oxytocin – involved in the process of childbirth, stimulates contractions of the uterus

Thyroid Gland
- mass of tissue located on either side of the larynx

Thyroxine – controlled by the secretion of TSH, rate of metabolism

Hyperthyroidism = overactive thyroid gland

Hypothyroidism = underactive thyroid gland

Calcitonin – lowers calcium concentration in the blood
Parathyroid Gland
- size of a grain of rice
- 4 glands that are located on the posterior side of the thyroid gland

PTH – parathyroid hormone (raises calcium concentration on the blood)

Thymus Gland
- located posterior to the sternum
- anterior & superior to the heart
- begins to disappear at puberty

Thymosin – activates the immune system (growth of T cells)

Pineal Gland
- small, pine cone shaped
- located in the diencephalon region of the brain

Melatonin – sleep & awake patterns

High levels = during the night

Low levels = during the day
Endocrine Glands
Endocrine Hormones Part Two: Notes

Adrenal Glands

- located on the top of the kidneys
- considered to be 2 glands in one
  - outer cortex
  - inner medulla
- response to extreme situations

Adrenal Cortex

- releases corticosteroids (made from cholesterol)
- stronger, longer response
- arranged in 3 layers

OUTER LAYER = zona glomerulosa (controls mineral & water levels in blood)

MIDDLE LAYER = zona fasciculata (controls rate of metabolism)

INNER LAYER = zona reticularis (controls the sex hormones)

Aldosterone (glomerulosa)
- sodium retention
- blood pressure

Cortisol (fasciculate)
- mobilize fats for metabolism
- burst of energy in the morning (some)

Testosterone (reticularis)
- reproduction
**Adrenal Medulla**

- weaker, brief response (compared to the adrenal cortex)
- inner layer of the adrenal glands

**Epinephrine (adrenaline)**
- increases blood sugar
- blood vessels constrict
- increases blood pressure
- epipen (anaphylaxis) – allergic response

**Norepinephrine (noradrenaline)**
- less reactive
- increase blood pressure

**Pancreas**

- contains endocrine & exocrine glands
- located near the kidneys and liver
- islet cells produce hormones (α and β cells)

**Glucagon**
- produced by α cells
- increases blood glucose level
- hyperglycemic hormone
- travels to liver
- stimulates the breakdown of glycogen (stores carbs)

**Insulin**
- produced by β cells
- decreases blood glucose levels
- hypoglycemic hormone
- travels to liver
- stimulates the uptake of glucose form the blood forming glycogen
Gonads
- produce sex hormones in males & females
- testes & ovaries

Estrogen
- puberty
- egg development

Progesterone
- puberty
- preparation for pregnancy

Testosterone
- puberty
- sperm development

Placenta
- sustain fetus during development

hCG – human chorionic gonadotropin
- nourishes fetus
- promotes cellular differentiation

Estrogen & Progesterone – fetus development
Reaction Time Lab Report

*must be typed and printed out

Format:

Title Page (title, name, date experiment was conducted, class & section) – separate sheet of paper

Background Information (introduction to the experiment – well composed paragraph)

Purpose (simple statement describing the purpose of this experiment)

Hypothesis (restate in lab report)

Materials (bullet point list of all materials used)

Method (numbered steps – describing in detail how to EXACTLY recreate what you did)

Observations (summary of data collected – graphs)

Conclusion (paragraph describing: what you did, what you found, relate to hypothesis, sources of error)

Discussion Questions (answer in complete sentences)

Appendix A (data tables and hypotheses)

Background Information:

Discuss in detail the transmission of nerve impulses that were tested in this experiment and how they travel throughout the body. Lower extremities: moving your foot out of the way (control, in conversation, and word association). Upper extremities: catching a ruler with your right and left hand (control, conversation, and word association).
Discussion Questions:

1.) Lower extremities – explain a rationale for your results.

2.) Upper extremities – explain a rationale for your results.

3.) What was the best part of this experiment?

4.) What was not the best part of this experiment?

5.) If you were designing this lab, how would you change it?
**Reaction Time Lab Charts**

**Hypothesis:** Reaction Time – Lower Extremities

#1, 2, 3 A -

#1, 2, 3 B -

#1, 2, 3 C -

At what measurement do you think you will be able to move your foot out of the way?

Overall how do you think talking to someone and word association will alter your reactions?

---

**Reaction Time – Lower Extremities**

<table>
<thead>
<tr>
<th></th>
<th>#1 A</th>
<th>#2 A</th>
<th>#3 A</th>
<th>#4 B</th>
<th>#5 B</th>
<th>#6 B</th>
<th>#7 C</th>
<th>#8 C</th>
<th>#9 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10 cm</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A – control         B – talking to someone         C – word association
**Hypothesis:** Reaction Time – Upper Extremities

At what measurement do you think you will be able to catch the ruler? Be sure to hypothesize for the RIGHT and LEFT hands.

Overall how do you think talking to someone **and** word association will alter your reactions (RIGHT and LEFT hands)?

---

**Reaction Time – Upper Extremities**

<table>
<thead>
<tr>
<th></th>
<th>#1 A</th>
<th>#2 A</th>
<th>#3 A</th>
<th>#4 B</th>
<th>#5 B</th>
<th>#6 B</th>
<th>#7 C</th>
<th>#8 C</th>
<th>#9 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Hand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Hand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Gland Activity

- each group will be responsible for becoming experts on one endocrine gland
- groups will conduct research and teach the class what they learn about the gland
- each person will be responsible for writing a research report for the topics they decide to cover relating to the gland (divide and conquer)

What to research?
- structure of the gland
- function of the gland
- location of the gland
- hormones associated with the gland
- disorders associated with the gland
- current events: articles, newscasts, etc that discuss the gland
- medical innovations associated with the gland

Presentations
- each group will be given a total of 30 minutes
- 20 minutes should be spent educating the audience about the gland
- 10 minutes should be spent involving the audience in the presentation
- there must be some form of assessment where you evaluate the knowledge of the audience on what your group taught them
- audience members must use their mobile device (m-device) to engage with your presentation in some way

Timeline
- you will have the rest of today to work on this
- you will also have 2 full class days to work on this project
- presentations will be scheduled at the end of the 2nd full day
Assessment

Research Report Rubric

4 = A  
3 = B  
2 = C/D  
1 = F

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Information</td>
<td>Information clearly relates to the main topic. It includes several supporting details and/or examples.</td>
<td>Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.</td>
<td>Information clearly relates to the main topic. No details and/or examples are given.</td>
<td>Information has little or nothing to do with the main topic.</td>
</tr>
<tr>
<td>Sources</td>
<td>All sources (information and graphics) are accurately documented in the desired format.</td>
<td>All sources (information and graphics) are accurately documented, but a few are not in the desired format.</td>
<td>All sources (information and graphics) are accurately documented, but many are not in the desired format.</td>
<td>Some sources are not accurately documented.</td>
</tr>
<tr>
<td>Amount of Information</td>
<td>All topics are well addressed demonstrating a thorough level of understanding.</td>
<td>All topics are addressed demonstrating a surface level of understanding.</td>
<td>Most topics are addressed (80%) demonstrating a surface level of understanding.</td>
<td>Several topics were not addressed.</td>
</tr>
<tr>
<td>Mechanics</td>
<td>No grammatical, spelling or punctuation errors.</td>
<td>Almost no grammatical, spelling or punctuation errors.</td>
<td>A few grammatical spelling, or punctuation errors.</td>
<td>Many grammatical, spelling, or punctuation errors.</td>
</tr>
<tr>
<td>Notes</td>
<td>Notes are recorded and organized in an extremely neat and orderly fashion.</td>
<td>Notes are recorded legibly and are somewhat organized.</td>
<td>Notes are recorded.</td>
<td>Notes are not present.</td>
</tr>
</tbody>
</table>
Presentation Rubric

4 = A  
3 = B  
2 = C/D  
1 = F

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparedness</td>
<td>Student is completely prepared and has obviously rehearsed.</td>
<td>Student seems pretty prepared but might have needed a couple more rehearsals.</td>
<td>The student is somewhat prepared, but it is clear that rehearsal was lacking.</td>
<td>Student does not seem at all prepared to present.</td>
</tr>
<tr>
<td>Content</td>
<td>Shows a full understanding of the topic.</td>
<td>Shows a good understanding of the topic.</td>
<td>Shows a good understanding of parts of the topic.</td>
<td>Does not seem to understand the topic very well.</td>
</tr>
<tr>
<td>Speaks Clearly</td>
<td>Speaks clearly and distinctly all (100-95%) the time, and mispronounces no words.</td>
<td>Speaks clearly and distinctly all (100-95%) the time, but mispronounces one word.</td>
<td>Speaks clearly and distinctly most (94-85%) of the time. Mispronounces no more than one word.</td>
<td>Often mumbles or can not be understood OR mispronounces more than one word.</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.</td>
<td>Facial expressions and body language sometimes generate a strong interest and enthusiasm about the topic in others.</td>
<td>Facial expressions and body language are used to try to generate enthusiasm, but seem somewhat faked.</td>
<td>Very little use of facial expressions or body language. Did not generate much interest in topic being presented.</td>
</tr>
<tr>
<td>Audience Involvement</td>
<td>Group is effective with the audience use of m-tech in an engaging and meaningful way and assesses their knowledge.</td>
<td>Group has audience use m-tech in a way that is somewhat engaging and assesses their knowledge.</td>
<td>Group has audience use m-tech and does not assess their knowledge.</td>
<td>Group does not have audience use m-tech nor do they assess audience knowledge.</td>
</tr>
<tr>
<td>Time-Limit</td>
<td>Presentation is 27 - 30 minutes long.</td>
<td>Presentation is 22 - 26 minutes long.</td>
<td>Presentation is 18 - 21 minutes long.</td>
<td>Presentation is less than 18 minutes OR more than 30 minutes.</td>
</tr>
</tbody>
</table>
Nervous

Reflex Arc
1.) stimulus
2.) sensory input (PNS to CNS) afferent impulse
3.) integration (CNS)
4.) motor output (CNS to PNS) efferent impulse
5.) response
Nervous System

• Glial Cells
  – CNS
    • Astrocytes – capillaries, chemical environment
    • Microglia – neuron health
    • Ependymal – ciliated, fluid movement
    • Oligodendrocytes - myelin sheath
  – PNS
    • Satellite – surround cell body, function unknown
    • Schwann – myelin sheath

Nervous System

• Neuron AKA Nerve Cell
  – Nerve impulses
  – Amitotic (exceptions: olfactory + hippocampus)
  – High metabolic rate
Nervous System

- Dendrites—input region
  - change in environment

- Axon—conducting
  - generate nerve impulse
  - movement away from cell body

- Myelin Sheath—protection
  - increase speed of transmission

Nervous System

- Functions of Neurons

  - Sensory or Afferent
    - From receptors (PNS) to CNS

  - Interneurons or Association
    - INTEGRATION between sensory & motor

  - Motor or Efferent
    - From CNS to PNS—effector organs
Nervous System

• Brain

  — Gray Matter
    • Place of integration
    • Dendrites, cell bodies, unmyelinated axons

  — White Matter
    • Myelinated axons
      — Fatty (lipid) covering that increases speed of transmission

Nervous System

• Cerebrum

  — Frontal Lobe
    • Somatic motor functioning

  — Parietal Lobe
    • Somatic sensory input

  — Occipital Lobe
    • Visual input

  — Temporal Lobe
    • Auditory input
Nervous System

- Diencephalon
  - Thalamus
    - Sensory relay station
  - Hypothalamus
    - Control of ANS
    - Hunger, satiety, thirst, emotions

Nervous System

- Brainstem
  - Midbrain
    - Skeletal muscle
  - Pons
    - respiration
  - Medulla Oblongata
    - Respiration, heart rate, blood pressure
Nervous System

- Spinal Cord
  - Major reflex center
  - Information to brain and PNS
  - Protected by bone, fluid, connective tissue

Nervous System

- Spinal Cord
  - Embryonic Development
    - Sensory Neurons - dorsal root ganglia
    - Interneurons - alar plate
    - Motor Neurons - basalplate
Nervous System

• Cerebellum
  – Smooth muscle
  – Balance (skeletal muscle)
  – Posture (skeletal muscle)

Nervous System

• Spinal Cord
  – Gray Matter
    • Somatic Sensory
    • Visceral Sensory
    • Visceral Motor
    • Somatic Motor
Nervous System

• Spinal Cord
  — White Matter
    • Nerve fibers – communication to brain
    • Myelinated and unmyelinated

• 3 columns
  — Ascending – sensory input
  — Descending – motor output
  — Transverse – one side to the other

Nervous System

• Spinal Cord

  — Spinal Nerves

    • Dorsal Root – sensory nerve impulse from receptor

    • Ventral Root – motor nerve impulse to effector organ
Nervous System

• Sensory Receptor Classification

  – Location

    • Exteroceptors- outside the body
    • Interoceptors- inside the body
    • Proprioceptors- inside the body (musculoskeletal)

Nervous System

• Sensory Receptor Classification

  – Structure

    • Simple - modified dendrites
    • Complex- sense organs
Endocrine System

- Endocrine Glands- secrete hormones into the blood

- Exocrine Glands- secrete a substance through a duct

Endocrine System

- Negative Feedback Loop

1.) blood level of hormone falls
2.) brain gets message, hormone stimulate gland
3.) gland stimulates release of more hormone
4.) blood level increases, stimulation stops

Controlled by sympathetic and parasympathetic nervous system!
Nervous System

• Sensory Receptor Classification
  
  — Type

  • Mechanoreceptors - touch
  • Thermoreceptors – temp.
  • Photoreceptors - light
  • Chemoreceptors - chemicals
  • Nocireceptors – pain

Endocrine System

• Anterior Pituitary
  
  — TSH
  — FSH
  — LH
  — ACTH
  — GH
  — PRL
Endocrine System

- Thyroid Gland
  - Thyroxine
  - Calcitonin

- Parathyroid Gland
  - PTH
Endocrine System

• Thymus
  — Thymosin

Endocrine System

• Posterior Pituitary
  — ADH or vasopressin
  — Oxytocin
Endocrine System

- Adrenal Cortex
  - Aldosterone
  - Cortisol
  - Testosterone

Endocrine System

- Adrenal Medulla
  - Epinephrine
  - Norepinephrine
Endocrine System

• Pancreas
  – Glucagon
  – Insulin

Endocrine System

• Pineal
  – Melatonin
Endocrine System

• Placenta
  — hCG
  — Estrogen + Progesterone

Endocrine System

• Gonads
  — Estrogen
  — Progesterone
  — Testosterone
Nervous Endocrine Study Guide
THYROID, PARATHYROID, THYMUS, PINEAL
ADRENALS
PANCREAS, GONADS, PLACENTA
Who Am I?

Read each of the following riddles and decide which member of the endocrine system is being described.

_______________

I am the vanishing gland. You need me most during your early childhood years and I begin to disappear when you reach puberty. I am considered a member of both the endocrine and the lymphatic system. I secrete a hormone, which helps to stimulate lymphoid cells to produce T-cells. You need me to help fight off diseases. Who am I?

_______________

I control how “sweet” you are. I keep your blood sugar within normal limits. If you blood sugar is too high I produce insulin and if it is too low, I produce glucagon. I also play a role in the digestion process. Who am I?

_______________

You can thank me for all those muscles you have and that deep voice. I am also the reason you need to shave every day. I play a role in reproduction by allowing you to make sperms. Who am I?

_______________

They say “good things come in small packages” and that is true with me. I am very tiny, but I do a lot of jobs in the endocrine system. I help you grow and develop. I also provide the milk for a new mother to breast-feed her baby. The back part of me helps maintain your body’s water balance. Finally, when I release my hormone, oxytocin, is will cause the uterus to contract so a new life can be born. Who am I?

_______________

Many people say I am shaped like a butterfly. I increase metabolism and influence both physical and mental activity. I help with tissue growth. I also cause calcium to be stored in bones. Who am I?

_______________

There are two of me in your body and I have two parts. I help keep your electrolytes balanced by deciding how much sodium and potassium your body needs. I also play a role in pain control. I am a good friend of the sympathetic nervous system and I play a role in preparing your body to handle emergencies. I help you decide whether to “fight or flight!” Who am I?

_______________

Many say I resemble a “pine cone.” I am stimulated by the amount of the light that enters your eyes. Many believe I help prevent the early onset of puberty. I produce a hormone, which causes your body temperature to drop. Who am I?

_______________

A chicken and I have a lot in common. We both produce eggs. I also stimulate the development of breast and pubic hair. I want that egg to have a good cushion, so I help make a lining for the uterus. Who am I?
THE NERVOUS SYSTEM

map out the branches of the PNS & CNS (elaborate)
FIGURE 11.4b  Structure of a motor neuron, page 391.
True or false, write out the entire word. **T & F will not be graded.** (15 points)

A__________________ Efferent nerve impulses carry messages toward the CNS. B__________________ Ependymal glial cells are associated with the movement of spinal fluid.

C__________________ Nerve cells are considered to be amitotic except for nerve cells that are found in the hippocampus and olfactory regions of the brain.

D__________________ An axon generates a nerve impulse and transmits the message toward the cell body of the nerve cell.

E__________________ Integration in the brain occurs in the gray matter.

F__________________ The parietal lobe of the cerebrum is associated with the control of somatic motor functioning.

G__________________ The hypothalamus controls the autonomic nervous system.

H__________________ The pons is located superior to the medulla oblongata.

I__________________ Motor neurons are formed from the basal plate.

J__________________ The dorsal root of cranial nerves transmits nerve impulses from sensory receptors to the spinal cord.

K__________________ Exocrine glands secrete hormones through a duct.

L__________________ TSH is released from the posterior pituitary and stimulates the release of thyroxine.

M__________________ Oxytocin is released from the posterior pituitary and stimulates the uterus to contract during childbirth.

N__________________ The thymus gland releases thymosin and is associated with the immune system and the growth of T cells.

O__________________ Aldosterone is released from the adrenal medulla and is associated with Na+ retention and blood pressure.
Matching, write the word that best corresponds with the following prompts. (15 points).

A ______________________ Region of the brainstem that is associated with the control of respiration, heart rate, and blood pressure.

B ______________________ Region of the brainstem that is associated with the control of respiration.

C ______________________ Region of the brainstem that is associated with the control of skeletal muscle.

D ______________________ This column of white matter in the spinal cord transmits motor impulses.

E ______________________ This column of white matter in the spinal cord transmits nerve impulses across the spinal cord.

F ______________________ This column of white matter in the spinal cord transmits sensory impulses.

G ______________________ These sensory receptors sense light.

H ______________________ These sensory receptors sense pain.

I ______________________ These sensory receptors sense temperature.

J ______________________ This hormone stimulates the development of breast tissue.

K ______________________ This hormone stimulates the uptake of water and concentrates urine.

L ______________________ This hormone stimulates the rate of metabolism and is stimulated by the secretion of TSH.

M ______________________ This hormone controls your sleep and awake patterns.

N ______________________ This hormone mobilizes fats for metabolism.

O ______________________ This hormone increases blood glucose levels.

TRANSVERSE NOCIRECEPTORS THYROXINE CORTISOL
MEDULLA OBLONGATA PHOTORECEPTORS PROLACTIN
GLUCAGON MIDBRAIN MELATONIN PONS ANTIDIURETIC
DESCENDING THERMORECEPTORS ASCENDING
Multiple choice. Circle the correct answer. (15 points).

1.) The efferent motor nervous system is comprised of the following
   a. Somatic
   b. Autonomic
   c. Parasympathetic
   d. Sympathetic
   e. All of the above

2.) The following glial cells are found in the PNS
   a. Oligodendrocytes
   b. Microglia
   c. Satellite
   d. Astrocytes
   e. Ependymal

3.) All of the following are true about nerve cells EXCEPT for
   a. have a high metabolic rate
   b. are short lived
   c. conduct messages
   d. are amitotic
   e. are found in the PNS and CNS

4.) Afferent neurons conduct messages in the following ways
   a. between motor and sensory neurons
   b. from receptors to the CNS
   c. from CNS to effector organs
   d. from receptors to the PNS
   e. from PNS to effector organs

5.) The following lobe of the cerebrum is associated with auditory input
   a. Cerebellum
   b. Frontal lobe
   c. Parietal lobe
   d. Occipital lobe
   e. Temporal lobe

6.) The following region of the brain is in control of maintaining body posture
   a. Medulla oblongata
   b. Midbrain
   c. Cerebrum
   d. Thalamus
   e. Cerebellum
7.) This region of gray matter in the spinal cord is associated with involuntary output movement
   a. Visceral motor
   b. Visceral sensory
   c. Somatic motor
   d. Somatic sensory
   e. None of the above

8.) This region of gray matter in the spinal cord is associated with involuntary input movement
   a. Visceral motor
   b. Visceral sensory
   c. Somatic motor
   d. Somatic sensory
   e. None of the above

9.) This region of gray matter in the spinal cord is associated with voluntary output movement
   a. Visceral motor
   b. Visceral sensory
   c. Somatic motor
   d. Somatic sensory
   e. None of the above

10.) This region of gray matter in the spinal cord is associated with voluntary input movement
    a. Visceral motor
    b. Visceral sensory
    c. Somatic motor
    d. Somatic sensory
    e. None of the above

11.) The following sensory receptor is associated with touch, pressure, and itch.
    a. Nocireceptors
    b. Chemoreceptors
    c. Mechanoreceptors
    d. Photoreceptors
    e. Thermoreceptors

12.) Which of the following hormones is released from the anterior pituitary and is associated with the ovaries and testes.
    a. ACTH
    b. GH
    c. FSH
    d. TSH
    e. PRL
13.) Which of the following hormones is released from the anterior pituitary and is associated with stimulating the adrenal cortex.
   a. ACTH
   b. GH
   c. FSH
   d. TSH
   e. PRL

14.) Aldosterone is released from this zone in the adrenal cortex
   a. Zona glomeruosa
   b. Zona fasciculate
   c. Zona reticularis
   d. Zona medulla
   e. None of the above

15.) Testosterone is released from this zone in the adrenal cortex
   a. Zona glomeruosa
   b. Zona fasciculate
   c. Zona reticularis
   d. Zona medulla
   e. None of the above

Label the following diagrams. (10 points).
Response Questions:

Choose 2 of the 3 following prompts to answer on the first 2 pages (10 points).

A – Describe in detail all of the branches of the peripheral nervous system. Be sure to explain each section of the PNS.

B – Using a specific hormone discuss in detail the communication pathway of the endocrine system. Be sure to include as much information as possible.

C – Using a specific stimulus discuss in detail the communication pathway of the nervous system. Be sure to include as much information as possible.
APPENDIX B
## Assessments in M-Learning Curriculum

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<th>System</th>
<th>Watching Videos</th>
<th>Online Polling</th>
<th>Lab Activity &amp; Uploading data</th>
<th>Research Activities</th>
<th>App Use: Flashcards &amp; Quiz Practice</th>
<th>e-mailing in responses</th>
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<td>Flow thought the heart</td>
<td>Heart model de-brief</td>
<td>Cardiovascular Lab</td>
<td>Cardiovascular Disorders</td>
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<td>Partner Challenge (blood flow)</td>
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APPENDIX C
List of Educators

Content Validity Panel

Jamil Dawsari – High School Social Science Teacher
BA History, University of Arizona
MA History, San Francisco State University
3 years experience

Deb Fitch – High School Math Teacher
BA Mathematics, UCLA
Single Subject Credential, Sonoma State University
39 years of experience

Danielle King – Junior College Professor
BS Ecology, UC San Diego
MS Wildlife, Humboldt State
12 years of experience

Colleague Observation

Andrew Aja – Social Science Teacher
BA, Political Science, UC Davis
Single Subject Credential, Sonoma State University

Deborah Richardson – High School Assistant Principal
BA, Bucknell University
MA, Educational Leadership, San Jose State

David Stirrat – High School Principal
AA, Simon's Rock of Bard College
BA, American University
MA, Journalism, Northwestern University
Single Subject Credential, Sonoma State University
Admin Credential, Chapman University

Rachel Yannes – Science Student Teacher
BS, Kinesiology, Sonoma State University
Single Subject Credential, Sonoma State University
APPENDIX D
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APPENDIX E
Sonoma State University
Institutional Review Board

Dear Ms. Reed:

Subject: IRB Application # 2344, INCORPORATING MOBILE LEARNING IN THE DESIGN OF CURRICULUM

I am pleased to inform you that your application to the Sonoma State Institutional Review Board has been reviewed and approved. Please contact Carol Hall or me immediately should you encounter any unforeseen difficulties, or make any significant changes to your planned procedures.

This approval is effective from 10/29/12 through 10/28/13. Please notify Carol Hall (707-664-2448, carol.hall@sonoma.edu) when your project has been completed. A progress report and renewal application is required by 09/28/13 if your project will continue past the end date listed above.

Thank you for your cooperation with our processes. We wish you the best of fortune as you complete your research project.

Sincerely,

Duane Dove,
Ph.D Chair,
Sonoma State IRB
References


