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REFLECTION AND GROWTH IN TEACHING: DESIGNING AND IMPLEMENTING A
HIGH SCHOOL BIOLOGY AND SOCIETY COURSE USING ACTION RESEARCH

by

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SYNTHESIS*
MASTER OF ARTS
CRITICAL AND CREATIVE THINKING
UNIVERSITY OF MASSACHUSETTS BOSTON

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Abstract: The world that we live in is constantly changing and educational systems need to reflect these changes. High stakes testing, stress and anxiety in students, and smartphones in the classroom are all aspects of current schools that move us away from authentic learning. Student choice in education, pursuing answers to real world questions and developing critical and creative thinking skills upends this existing paradigm. To achieve this, teachers must turn to the most important work, which is to *know* each student and give them agency in their education. Teachers no longer need to occupy the center stage of the classroom and instead should be guiding students in their learning. This synthesis uses action research to construct and present a student-centered, process-oriented course titled *Biology and Society*. The course serves high school seniors in a small learning community within the greater Boston area. The synthesis provides a rationale for the course, presents its pedagogical framework, and discusses its future implementation and evaluation. The creation and teaching of this course is a first step toward student-driven learning in which teachers are reflexively asking, “why this class, for this population, at this time?”

* The Synthesis can take a variety of forms, from a position paper to curriculum or professional development workshop to an original contribution in the creative arts or writing. The expectation is that students use their Synthesis to show how they have integrated knowledge, tools, experience, and support gained in the program so as to prepare themselves to be constructive, reflective agents of change in work, education, social movements, science, creative arts, or other endeavors.

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Chapter One - Introduction

The Saber-Tooth Curriculum

In my first year at Brookline High School (BHS), the Assistant Headmaster gave a speech about the lessons the Saber-Tooth Curriculum can teach us as educators (Peddiwell, 1939). The satirical curriculum emphasized the three essential skills needed in Paleolithic times: wooly horse clubbing, scaring saber-tooth tigers with fire, and fish grabbing. To maximize the success of the tribe, one of the leaders, New-Fist, established systematic education of the young cave people. Over time, it became common knowledge that all young Paleolithic children needed to understand these foundational concepts to be successful. As the world changed - the wooly horses moved east, the saber-tooth tigers died of pneumonia, and fishing nets were invented - the New-Fist education system persisted. New skills such as net making, bear trapping, and antelope snaring became staples for success, and some (those considered radicals) suggested that the educational curriculum should be updated to match the new world. The New-fist educational system, and what it taught, became something that young people tolerated. It was considered a rite of passage, something to be overcome before real world education could begin. The speech and the story within it have stuck with me over my years teaching. Our assistant headmaster ended his talk with a question for us to consider: why this lesson, at this time, for this student?

Hearing that question over a decade ago left me with the sense that I worked in a place that valued reflection on practice and a place where trying new approaches would be welcomed. I have come to believe that this value is easily stated but very hard to achieve in a high stakes environment and in the arc of a typical school year that rarely offers the chance for educators to reflect and ask *why this lesson, at this time, for this student?* For the most part, the students I teach are very preoccupied, and motivated, by grades. The system they need to navigate to progress to college and beyond reinforces these preoccupations. Creating a curriculum that is highly organized and predictable allows us teachers to assume some control over the grading process. It can be argued that this is simply a method of setting clear expectations, but it also reinforces the paradigm of measuring success against a set of content standards as opposed to measuring success as a process of growth over time toward particular competencies. Movement toward process-based instructions upsets standard ways of ranking students against each other.

I have come to believe that educators are in another critical moment in which the curriculum we present is something that is tolerated until the real learning can begin in college, reminding me of the saber-tooth curriculum's trajectory. We seem to be so concerned about *what* students know that we have overlooked *how* they think and solve problems. Instant access to information and dynamic computer-based educational videos suggests a content-based course loses some of its necessity. Generally, students just do not need me anymore to answer their technical questions about Biology. They seek other sources. The static nature of the textbook becomes antiquated. Why look at a picture model of DNA replication when they can view it in motion online? The courses focused on content and assessment leave little time for inquiry and creative and critical thinking in Biology, yet inquiry and creative thinking are key to success in pursuing the sciences, and are skills that transfer to other areas of life. What students do need is someone to help them learn to evaluate and critique resources, approach questions in systematic ways that lead to deep insight, understand that their interests are valid and worth pursuing, and finally provide them the pathway to deep and engaged thinking.

My Setting

Brookline High School (BHS) is an urban-suburban high school that serves close to 2,000 students. The school is faced with growing enrollments and a building renovation in the near future. The student population is diverse with approximately 45% students of color (<http://profiles.doe.mass.edu/general/general.aspx?topNavID=1&leftNavId=100&orgcode=00460505&orgtypecode=6>). We graduate and send the majority of our students to a 2 or 4-year college or university. By most quantitative measures, the school is successful; however, as with all schools, there are issues on which we can work. These issues are local manifestations of larger issues that grip the country. The school is engaged in bringing awareness to an array of non-academic issues connected to our curriculum, such as human trafficking, LGBTQ issues, issues of race and identity, climate change and sustainability. Each of these topics is tackled with school wide days of learning and special programming. These days are planned by student groups and represent BHS at its best. Additionally, the staff of BHS is working on identity, race and institutional racism through our professional development days and specific initiatives lead by teachers and funded by district level grants. The identity curriculum is a project specifically

designed to broaden our curriculum to represent various identities within our school. The school is a wonderful place to work and grow as an educator and I consider myself lucky to be a part of the institution.

Many educators in the district believe, as do I, that a school that remains in the same place - culturally, circularly, and pedagogically - cannot be serving its students well. The world is a changing place, and schools need to be refreshed and renewed to keep pace with current demands and opportunities. This type of change is difficult, even in an institution that has stated congruent values. The school year is demanding - preparing and running a class, grading assignments, keeping abreast of the complexities in students' lives is plenty of work to fill a school year.

The science department in which I teach is successful. We stay within our disciplines and teach mostly in traditional formats of lecture and lab. Innovations have come in the form of embedding inquiry-guided learning activities and some case study learning. Additionally, my Biology colleagues are strong collaborators and support each other in implementing our shared common curriculum. This collective effort at times has led to a deeper and richer experience for our students. In a topic as broad as Biology, having a contingent of Biology teachers match the sprawling topic enriches our curriculum. The overlooked danger, I believe, is potential stagnation. There becomes a sentiment of "if it isn't broken, don't fix it". This does not arise from a lack of interest, but a lack of time to sufficiently internalize student-learning outcomes in an incredibly busy school year. The busy school year also interferes with our ability to pause and collect student feedback on their experiences. We teachers are left with only the most narrow of feedback in the form of student grades. Their grades then become the justification and sole reasoning behind curricular choices going forward. It leads to a perpetuation of classroom experiences that exclude student voices. Creative and critical thinking rarely occurs without deliberate time and attention toward it. The common curriculum then becomes a crutch to lean on in the busiest moments in the year. This collaboration amongst colleagues can be invaluable in the moment, but if we do not consistently and deliberately reflect on and refresh our curriculum, we run the risk of queuing up the same lesson long after that lesson is relevant. The more problematic ramification of the lack of time to reflect on and develop our curriculum is that we can never see beyond superficial changes. The idea of fundamentally changing how we teach

is never on the table because we never approach the conversation because it is just too big of a conversation.

My role in the BHS community is to teach Biology and to be a part of an alternative school, School within a School (SWS) that exists within BHS. I teach Biology in both settings. The courses are circularly very similar but very different in feel. The SWS sections are much more discussion based, we often have fruitful digressions that lead to interesting scientific, ethical and human questions. These classroom moments are part of the impetus for this synthesis.

There are approximately 120 sophomores, juniors and seniors that comprise the SWS student community. Students apply to be in SWS and are selected via a lottery system. The lottery has affirmative action procedures that strive to match the demographics of SWS to the demographics of the main school. The students that are attracted to SWS have often felt marginalized in the mainstream population and tend to value the close-knit environment of SWS. SWS students and staff all participate in a weekly town meeting, at which students and staff members have a voice in how SWS is conducted. This democratic component is central to the SWS community. Students who have struggled in mainstream classes due to motivational, personal or behavioral issues have often found success in SWS. The smaller community, combined with the structure of SWS, dictate that students take more ownership over their education and participate in the community by governing its rules and participating in their peers' education. The vast majority of SWS'ers embrace these ideals and are inspired to flourish as learners. The environment breeds curiosity about the world and about the human condition.

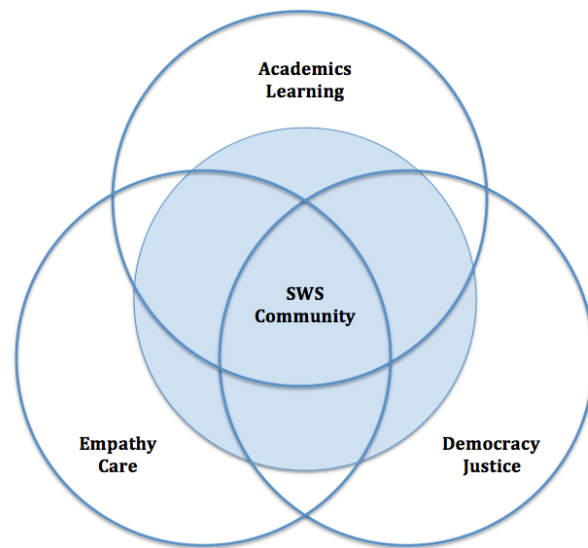


Figure 1: 4 circles framework for the SWS community, shows the SWS community sits at the intersection of the 3 aspects of the SWS program: Academics/Learning, Empathy/Care and Democracy/Justice

The program was founded in the late 1960s at the time School within a School (SWS) was one of several democracy-based schools established across the country. It was housed within BHS as an alternative pathway to learning than the larger traditional school environment. The teachers at BHS established SWS to capture the attention and minds of students who likely would have otherwise dropped out of school. The goal was then, as it is now, to establish a closer-knit school community (Bresman, Erdman, Olson, 2009).

One dominant aspect of SWS is the consistent interaction between SWS staff on a weekly basis. This communication often generates ideas that continue into summer workshops. For example, in the summer of 2016, the staff developed a framework for thinking about the SWS community, referred to it the 4 circles (Figure 1). The framework is based on the 3 primary aspects of SWS (i.e., Teaching-Learning, Care-Empathy, and Democracy-Justice) that envelop and drive the community, which is applied to the students, staff members, and courses. This framework helped the staff start to conceptualize how our students participate, or struggle to participate, in the community. The SWS students are asked not to only strive toward learning, but to care for each other and to add their voice to the governance of the community. We believe that all these aspects are related and that students who invest in each other will be inspired to reach higher academically, or students who express their views on the policies of the school will find connections with students beyond their typical friend groups. This web of interaction is complex, experienced differently for each individual and potentially empowering.

Chapter 2 – Using Action Research Within My School

Defining Action Research

Given the tensions (e.g., high stakes learning versus growth over time, heavy content-based curriculum versus student-driven inquiry) I see in public education and my desire to influence broad changes in approaches to teaching at BHS, I envision the new course I present in the synthesis as a piece of a larger effort to shift how teachers at BHS collaborate, plan curriculum, develop relationships and view pedagogy. This new course is a product of my growth and reflection on teaching and represents a pedagogical experiment that aims to blend the unique environment of SWS with the teaching of Biology and society. The action research framework provides the structure and processes for this new proposed course and how I envision it influencing both my smaller school community (SWS) and my larger school community (BHS).

There are several different approaches to action research, but all have the common feature of taking action in order to modify situations, coupled with evaluation of that action. The specific process undertaken in this synthesis follows the model of action research presented in the graduate program in Critical and Creative Thinking (CCT) through the course CCT 693 Action Research for Educational, Professional

and Personal change (Taylor and Szteiter, 2012). (Figure 2) It involves reflection and evaluation on previous actions, a movement toward a planning and proposing of a new action, implementation of the planned action and deliberate evaluation of the action in relation to how it influenced the situation. In addition to the primary aspects of the action research cycles, important epicycles proceed in conjunction with, and influence, the primary cycle. These epicycles involve inquiries into the situation's background to help inform planning of the action and processes of building a constituency within an organization to bring the action and its

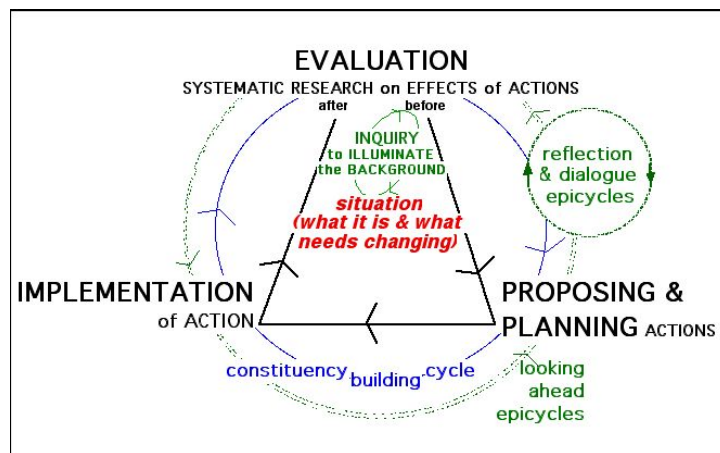


Figure 2: Visual framework for the action research project presented in CCT 693 and the model used in this synthesis.

implementation toward reality. Other epicycles include moments to reflect on the process of action research and participate in dialogue with stakeholders and/or neutral parties in order to reveal different approaches and nuances to the unique situation that is the subject of action research. These reflection and dialogue processes feed into epicycles of looking ahead with the goal of predicting possible outcomes that inform the action's success or failure. The looking ahead epicycles are especially important when planning a deliberate evaluation of the action and in identifying the various entities that should be brought into one's constituency. The writing in this synthesis is organized to address the major sections of the action research cycle and the adjoining epicycles of action research. Major sections of this synthesis are titled to correspond to this iteration of action research (i.e. proposing and planning, implementing and evaluation). Discussion of epicycles occurs within these sections.

The perpetual refinement of practice through reflection, dialogue, creating new actions, implementing those actions, and evaluating those actions is key to the process of action research. While this happens intuitively over time (e.g., an experienced teacher may try various approaches and wrestle with successes and failures in a classroom), what may be lacking through informal refinement centers on three areas of the action research cycle and epicycles. First, actions are planned and implemented based on full inquiry into the situation and associated issues. Second, the looking ahead epicycle influences how the action is implemented and yields insights that become central components to the evaluation. Third, action research requires a deliberately planned evaluation of the action with the expressed goal influencing the next steps taken toward the situation. *Why this lesson? At this time? For this student?* These questions are at the heart of the action research process (and my synthesis) and speak to the necessity of evaluating the action.

The action research cycle and the adjoining epicycles provide a structure to implement and evaluate a change that is unique to my classroom, but also places that change within the larger communities of SWS and BHS. This quest will originate within SWS as I will place my new course within SWS, with the distal goal of influencing the BHS community.

Situation

Framing the situation is a key component in action research. I find myself in my own saber-tooth curriculum moment. I want to challenge the narrow standards-based curriculum that

aims toward high stakes tests. I want to create learning environments that inspire students to be critical and creative thinkers.

High stakes learning, culture of cheating and the technology conundrum. One factor influencing the development of this new curriculum is the need to address student learning through curiosity and empowerment rather than anxiety and nervousness, which may lead to maladaptive student behaviors. Currently, grades are the easiest mechanism to quantify the growth of a student's engagement with material. There are several problems with giving so much attention to grades. The intensity of the school year and the high achieving environment leads to a culture of cheating. The traditional model of teaching is not focused on growth but on attainment of factual knowledge for just the amount of time needed to retain it. As long as testing is a focus and a primary form of assessment, students may not focus on learning but instead focus on grades. This model can be anxiety producing. The competition brewing between students may build anxiety and it may lead to more cheating. This conundrum needs to be addressed in the context of students needing foundational knowledge in order to think deeply coupled with the realization that sometimes that foundational knowledge is complex. The moment of attaining a piece of knowledge can be arbitrary and does not always happen along the set schedule of the teacher. Therefore, capturing the growth of a student can be difficult with our current narrow view of assessment.

An additional factor influencing student engagement in the classroom is the prevalence of technology, specifically smart phones. The advent of technology use in the classroom has benefits, but there are clear drawbacks in the area of attention (Kim, 2018; McSpadden, 2015) and getting work from other students (Redding, 2017). There is increasing evidence that access to phones and other technologies in class have detrimental effects. Alerts on smartphones produce neurological feedback that taps into students' fear of missing out, which leads to problematic behavior (Przybylski, Murayama, DeHaan, & Gladwell, 2013). Furthermore, the practice of typing notes on a computer as opposed to writing out information has retention ramifications, while the cognitive process of integrating and writing notes has benefits for learning (Muller & Oppenheimer, 2014). This suggests divorcing our reliance on technology in the classroom; however, how do we fight against a cultural revolution? We are more connected to information than we ever have been in history. The opportunity to tap into primary resources has never been easier. The richness of information available to the young learner is empowering.

This has led many to take the position that we should be teaching students how to engage with technology as oppose to restrict it. Easily said, very difficult to do.

The climate is shifting with major investors pushing Apple to address the addictive nature of their products (Booth, 2018) and revelations that tech giants Steve Jobs and Bill Gates raised their children without smartphones (Weller, 2018). This information is important to consider from the teacher perspective at a classroom policy level, but it brings in an important variable, the parents. In the book, *Glow Kids* (2016), Nicolas Kardaras interviews a high school principal who acknowledges the real detriment of phones in school but comments that parents will never allow a phone ban at school with the rationale that they would like to reach their children at anytime. This convenience comes with some real learning consequences that educators need to address. To create a rules-and-consequence based approach to this issue would feed the narrative that teachers are in-charge and students are disempowered. For several reasons, I believe this is the wrong approach for my school and me. Instead, I believe this is another call to fundamentally shift what students are doing in school: pedagogically undercut the insistent need to check the phone and unlock the aspects of classroom technology that enrich the learning experience.

Linn (2003) described the essential role of technology in the science classroom. First, student access to technology increases their ability to receive and share information more efficiently, which has the potential to enhance teacher curricula methods. Second, technology in the science classroom allows for more customized student inquiry. The conceptual framework called Technological Pedagogical and Content Knowledge (TPACK) illustrates that the intersection of content, pedagogy and technology is important when integrating technology into the classroom. It highlights that when technologically driven classrooms fall short, it is because all three aspects of teaching and learning are not considered synergistically (Koehler & Mishra, 2009). This speaks to the issues in the classroom of when *and* how technology is used. Distinguishing between productive and destructive technology use in a learning setting is a very fine line for young people who are pulled in many directions academically and interpersonally. It would not serve students to abandon technology. Instead, educators need to do the important and painstaking work of teaching students how to access the wealth of information available for their academic and personal growth, while simultaneously helping them understand the complex role

of technology in people's lives. Recognizing the strengths and challenges of a technology-infused classroom allows me to better understand how to serve my students appropriately.

The human enterprise. I was, by all accounts, a good science student in high school. I took challenging classes and earned good grades. I received positive feedback from teachers and was encouraged to cultivate what was described as 'my thing'. Interestingly, I found myself in college with some clear gaps in fundamental scientific principles. For example, osmosis and tonicity are two very basic aspect of cellular homeostasis. Every first year Biology student should learn about osmosis and movement of water over a semipermeable membrane. I did not. It wasn't until I was in a learning environment that was very specific that I retained complex ideas. I found myself in a lab setting in college that was focused on providing hands on experiences. The lab worked on cystic fibrosis (CF), a disease that requires a basic understanding of how an impermeable substance, Chloride ions, moves through the cell membrane. The disease essentially does not allow for normal chloride transport and that leads to atypical water movement in epithelial membranes and thus all the symptoms of CF. I have a distinct memory of sitting with my professor, reviewing a journal article that just came out, and us both realizing that I did not know how this basic principle worked. He very professionally and patiently explained the big idea to me, surely internally cursing his choice to let me into his lab. That was the moment that I obtained that piece of knowledge and I have had it ever since. What were the circumstances that led me to never obtaining that information in the first place? Why was this moment the right one? I believe it was because at that exact moment, I had an intense want and need to understand tonicity for two primary reasons: to understand CF and to be accountable to my professor. The experience of the class was real; we were learning Biology in the context of a specific disease, in the context of scientific inquiry, and in the context of the technological application of a Biology lab. It led to an experience from which I took a tremendous amount. I understood that his work was important to people suffering from the disease. We were not separated from the human impact of the disease. Second, the relationship I had developed with that specific professor, whom to this day I credit with helping me understand why one should learn Biology, was authentic and motivating. The experience was immersive.

I have come to wonder after 15 years of teaching high school Chemistry and Biology in 3 different public school settings, what is it that I am preparing students for? What are the

important lessons of biological sciences and what are the important human lessons that can be learned from Biology? I want to inspire my students to see the intricacies of living systems for their intrinsic worth, but also to inspire some personal connection. The argument as to why this is important usually carries human ramifications (we are unarguably the most selfish species). Climate change, limitations of medical sciences, and use of genetically modified organisms all are intersections between biological knowledge and human endeavor. These are topics that require some foundational knowledge in Biology and understanding in the philosophy of scientific inquiry. The curriculum that is presented in this synthesis represents a trade-off between teaching foundational knowledge and merging that with teaching about Biology's unarguable connection to humanity. All of science, including Biology is a human enterprise, just like teaching. I believe that it is important for students to learn Biology within that context. In my school environment, due to its institutional constraints, converting a first year content-based course into a Biology and Society course would likely be met with strong opposition. The shift would undermine the common practice of keeping the Biology classes fundamentally the same across all the sections no matter which teacher was teaching the material. This change would also disrupt pathways that students and parents have come to expect, many students have their eye on AP Biology and the first year Biology I Honor course is the gateway. Additionally, the syllabus for the Biology I Honor class is attractive to college admissions personnel as a challenging, standards based course. Given all these factors, I have determined experimenting with a new approach to teaching Biology in the context of societal issues is best placed in a senior year elective.

Epicycle on Inquiry to Illuminate Background: Student-centered learning and teaching practices in SWS

The most memorable moments in any learning settings are ones that create meaningful and personal connections. The learning should be experiential and exciting. Reeve (2012) describes the specific aspect of student-teacher relationship as it relates to engagement and motivation through the lens of Deci & Ryan's Self-Determination Theory. Reeve's work describes the complex inner motivational recourses that orient them in the learning environment. Additionally the learning environment has aspects that support or impede these resources (Reeve, 2012). I see the students interests wax and wane in a non-uniform way over the course of the year. The trend that I see is toward students taking classes that are content heavy and have

diluted experiential learning. Reeve's emphasis on the unique collection of interests and motivations of each student is reinforced in my observations of my students. The current paradigm captures many students, but not everyone *and* not all the time. I believe that, generally, teachers worry too much about every student learning the exact same collection of material instead of following their own line of inquiry. I wonder, is it more important that every student has the exact same experience or is it more important that they have a personal and meaningful experience?

The class proposed in this synthesis will introduce a different kind of science learning experience for students, one in which students individually and as a classroom community will be able to shape the direction of the curriculum. This is an academic value of the SWS community that exists in the English classes as students involved with selecting themed classes that the teachers develop in response to student input. English class titles include "Friendship and literature", "LGBTQ Lit" and "Nature and Literature". The history teacher teaches Project Based Learning classes, one using the musical Hamilton as a road map for US History and a current events senior elective. The SWS Biology and Society class will be an important learning experience to complement the work of these other courses by allowing students to engage in scientific questions that often arise in the contexts of their other courses, and vice versa.

In CCT 692, I explored several teaching methods and technological applications that I plan to incorporate into this class. DeWitte and Rogge (2014) write, "The main reason for the controversy is that, in spite of being the subject [PBL] of extensive research, several aspects and influences of PBL remain unclear" (pg. 59). The authors of the paper are attempting to fill in a gap in the research on project-based learning (PBL) in high school classrooms. One clear challenge was simply defining the method because it is implemented in so many different ways. In this study, DeWitte and Rogge (2014) showed significant improvement in student motivation, higher classroom environment satisfaction, and content knowledge as measured by test scores, when the method was defined as, "PBL is an active learning method that starts from a concrete problem. Through group discussion, individual study and collaboration in small groups, students discover their own knowledge, try to understand the underlying mechanisms of the problem and solve the problem together. The teacher acts as a tutor that guides the students and supports the students' initiatives" (p. 67).

The case-based method has potential to provide students with examples of science playing out in the real world. Using cases as a teaching tool provides a wealth of techniques and topics that cover virtually all areas of Biology content. Clyde Freeman Herreid (2005) has written widely on using case studies to develop critical thinking and to engage students in learning in the contexts of stories. One area in which I have used cases is when teaching bioethics. Siew and Dawson (2014) studied the use of ethical frameworks when teaching controversial issues in Biology. They discovered that giving students a process to evaluate a complex issue leads to better developed and supported positions on that issue (Siew and Dawson, 2014). Ethics provides students a space to engage in passionate discussion and debate. Young peoples' concept of right and wrong is explored and questioned, yielding the potential for learning but also the danger of entrenchment. The article illustrates and encourages thinking about complex issues from different stakeholders' perspectives and through different ethical viewpoints. I think this empathy-building skill is important in fully understanding and engaging in a world in which we have increasingly more biomedical and environmental choices relating to ethics.

Epicycle: Reflection and Dialogue on the Situation: Balancing Teacher-Centered Practices with Student-Centered Learning

One tension that exists in the shift from teacher-centered practices to student-centered practice is the issue of foundational knowledge. What do students need to know in order to engage with high-level inquiry into issues of Biology and society? As I mentioned earlier, I believe it is time to incorporate student voice into the direction of a class and its learning methods. However, it is still necessary, for example, for a student to understand the science behind gene editing if they are to have a fully informed position on policies related to its use. Part of the reason that the proposed course is geared toward seniors is that they will have taken a first year Biology class. The course I propose side-steps the issue of foundational knowledge given students' previous Biology class. The rationale for this relates to the programmatic need that I am attempting to fill within SWS. In addition, and more importantly, I hope to focus on developing classroom practices that could potentially be transported into a first year Biology class. At BHS, the focus on standards based education and aligned curriculum is emphasized at this first year level. As I look ahead to future years of teaching, I envision an incremental conversion of my first year classes as opposed to a full redesign.

Epicycle: Constituency Building

There are two distinct constituency groups to define in this situation, the members of the SWS community and the members of the BHS community. This is not an adversarial division, and all the members of the SWS community are also members of the BHS community. This distinction is important because of the way in which classes are developed and implemented in SWS compared to BHS. The historical practice in SWS is to plan and implement courses based on SWS student input and based on the general temperature of the SWS community. The SWS group of teachers, administrators and support staff weekly to discuss individual student concerns, programmatic philosophy and the issues that are floating in the air of the community. Much of the conversation that the staff has is also influenced by what the students discussed in the previous weeks town meeting. These are the conversation where ideas for new courses are born. For example, recent classes in English have focused on nature in literature, LBGTQ literature and semiotics. In History, the senior elective is a current events course where topics are democratically chosen. This is the context that has inspired me to add a scientific option for students. Courses are developed from these conversations, then students are asked to vote on the courses that they would most like to take. This process of course development is highly responsive to student wants and needs and results in meaningful learning experiences. The SWS staff is invested in the idea of adding an exploratory science course that would dovetail with the SWS history courses. This group of colleagues provides a strong base constituency that is completely supportive and encouraging of my efforts. This cross-curricular collaboration is effective because we are collaborating about students, not about content. In this student-centered collaboration, curricular and pedagogical connections arise.

There is a tension that exists because of my dual role as a member of SWS and of the BHS science department. Ever since starting the SWS Biology classes there has been a pressure to not change the courses too much from the standard curriculum that is offered to the main school students. The variation in the classroom environment is expected to only correlate with the variation that might exist between any of the Biology teachers. The primary difference in SWS Biology to BHS mainstream Biology is centered on who is in the classroom as opposed to what we do in the classroom. I have found after teaching SWS Biology for 6 years that this cannot be the case. Because students share so many experiences beyond the classroom in the SWS community, those relationships spill over into the academic environment. The process to

propose, attract students, and run a class is much more involved in the wider BHS community. This process involves an official proposal to an academic standards review committee that consists of department heads, administrators and district level officials.

Epicycle: Looking Ahead to Connect the New Course to the Values of the SWS Community

Ever since joining SWS as the Biology teacher 6 years ago, I have struggled to find my voice in the community. So much of the SWS experience is about developing the whole person and guiding student in their moral development as we all strive to be our best selves. The English and History teachers have strong position through their disciplines to bring this type of learning to the students. English courses are the backbone of the SWS academic experience and have rotating courses that are offered based on student feedback and the collective pulse of the community as measured by the staff. The weekly staff meetings are often about local, national and international issues and how those impact us as individuals. We discuss what teaching moments can and should arise. The SWS way is to refresh and make relevant education for the students. To this point, I do not believe I have contributed to this approach in a curricular context. I have adjusted my curriculum somewhat; I have made my classes more democratic in some ways. But I am still in the driver's seat and I rarely hand over the controls.

The students of SWS see me in the context of my Biology teaching and some of the SWS students know me through a supportive role in SWS tutorial, an academic support experience adapted and implemented as a result of my CCT 693 action research course work. I also participate in the weekly town meetings and the periodic community building day away activities. My participation in these areas, while positive, have not yielded, in my view, equal footing with my SWS colleagues in the SWS community. My colleagues are supportive and inclusive of me in the program and I feel very much a part of the staff but my involvement in the community still lags even after 5 years in the program. I see this situation resulting from a combination of personal and professional factors. SWS has challenged me to become more personally involved with the SWS students and staff and SWS activities, something that does not come completely natural to me. There are sponsored SWS events in the evenings that go beyond the traditional teaching expectations and contractual obligations. While I have always considered relationships essential to reaching students and developing collaborative environments, the SWS experience takes this to a different level through weekly staff meetings

in which we discuss the tensions in our lives and our work. The perspective is that all aspects of our lives intersect into our ability to effectively reach students and to serve them best.

I spent much of my first two or three years trying to figure out how my SWS Biology curriculum should, or should not, be different from the mainstream curriculum. While I was never asked from my SWS colleagues to do a major curricular change to align with the discussion based English and History classes, I felt that I wanted to address the uniqueness of teaching in an alternative school and the reality that the students in my SWS Biology sections had several shared experiences through the other SWS structures and activities. It feels as if there is an opportunity to carry forward those relationships and experiences into the Biology classroom. I have changed my curriculum in first year Biology classes by adding in case studies, discussions on bioethical issues, and very contained PBL independent assignments. The student responses to these changes are in large part the motivation to propose and teach the new course proposed in this synthesis. In my end of the year evaluation, they are the experiences that are the most mentioned and produced the most impact on how the students thought about Biology and the intersection of Biology and society. The experiences also started to spill over into other SWS spaces, with students making connections in to Biology in town meeting, History and English classes.

The SWS History senior elective is a course called Current Events. The vague title is purposeful so that students can explore a wide range of topics that are important to themselves, the community and the wider world (personal communication with teacher). In part, the SWS Biology and Society course is designed to offer another philosophical approach to understanding the world around us. It can be argued that subjects such as Bioethics, sustainability and public health are extensions of the social sciences but with important connections to the sciences. This class is presented to illustrate the blurred lines that exist between social constructs and scientific constructs and that the understanding of each leads to a more complete view of the world. My SWS History colleague and I have identified areas in which her class addressed scientific concepts in the social context but lacked an understanding of the scientific significance or rationale for the concept. For example, the emergence of CRISPR, the single nucleotide editing system, has led some of her students to research the possible mishandling of the gene editing technology. Information about such technology (often when filtered through the popular science media) can lead to misconception and misinformation about how the technology is being used

(article examples here). Understanding the topic CRISPR then becomes essential in order to evaluate its promise and peril. Like most advancements in science, how and why a technology is implemented is a bioethical dilemma that requires a view of what is scientifically true before evaluating what ought to occur in accordance with ethical frameworks. In this way, I see SWS Biology and Society dovetailing with the SWS current events class, allowing students to explore overlapping topics in different contexts. I envision ideas that are generated in one learning space influencing what is discussed in the other learning spaces and extending into the community spaces such as town meeting.

Chapter 3 – Proposing and Planning a New SWS Course

This chapter introduces the SWS Biology and Society course. The structure for the new course allows for a group of students to select topics together and to gain a deeper understanding of the issue in which they are interested. Therefore, the planning here focuses on creating a pedagogical framework that is adaptable to many different topics. The framework integrates several critical and creative thinking practices. These practices and additional course processes are introduced to the students through an introductory unit that is outlined in this section.

Overview of Proposed Course - SWS Biology and Society

The new course is one in which students explore the intersection of Biology and society. The human element in Biology allows for deep dives into environmental issues, bioethical issues, privacy, equity, heredity and history. The goal would to illustrate the entanglement of biological sciences with other human pursuits and how each, in turn, affects the other. The class will operate in a democratic fashion in which students are involved in determining the direction of the course and the depth in which we cover topics. The class structure will heavily rely on PBL, cooperative learning, case based learning and individual research projects. The class community structures will be cultivated by weekly discussions of themes that emerge from group and individual research and student presentations will be a centerpiece of learning. The role of the teacher will be to establish broad themes and topics to be explored, instruct students in best research and presentation best practices and push students towards deeper analysis along appropriate lines given the topic and the student. The classes content, while hard to predict given the student guided nature of the course, will fall into the following major categories: conservation and sustainability, climate change and biodiversity, genetically modified organisms, human health and well-being, history of science and Biology, and ethical considerations in Biology. The lines that separate these groups are blurred and the complexity that arises from the various intersections is one of the broad themes of the course. Students will be empowered to research issues about which they deeply care within those broad categories (see Appendix A).

Pedagogical Framework and Introductory Unit of SWS Biology and Society

The course will commence with an introductory unit on technology, addiction, learning and schools (see Appendix B). This unit will serve the role of establishing the main theme of the course, which is how Biology intersects with society. Educators, students and parents are still adjusting to the impact of technology in our lives. The smartphone and social media has

revolutionized the world and placed a wealth of knowledge at our fingertips. It also has placed in the hands of our young people a device that has applications that are designed to be highly addictive. This brings up several important questions to ask and to pursue. What is addiction? How does it develop? Is it experienced the same by everyone? How does the brain respond to varied stimulus? What are the impacts on attention? What are the short and long term intersections with learning and mental health? These questions have biological, physiological and sociological contexts that need to be explored. The end product of this unit will be a classroom technology policy that is approved by a two-thirds majority vote in the class. The class will present the policy to the SWS community at a town meeting with the purpose of initiating a community-wide conversation on personal interaction with technology in learning spaces.

The issue of addiction and cell phones is complex and multifaceted; therefore one of the primary goals in this introductory unit is to illustrate to students how to unpack a broad topic into digestible components that can be researched, discussed and placed into the overall context. The classroom processes that are modeled in this first unit will be classroom routines that extend throughout the course. The general format of the units will progress through a modified version of the 5E instructional model (Baybee et. al., 2006). The 5E instructional model guides students through phases of learning; engage, explore, explain, elaborate, evaluate. The model is often presented as a linear progression

of learning experiences, but I believe that it is best understood as a cycle as opposed to a process with a start and a finish. In this way, students engaged in a process of learning that mirrors the action research that provides the framework for this synthesis. Additionally a sixth E modification is added, the Extension phase, in which we

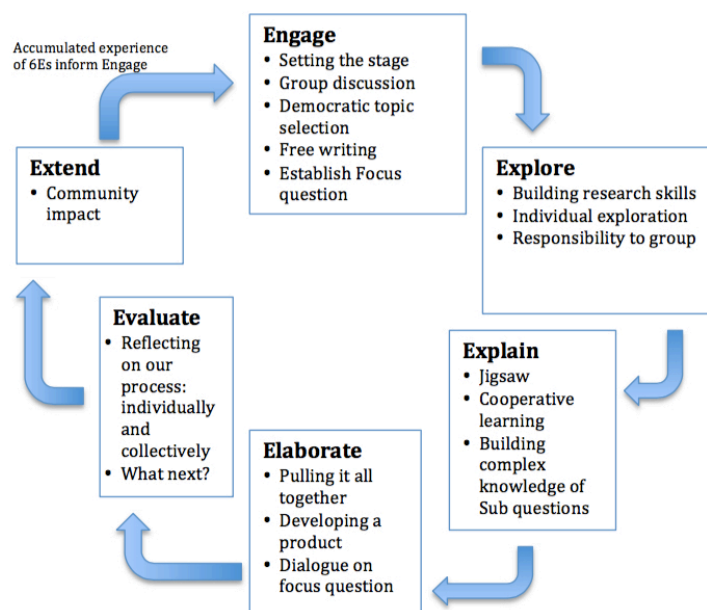


Figure 3: Modified 6E instructional model used in the SWS Biology and society course presented in this synthesis.

share the learning we have done with the wider community (Figure 3). Our pace through the phases will vary according to feedback from formative assessments coupled with the nature of the material. The flexibility of progressing through this sequence is part of its attraction as a learning framework. As a touch point for timing, the first unit is planned to take approximately 4 weeks to complete (see Appendix B); however, this unit has the additional purpose of introducing course processes.

Engage. In the introductory unit on addiction and cell phones, students will be engaged in the topic with a collection of readings and news reports in multiple formats (see Appendix B) that are designed to generate discussion. As a class we will try to answer the question, “What is a well-founded cell phone policy that is scientifically founded and socially responsible?” The classroom processes initiated here will focus on close readings, perspective taking and classroom discussion. Classroom discussion will proceed along the lines of well-established common SWS practices. SWS student use these same set of practices in all their classes and during town meeting. Discussions in SWS aspire to equal voice among community members (e.g., teacher does not facilitate; teacher is a participant; no one person or group occupies a disproportional amount of airtime, speak for yourself not others, be aware of intent and impact, build on ideas and nonverbal agreement and disagreement through the practice of “knocking” and “anti-knocking” (i.e. think nodding yes or nodding no but with your fist)). This classroom structure is a centerpiece to all SWS classes and employing it in this new course will link it to the ethos of SWS.

Explore. Student’s transition into the exploration phase of the framework as they identify some aspect of the topic they want to further explore, which could be scientific or social in nature, or undefined in its relationship to the topic. This phase opens up the topic to a wider range of ideas to attempt to grasp the breadth of the question at hand and the various scientific questions and social questions that need to be considered. Students will come to these areas of interest through the free writing process. The concept of free writing is not new to the students in SWS, as it is a common practice in several of the English classes. The practice can be employed at several stages of the inquiry to help students collect their thoughts, help a focus emerge, or to break through a block in their thinking. At this exploration phase, the goal of the free writing is for each student to narrow down on a handful of sub questions or connected topics to the central question. The students write continually for 7 minutes and then do a think-pair-

share protocol in which they share what emerged in the writing. The class will do a full share of the sub questions and connected topics and record them on the board. This list becomes the individual tasks that each student will look into during the explore phase. Other common course practices include processes to find, evaluate and digest outside resources. These skills introduced here will be monitored for growth throughout the course. Additionally, students will be introduced to another common practice and theme of the course - learning from each other.

Learning from each other is a SWS value that is reflected in the English classes and History classes. In SWS English, it is common practice to read out loud their papers to the class at multiple drafting phases. The practice is essential in creating classroom communities of support on written work and the personal revelations that emerge in that writing. These classroom communities extend into the larger community and serve as a mechanism to connect everyone. Sharing work, especially work that is not complete, can be very intimidating for anyone. The investment in their peer's growth is key in this practice and serves to enrich the goal of developing empathy and care in the students of SWS (Figure 1).

In this exploratory phase of the learning, each student will present their article to the class using a quick present protocol. The practice is aimed at widening the scope of the topic at hand through the student voices and developing opinions. The instructor also participates in this process to break down the existing paradigm of the teacher as separate from the students in the process of figuring out the answer to the question at hand. In this course, the goal is to wrestle with questions that may not have just one answer. It is important that the students are not looking to me as evaluating the work as right or wrong. Instead we are looking for work that moves us forward in our process. Additionally, and perhaps counter to the philosophical underpinnings of my previous point, participation in the process allows me to introduce considerations and extensions on the topic that I know to be important. It is entirely possible that students could capture the necessary scope in their collective research, but they might not. My participation offers a way for me to guide the conversation into necessary realms. For example, in this inquiry there will likely need to be some basic understanding of how the rewards system works in the brain. If the students do not draw that into their work, then I will.

Throughout the explore process, we refine the list of sub questions and connected topics that we need to answer in order to fully understand our central question. This is achieved through a closing discussion during each class period after presentations and by visually diagramming the inquiry on the wall in the classroom (Figure 4). The class will engage in creating a full wall mind map that can be collaboratively edited at any



Figure 4: Example of a wall mind map created on the topic of “musicology and its debates”. (Image: <https://www.flickr.com/photos/dumbledad/4440370589>)

stage of the process. Mind maps provide a method of organizing information by showing connections between topics. This process will also provide a visual reminder of where we started and how the inquiry has grown over time. The second purpose is conceptualize the inquiry that is a largely an intellectual process achieved through discussion, web-based research, and computer-based product composition, and convert it into a visual and tactile representation of the inquiry. Students in the course, at any point, are invited to edit the mind map with sticky notes, post relevant articles or pictures. This invitation is extended to the SWS community as a way to draw in other perspectives.

The goal at the explore stage is to use the student presentations to grow the mind map into 5 or 6 sub questions to the point of class consensus. We do not progress to the next stage until we can say as a group that inquiry into each of our sub questions and connected topics (i.e. the outgrowths of our central question) will sufficiently help us accomplish our purpose.

Explain. The explaining phase of the learning cycle involves group based inquiries into sub questions or topics identified in the explore phase. Students will be asked to identify one or more of the out growths of the map on which they are interested in becoming the class expert. Group sizes and number of groups will be determined by the depth and complexity of the topic

they are tasked with researching. The goal here is to uncover and understand necessary and relevant information. Areas I anticipate being covered in this unit include: historical perspectives on emerging technologies, cognitive development in relation to attention control, tech industry practices in app development, executive functioning intersection with distraction and technology, school system policies that control student technology use, addiction and rewards systems.

The common classroom practice introduced at this phase is cooperative learning. Group based work in the explain phase will be focused on role taking, individual responsibility to the group and group responsibility to the class. Cooperative learning has been shown to promote academic learning and interpersonal development; however, the researched form of cooperative learning does not always occur in classrooms as teachers have to consider the content to be covered and the personality of the students (Siegel, 2005). Grouping students will allow for deeper and more focused inquiry, but without defined structure can devolve into one person doing the work and the others getting pulled along. At this introductory stage, we, as a class, discuss the range of group roles that exist both from deliberate action and from unintentional dynamics. Johnson and colleagues (1998) define group roles that can be used to establish a framework for how students interact in a group in both constructive and destructive ways.

Cooperative learning groups will consist of 3 students. Common group roles are variations on group roles defined by Johnson and collaborators (1998). Each will include a group leader who is responsible for facilitating group meetings, negotiated shared and individual tasks, and keeping track of time in meeting sessions so that each session ends with clear expectations for the next meeting. There will be a group member who occupies the organizer and communicator role, who is responsible for creating shared Google documents and ensuring that those documents are shared to all the group members and the instructor. This person will keep notes in the shared document that keep track of the group's research plans and will document relevant action items. This person also curates contributed items to the document according to the group discussion. The spokesperson/reporter is responsible for keeping the big picture in view and describing the group process during teacher and class-wide check-ins. This person is responsible for being familiar with the timeline for the overall project. All members of the group are considered researchers and have the responsibility of contributing ideas and supporting documents to the group.

Each group will generate a report on the sub question or the topic they selected to research. Throughout the explain phase of the learning cycle, the groups will be asked to contribute to the mind map in the room. The contributions here are more formal as the work completed in the explain phase is about answering sub question or gaining required knowledge. Key findings will be added as off shoots of the sub question/concept they studied. Any opportunity to depict findings through visual representations of data, figures or images will be added to the mind map. Presentation of this information follows in the elaborate phase.

Elaborate. The elaborate phase returns the class to the full group and reorients everyone to the larger questions we are considering. The process consists of student groups reporting on their group inquiries. Each group will have time to present their major findings, reference the items they added to the mind map, and offer suggestions to the class on further readings. The mind map serves as a visual reference for the class discussion and a resource that students can visit to extend their understanding of what their classmates uncovered in their research. The discussion returns to the central question and asks the class, in light of what we have learned, how do we now develop a technology policy that is scientifically informed and socially responsible?

In a writing exercise, the students are asked to compose what they individually feel should be included in this technology policy. The prompt will ask them to address use of smart phones and laptop computers and ask them to support with evidence why they have drawn their conclusions. At the end of the free writing, each student is asked to share the single most important aspect of the policy they conceptualized in their mind map. The instructor documents each of the points in a visible location in the room. The resulting collection of points is considered a first draft of our technology policy. This class discussion follows the SWS town meeting legislative practices that incorporate an opportunity to make amendments and a specific format for voting to approve the policy. Once the policy is approved, the expectation is that students abide by the agreed upon technology policy.

Evaluate. The evaluation phase of the learning cycle is a time to reflect on the processes that brought us to determining the technology policy, not the policy itself. Students fill out self-evaluations on engagement in discussion, group participation, and contributions to the overall process. Students write a short reflection on how their thinking about technology, learning and

school has been influenced by the inquiry and will offer feedback to the instructor on improvements to the processes.

The mind map is archived in the evaluation step by taking close up pictures of all sections, color printing the photos, removing and preserving added documents, photographs or other artifacts of the inquiry. The archive will be stored in the SWS Laurie Room, a library space devoted to quiet study that holds much of SWS's history. As the evaluative exercises (largely independent work) begin, the classwork transitions to the last phase of the learning cycle - extension of what we have learned into the larger community.

Extend. The extension phase offers the students a chance to share their conclusions with the wider school community. The introductory unit is focused on developing a technology policy that is scientifically informed and socially responsible. In an effort to spark community wide conversation and feedback, we will present the policy and its rationale to SWS town meeting, following in the occasional tradition of SWS classes using the community space to bring classroom learning to the community.

Depending on the learning and the central question addressed, this could take the form of a presentation to SWS town meeting, bulletin boards displayed in the school, or an action project such as plantings of butterfly plants on the school grounds with accompanying educational information labeling the plantings. Extension is a key addition to the learning cycle as it illustrates that the questions the class addresses is not only for the benefit of the questioners but also for individuals in the wider community. The extension practice is important to influence the BHS mainstream community. The audience for the learning outcomes of the students is not only the students of BHS, but also the faculty and staff. I hope the lessons learned in the class influences everyone in BHS community in the area of critical investigation of Biology and society. Additionally, I hope the display of student work influences the staff of BHS as we consider how to best serve our students teaching and learning needs.

Additional SWS Biology and Society Course Processes

The introductory unit to SWS Biology and Society is highly structured and involves digression into explanation of course processes and expectations for assignments. What is most notably different about this first unit compared to the rest of the class is the manner in which we select the topic to be studied and the central question related to that unit. Primarily, this is a course about students democratically navigating the topics of inquiry. Therefore at the outset of

the second unit of study, students will need to become familiar with variety of ways that we can enter into our next inquiry. This is where it is best to envision the modified 5Es+1E learning framework as a cycle, since the work in one unit of study will undoubtedly extend into the next.

Democratic topic selection. In the course of engaging with a complex issue, the digressions and sub questions that naturally arise reveal whole realms to explore. These additional avenues for inquiry are documented on our wall mind map as a placeholder and are briefly revisited when we archive the wall mind map. Class consensus is defined as a show of hands vote with a two-thirds majority (teacher has an equal vote). This practice mirrors the SWS town meeting practice of entering a narrowed discussion. If class consensus is reached, I then plan a new set of engage activities and we progress through the learning cycle.

If consensus cannot be reached, we progress into a round of presentations on potential topics that can be completed in one class period. Individual students or small groups of students use the quick present protocol to create a 5-minute pitch for the next day's class period. The application Poll Everywhere (<https://www.polleverywhere.com/>) is used for a class vote to determine the top two choices; students cannot vote for their own pitch. Classroom discussion begins with an alternating format with 2 people speaking for the 2nd place vote choice and one person speaking for the 1st place vote choice (i.e. minority, majority, minority). Speakers have the task of arguing why we should investigate their choice over the others. A show of hands vote follows with a simple majority winning. This voting format mirrors practices in the SWS History courses and in the SWS town meeting proposals process.

Case studies. Case studies provide a potential entry point into a topic and will be useful tools in the engage phase of the learning cycle. Case studies often start with a story that provides important social context to an area of Biology. Clyde Freeman Herreid (2005) has written widely on using case studies to develop critical thinking and to engage students in learning in the contexts of stories. In Herreid's (2006) book, *Start with a Story*, he defines a case study simply as a story with a biological message. Stories can be the perfect entry point to an inquiry in a Biology and Society course because they show the entanglement between science and the related social structures.

Individual inquiries. In the event that the interests of students diverge, and as students show competence in various skill areas, the class transitions into an individual inquiry format. The course's process-oriented format makes it difficult to predict how long inquiries might take;

however, the goal is that students are working on personal interest inquiries during the 4th quarter of the school year. Keeping the class together can keep teacher planning manageable, but transitioning to individual work allows for maximum student choice and individual responsibility. This is a tension that will need to be weighed in light of how well the class is progressing. There is flexibility to do an alternative step in which students are working in small groups.

Students come to their topics based on a number of factors. The expectation is that through the progress on of the course, students will have a collection of lingering questions that emerged from previous work or from intrinsic curiosity. Students prepare a proposal that follows the format of the engage section of the learning cycle: they identify a topic, state a central question and find one or two introductory research sources. Students are paired and present their proposal to each other and receive peer feedback. They then progress to teacher proposal, which is a one-on-one meeting to determine the potential of the project and to discuss the next steps. Individual inquires follow the same processes as class level inquires but with periodic teacher advisor meetings. If a writing component is added to this individual inquiry then the project can count as the senior paper, a BHS graduation requirement.

Epicycle: Dialogue and Reflection on Proposing and Planning

Why this class? Sometime over the past 15 years, I stopped thinking of myself as an authority on high school level Biology content and instead as a trusted adult charged with guiding young people in their growth and development. A colleague of mine, often in referring to John Dewey and teaching will say, with his most profound inflection: “This thing we do, it is a human enterprise.” It does not always matter what the content of the day is; it matters that a genuine and authentic learning experience is fostered and a large component of that is centered on the human relationships that are built in the classroom and in the wider community.

Why this population? The School with in a School (SWS) programs mission statement states the values of SWS to include, “students build honest and supportive relationships with teachers and peers, ...encourages communication, values respect, embraces diversity and promotes social inclusion. Practices direct democracy in a weekly town meeting” and [SWS is an]...ever-changing fluid community, and thus as strong as its members.” (SWS mission statement, 2003). The targeting of this community specifically is to address a student voiced desire to learn more about aspects of Biology that affect them or in which they have an interest.

The community is primed to delve deeper and to make a somewhat abstract topic more relatable. Additionally, SWS is an environment that allows for a more exploration and leeway in the development and implementation of new courses. Students opt into the program and understand that it is alternative in its approach.

Why this time? The students are asking for this curriculum. Students are regularly engaged with questions about themselves and the world. Most of the time the questions they are asking are not the ones that their classes are directly answering. For example, in town meeting, a student asks the group about sleep, its relationship to stress and anxiety, and taking a Melatonin supplement. I realized that this student likely did not have a structure in her life that would actually cause her to explore the answers to those questions. In another experience, a very quiet student in my Biology class became impassioned when presented the ethical considerations of pre-implantation genetic diagnosis. On a separate occasion, another student realized the interplay between Biological understanding of hemophilia and historical context of the fate that befell the Russian royal family in the Bolshevik revolution.

The course is placed at the end of their high school experience to impress upon them of the complexity of the world and ones' ability to think deeply about those complexities. We are all faced with uncertain futures; equipping citizens with the ability to think critically about the challenges facing humanity and the biological world and developing creative solutions is imperative. The class is about seeking that growth for young people who are about to step into the world as voters, problem solvers and life long learners.

Chapter 4: Future Action Research Phases

Implementation

Anticipated implementation of the new course is for the 2018-2019 school year. One major consideration in bringing a new course to reality is populating that course. The SWS Biology and Society course will be offered to the SWS seniors based on interest, but also will likely draw students because of the requirement that every SWS student takes two SWS courses each year. Seniors have historically had difficulty scheduling a second SWS course due to school wide scheduling issues. SWS seniors report that they want to have more opportunities to take classes within SWS.

Implementation will require advertising the course to the SWS community to build interest and to help students conceptualize how the class is aimed at issues that exist in their world. Given that I teach the introductory Biology course, I can use that course to both teach content knowledge and introduce students to biological topics with relevant societal connections as a precursor to the newly proposed course. There are natural places within my current curriculum to suggest that further exploration of a particular topic requires societal context, but due to the standards based instruction I only allow for brief digression into the social context. For example, reproduction curriculums often present biological sex determination in very binary contexts. Phrases like “Y makes the guy” is a simplification of complex developmental processes involved with characteristics that are associated with male typical and female typical anatomy and hormone expression. There is an important discussion here around stigmatization of individuals born with ambiguous genitalia. There are several variations in the area of biological sex that present the more accurate spectrum of human differences as opposed to the binary view that students are largely taught (Montanez, 2017). This is just one of several instances in my first year curriculum to pause and frame the societal connections for the purposes of generating curiosity in the current class and to attract students to the SWS Biology and Society class where students will have the time and structure to wrestle with complex issues.

Epicycle: looking forward on implementation –presenting the course to SWS staff. SWS staff meeting provides the venue to present the intentions of the course and to explain the alignment with the various aspects of the 4 circles framework and the mission statement (see Appendix C). The course will embody the teaching and learning value by addressing challenging Biological questions that intersect with social constructs. The structure of the

inquiries and the expectations of the course will challenge students to engage deeply with these questions. The course will embody the democracy and justice circle in the course practices that allow for students to guide their learning individually or select topics democratically.

Democratic intrapersonal interactions exist in the class discussion structures and group based cooperative learning structures. The concept of justice is inherent to the intersection of Biology and society since many of areas of inquiry delve into ethical dilemmas. Empathy and care is embodied through the course processes that involve perspective taking, an important part of ethical consideration, and the study of concepts that are intensely personal in nature. The hope is that students are selecting inquiries that are authentic and personally meaningful. The SWS mission statement refers to “discussion based courses”, “building supportive and honest relationships with teachers and peers”, “courses emphasize independent, self-motivated, active learning” and “value process as much as product” (SWS mission statement, 2003). The SWS Biology and Society course endeavors to embody these statements. The presentation of SWS Biology and Society to the staff will serve as an important pre-assessment of the stated goals of the course and a chance for feedback from the SWS staff as I make final preparations for the course. This exercise will also provide an important touch point for evaluation of the adherence to the stated goals.

Evaluation

Measuring the perceived impact of the course includes gathering the SWS staff perspectives of the course in relation to the SWS values defined by our mission statement and the 4 circles framework, understanding the perceived impact on the SWS student population who participated in the course, and understanding the perceived impact on the SWS student community and larger BHS community.

In addition to collecting the course’s perceived impact on members of the learning communities, evaluating the process and products that the students create during the class will be a key component to making real time adjustments to the course. This assessment work is central to guiding students’ learning in the areas of: skill development (e.g., journaling, assessing resources, written expression of ideas), reflective practices (e.g., free-writing, listening and responding in discussions, taking others perspectives), executive functioning (e.g., keeping track of assignments, being responsible to the group, initiating tasks), and deeper understanding of the intersection of Biology and society. The technology policy that the students create in the first

unit becomes a component of the course expectations once the students approve this policy using a democratic process. I expect students to then follow this policy. But if they do not, if the policy proves to be too idealistic or does not address the problematic behavior that we are trying to avoid, then I will reflect on the steps we took as a class as I refine the course going forward.

Epicycle: looking ahead – evaluating the SWS staff perspectives of the course.

Discussion of our classes is a common practice in the SWS weekly staff meetings. There is time to have informal conversation and time to work through preplanned action points. Evaluation of the staff's perspective will be collected at the culmination of each inquiry cycle. I will ask staff members to offer feedback in each of the areas of the 4 circles framework and the stated aspects of the mission statement. The data collected will be qualitative commentary on what the staff observes in the SWS community or the BHS community that stems from the SWS Biology and Society course. Since each cycle of inquiry in the SWS Biology and Society course could be very different in content, this feedback will be important real time data that can shape classroom practices.

Epicycle: looking ahead – evaluating SWS Biology and Society student perspectives.

Feedback from this group is key in determining if the course addresses the stated goals of aligning with the values of SWS. Students will be asked a similar set of questions as the SWS staff. In addition, I am interested in collecting data on the pedagogical approaches and students' perspectives on their engagement in the work and rigor of the work. This course endeavors to build skills that are important for the world, therefore, students will be surveyed about their perspectives on their growth in the areas of finding, evaluating and digesting resources, evaluating complex issues from a variety of perspectives and using a variety of approaches, group and individual responsibility, and experiences of stress and anxiety during the course. Student perspective data will be collected throughout the year in the form of the reflections completed in the evaluate phase of the learning cycle. Data on skill development will be tracked across the year as students submit resource summaries, group functioning surveys, culminating products from inquiries and as I document participation in class discussions. These data serve the purpose of not only guiding the growth and development of students but also evaluative data on the effectiveness of the class processes.

Epicycle: looking ahead – evaluating SWS community and BHS community impact.

Throughout the school year as a function of our extension (6th E) into the larger community, the

SWS Biology and society students are purposely attempting to generate discussion in the SWS community and the BHS community. This discussion may be formal in nature, such as the SWS town meeting presentations, or it might occur as ideas and learning bubble up in different community spaces. I am interested in trying to document as many as these moments as possible because I believe they reflect the authentic manifestation of internalized learning and are evidence of students making connections. SWS town meeting will be an important venue for capturing these moments. It is in SWS town meeting that several students vocalized their wonder in areas that have Biological and societal connection, so I believe it will be a natural outgrowth that SWS students bring these topics to the community. Additionally, SWS and BHS extension installations such as the bulletin boards or plantings will have opportunities for community members to provide feedback that is aligned with the display. Installations that reach the wider BHS community will include a way for individuals to respond to the material or contribute their ideas, such as the use of a hashtag to collect reactions via twitter. The potential application of technology here for educational purposes and evaluative data collection has a serendipitous quality to it.

Chapter 5 - Conclusion

The process of reflecting on my time in teaching and my experiences in the Critical and Creative Thinking program (CCT) has prompted the development of this new course. I have identified that I am in my very own saber tooth curriculum moment and that, personally and professionally, I need to grow into a new way of teaching: a way that prioritizes personal relationships over content-driven standardized education. Noddings writes in her 2012 article *The caring relation in teaching*, “a truly educational experience must be connect to past and future educational experiences and to other on-going life experiences” (p. 776) and “dialogue is fundamental in building relations of care and trust” (p. 775). The shift in my teaching that is represented in this new curriculum is an effort to move toward authentic student-centered education through the process of developing caring relationships while working on the real questions that students have about the intersection of Biology and society. I hope that I, and my curriculum, continue to grow and change as the world changes.

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Appendix A

Course Expectations Student Handout

SWS Biology and Society – Course Expectations

Introduction to the course: Biology, the study of life, and our society is inextricably linked. Scientific inquiry, environmental crisis, human health and well-being are all integral to Biology and all occur within human constructs. Scientific inquiry is undertaken for a stated purpose and that purpose has intersection with the advancement of some realm of humanity. Environmental crisis is defined in a human context and efforts to save the environment are present to undo some collection of human actions. Human health and well-being nicely merges human, living breathing humans, as the subjects that require deeper understanding. The pursuit of trying to understand the whole of life occurs within the diversity of geopolitical and cultural contexts, bringing up the complexities of policy making and personal ethics. How do we unpack an issue such as climate change when scientific, political and industrial biases interweave? How then do we act, as individuals, as communities, and as governments? This course will attempt to tackle these complexities by addressing pressing Biological question and the entanglements those questions have in our society.

Successful Students in SWS Biology and Society must...

- Challenge themselves and each other to be present and engaged in the daily work
- Challenge themselves to be open to different ways of thinking
- Challenge themselves to ask the next deeper question
- Be independent when its time to be independent
- Be collaborative when its time to be collaborative
- Be inquisitive

Major Topics – This is a partial list of potential topics. Due to the course structure, the depth in which we cover particular topics will be determined by classroom consensus. Having said that, I will at times exercise instructor privileges to guide the class toward or away from particular topics, but I will be transparent with my reasoning.

- Conservation and Sustainability
- Climate change and biodiversity
- Genetically modified organisms
- Human health and well-being
- Evolution of scientific thought
- Ethical considerations in Biology
- What else...?

Student-Teacher Expectation

- **Open Line of Communication** – You can expect from me clearly outlined assignments, due dates and instructions. I expect that you keep me informed about your progress and understanding of assignments. Please come to me with issues that you have related to the material, classroom culture or individual challenges. There is a solution to every problem, so lets talk about it!

Classroom Expectations: Best Practices

- **Please treat yourself and each other with respect and kindness.** The best learning environment is one in which everyone feels welcome, safe and valued. This is especially true whenever someone is speaking.
- **Devote your classroom time to class.** Arrive on time. Refrain from leaving class unless absolutely necessary, attempt to leave distractions at the door and stay focused on the work. This is about your success in the class but also about respect for your learning.
- **Please respect your classroom by cleaning up after yourself.** Water, tea, coffee and small snacks are permitted as long as collectively we are keeping the space clean. Do not bring your lunch or breakfast to class.
- **Academic Honesty** - You are expected to produce your own original work. Citing individuals' ideas and words are a must. Plagiarized work or cheating will result in a zero, immediate referral to SWS Review committee.
- **Discussion Norms**
 - **Speak for Yourself** – Use first person pronouns and acknowledge that your ideas represent your thinking and do not necessarily represent those of your specific identity groups.
 - **We will disagree and we won't have all the answers** – The basis of our discussions will be complicated and sometimes controversial, understand that we will not be able to resolve, conclude or come to agreement on these issues every time.
 - **Use Both/And.** When commenting upon another perspective, add to the discussion instead of negating another person's view.
 - **Be conscious of body language and nonverbal responses.** Gestures and expressions can be as disrespectful as words.
 - **Be aware of intent and impact.**
- **Technology** – We will work together to develop a classroom technology policy that is scientifically formed and socially responsible.
 - **Introductory Unit: Technology, addiction, learning and schools** - This introductory unit is designed to show you the common practices of the class and to address the Biology and societal issue of technology use in learning environments.

Academic Routines and Expectations

- **Weekly planners** – Every week or every two weeks you will be given a schedule that represents our best-laid plans. The planner will be an important reference to pace us through the work and to clearly identify due dates of assignments.
- **Types of learning experiences in SWS Biology and Society**- The main work of the class is to ask big questions about the intersection between Biology and society and to follow a series of learning steps to attempt to answer the question as completely as possible. The learning steps will include the following experiences at various points in the process. Some of these experiences will be considered in determining your grade for the class.

- **Classroom discussion** – Abiding by the SWS traditions and discussion norms listed above. Discussion will be the centerpiece to our classwork. Being prepared to share will be a part of your participation grade.
- **Free writing** – Writing continually for a set period of time on a given prompt helps to clarify thinking and helps new ideas to emerge. It is also an effective mindfulness practice to pull us toward the topic of the class period. We will free write regularly as an entry point into class discussion and at the start of inquiry.
- **Case Studies** – A case study in Biology is any story that has a biological message. Case studies provide good contextual understanding of how a biological topic and societal topics intersect for a specific topic.
- **Research digestion** – Identifying, citing and digesting recourses will be important skill that will be developed through out the year.
- **Quick Present** – This is a routine in which students create short one-slide presentations that are delivered to the class. This will be one of the ways individual students will share research to larger group.
- **Cooperative learning group work** – Groups of 3 or 4 students work together to address a sub-question that requires more time and effort to address. Specific roles are assigned within the group.
- **Keeping a journal** – Digitally or on paper, you will need to have a place to record the various types of writing you will do for the class. This journal needs to be organized so that you can find writings as needed.
- **Mind mapping** – Everyone in the class will participate in creating a map of our learning about each topic. This mind map will document the central topic and all of the sub-questions that stem from the topic. As we research and discuss the topic we will add our findings to the map in an effort to visually represent our process.
- **Democratic Selection of topics/Pitch day** – Identification of Biology and society questions is up to the class. If there is a class consensus on a topic, I then prepare introductory materials/activities for that topic (class consensus is considered two-thirds of the students present on the topic selection day). If consensus cannot be reached, then we proceed into a process of pitching a topic. Individual students or small groups of students use the quick present protocol to create a 5-minute pitch for the next day's class period. The topic with the most votes becomes the next topic investigated.
- **Reflective practice** – Through discussion or writing, you will be asked to reflect on your engagement throughout the class. We will also reflect on the processes of the class so that we can identify what works well and what might need to be changed.
- **Extension** – As we conclude each topic, we will determine some way to share our findings with the larger school community. This could take the form of presenting our findings to SWS town meeting, a display of our mind map or some representative action based on what we learned from our inquiry.
- **Individual inquiries** – During the 4th quarter students complete individual research project based their own interests. The research process reflects the group processes completed during the first 3 quarters.

- **Assignments** Several of the experiences listed above also will have related assignments. Assignments will vary from topic to topic. Check the weekly planner for assignment due dates, the point values and grading rubrics.
 - **Assignment Grade (85%)**– Based on total points earned on assignments.
 - **Participation Grade (15%)**– Determined using a self-assessment and teacher assessment rubric. The SWS attendance policy will be enforced and your grade will be lowered after the 3 absences in a quarter unless SWS attendance committee recommends otherwise.
- **Homework and Classwork** – The course is designed and paced such that time will be given in class to complete your work, however, there will be times that the work will overflow into homework. Using time efficiently in class will be key to limiting the amount of homework you have.

Appendix B

Unit Plan – Technology, Addiction, Learning and Schools – Teacher resources

Big ideas: This introductory unit to SWS Biology and society will delve into the complex interactions that exist with technology, such as smart phones and computers. These tools have become common in the classroom and can be useful learning tools but also can hinder learning. How a classroom or a school deals with technology varies greatly. (18+ class periods)

Learning Cycle Phase	Classroom Materials/Activity/Lesson	Responsibility to class/group/teacher
Engage	Lesson: Introduction to SWS Biology and Society (.5 class period) <ul style="list-style-type: none"> • Welcome, introductions and pronouns. • Class discussion on initial perceptions of Biology and society. Prompts - What is an example of a societal issue with connections to Biology? What experiences did you have in your Biology classes that you want to bring to this course? • Define expectations on readings. – Basic expectation -students must be prepared to share thoughts on the readings, introduction to keeping a journal. • Assign: Selected a reading from the list. 	<ul style="list-style-type: none"> • Prepared to share • Journal entry
	Lesson: Introduction to Unit on Technology, Addition, Learning and Schools (2 class period) <ul style="list-style-type: none"> • Watch TED talk from list • Quick overview of Learning Cycle and dual purpose of unit one; 1) Learning the course processes, 2) Investigating Technology, Addition, Learning and Schools. • State Central Question: How do we develop a classroom technology policy that is scientifically informed and socially responsible? • Day 1: Class discussion stemming from reading and TED talk, teacher records sub questions and connected topics that emerge in a visible space in the classroom. • Day 1 Assign: LaMotte article and take the Quiz • Day 2: Class discussion stemming from previous readings and the experience of taking the addiction quiz, teacher continues recording of sub questions and connected topics. 	<ul style="list-style-type: none"> • Prepared to share • Journal entry
	Reading: Is Google Wrecking our memory? By Clive Thompson.	N/A

	<p>http://www.slate.com/articles/health_and_science/science/2013/09/are_search_engines_and_the_internet_hurting_human_memory.html</p> <p>Reading and Phone Addiction Quiz: Smartphone addiction could be changing your brain. By Sandee LaMotte. Quiz in article created by Caglar Yildirim. https://www.cnn.com/2017/11/30/health/smartphone-addiction-study/index.html</p> <p>TED Talk: Why our screens make us less happy. Adam Alter TED2017 https://www.ted.com/talks/adam_alter_why_our_screens_make_us_less_happy/discussion</p> <p>Reading: Brookline High School Technology Policy – BHS Handbook</p> <p>Reading: A Learning Secret: Don't Take Notes with a Laptop. By Cindi May https://www.scientificamerican.com/article/a-learning-secret-don-t-take-notes-with-a-laptop/</p> <p>Reading: Smartphones Aren't Addictive – But Their Increased Usage Points To Bigger Problems. By Jason Hreha https://medium.com/@jhreha/smartphones-arent-addictive-but-their-increasing-usage-points-to-bigger-problems-2507991d3f04</p> <p>Radio Podcast: Smart Phone Detox: How to Power down in a Wired world. https://www.npr.org/sections/health-shots/2018/02/12/584389201/smartphone-detox-how-to-power-down-in-a-wired-world</p>	
Explore	<p>Lesson: Free writing exercise to identify area for exploration (1 class period)</p> <ul style="list-style-type: none"> • Introduction to free writing process • Free write for 7 minutes - Prompt: What areas of the readings or the discussion most interest you or what do you consider to be important in addressing our central question? What do you think we need to consider which has not come up yet? • Think-pair-share protocol with neighbor – 2 minute quick share on what emerged in the writing • Full group share with each person giving one point from their writing, teacher records in a visible space sub questions and connected topics that emerged. • Introduce: CRAP. test (Currency, Reliability/Relevance, Authority/Audience, Purpose/Point of View 	<ul style="list-style-type: none"> • Contribute to discussion. • Contribute to formation of sub-questions • Find one resource, use CRAP test • Journal entry

	<ul style="list-style-type: none"> • Assign: Find one resource using CRAP test protocol complete journal entry on article. 	
	<p>Lesson: Introduction to mind mapping (1 class period)</p> <ul style="list-style-type: none"> • Teacher preparation: Create the skeleton of the wall mind map. Place the central question in the middle, use the sub-questions created in the last class period to make the off shoots the central question. • Teacher preparation: Be sure classroom printer is set up. • Introduce the mind mapping concept and classroom application. • Activity: Have students place their article on the mind map, so that the headline is visible, important visual information should be emphasized (figures, photographs, data visualizations, etc). If a student resource is not represented, create a new branch to the mind map. • Discussion: Using the experience of looking for resources and mind mapping, discuss what areas of the map need to be edited, researched further, seem most important to the inquiry, etc. Edit during the discussion. 	<ul style="list-style-type: none"> • Bring article to class • Participate in activity and discussion
	<p>Lesson: Introduction to BHS Library resources and the quick present protocol (2+ class periods)</p> <ul style="list-style-type: none"> • Day 1: Teacher preparation: Schedule a visit from a BHS librarian to show students web resources and print resources, reinforce the concept of the CRAP test in finding quality resources. • Day 1: Activity: Librarian presentation • Day 1: Activity: Use the library resources to find another resource in the same area as your previous (i.e. it should occupy the same area of the mind map) • Day 1: Introduce the quick present protocol: Students prepare one-slide presentations on the resource they found. Shares the main idea of source, connection to the larger topic. Presentation time limited to • Day 1 and HW: Activity: Students prepare one slide presentations. • Day 2+: Activity: Student presentations, place work onto mind map 	<ul style="list-style-type: none"> • Day 1 Find additional resource using library resources • Journal entry on resource • Day 1-2: Create one slide presentation • Present to class • Edit class mind map

Explain	<p>Lesson: Introduction to Cooperative learning groups (1 class period)</p> <ul style="list-style-type: none"> • Free-writing for 7 minutes. Prompt – Now that we have done some research, what sub question interest you most? What are the most important sub-questions? • Class discussion: Share one thing that emerged in your free writing. • Introduction to Cooperative learning groups – Share group roles and schedule for group meetings. • Sign up for groups based on topic of interest and assign roles within the group. 	<ul style="list-style-type: none"> • Participate in class discussion • Establish groups
	<p>Group work: Setting a goal and first teacher meeting (Day 1) (1 class period)</p> <ul style="list-style-type: none"> • Based on assigned roles group members establish how they will address the sub question that is their focus. • Teacher meetings: Meet with each group to reinforce the group role structure and to hear what the group plans to do. 	<ul style="list-style-type: none"> • Participate in group meeting
	<p>Group work: Meetings (3+ class periods)</p> <ul style="list-style-type: none"> • Groups work on research and discussing what they find • Edit the mind map • Completing HW that is given at the group level • Meetings with teacher as needed. • Create a report to deliver to the class – the product can vary based on topic, creative options are encouraged (i.e. range from presentation, podcast, or skit), each class should plan on using half a class period for their report. 	<ul style="list-style-type: none"> • Complete group assigned tasks • Corresponding journal entries • Edit the mind map • Work with the teacher if the group gets stuck
Elaborate	<p>Activity: Reports on Sub-questions (3 class periods)</p> <ul style="list-style-type: none"> • Student groups teach the class on the sub question • Edit mind map as time allows 	<ul style="list-style-type: none"> • Participating in teaching the class
	<p>Writing assignment: Compose the ideal classroom technology policy using what you have learned up until now. Support your ideas with evidence (HW)</p>	<ul style="list-style-type: none"> • Technology policy writing policy
	<p>Class Discussion: Building a consensus. What should our classroom technology policy consist of and why? (1+ class periods)</p> <ul style="list-style-type: none"> • Have each student write one aspect of an ideal policy and why on a large piece of paper and post 	<ul style="list-style-type: none"> • Participate in class discussion • Collectively pass a technology

	<p>around the room.</p> <ul style="list-style-type: none"> • Ask: What if this collection of aspects was the policy? Follow standard SWS town meeting legislative practices to “pass” the policy as is or to amend the policy. • The process proceeds until a policy is passed. 	policy
Evaluate	<p>Student Reflection on process: Students complete self evaluation on participation of all phases of the learning (.5 class periods)</p>	<ul style="list-style-type: none"> • Completed self-evaluation
	<p>Students Reflect on their learning: Students write about how their ideas of technology have been influenced. (.5 class periods)</p>	<ul style="list-style-type: none"> • Completed writing assignment (in journal)
	<p>Class Activity: Archiving the mind-map (1 class period, can occur on the same day students are doing reflective writing)</p> <ul style="list-style-type: none"> • Photograph map and print • Collect materials into a file and put in the Laurie Room • Create a celebratory feel for this day 	<ul style="list-style-type: none"> • Archive mind map
	<p>Class Discussion: Closing the loop. What do we feel compelled to share with others? (1 class period)</p> <ul style="list-style-type: none"> • Introduction of the extension phase • Class discussion, guide students to presentation of our technology policy to SWS town meeting 	<ul style="list-style-type: none"> • Participate in discussion
Extend	<p>SWS Town Meeting – Presentation of our technology policy and its rational.</p> <ul style="list-style-type: none"> • Small group of student volunteers create a presentation and deliver it to town meeting. • Class time is given to this small group to do this work within the next unit of study • Teacher note: Each student in the class will have to do an extension project at some point in the year. 	<ul style="list-style-type: none"> • Create and complete an extension into the SWS community

Appendix C

SWS Mission Statement and 4 Circles Framework

The SWS Mission Statement was developed by a student committee and passed by SWS Town Meeting in June 2003.

SWS MISSION STATEMENT

School Within a School (SWS) is a democratic program within Brookline High School. SWS students are responsible members of both communities. SWS promotes academic and personal growth through an informal, challenging learning environment where students are encouraged to share feelings and insights. Students build supportive and honest relationships with teachers and peers. Together, they inform and assess curriculum in the context of discussion-based courses. Classes emphasize independent, self-motivated, active learning from students as much as from teachers. By valuing process as much as product, SWSers find meaning in lifelong learning. The tightly knit SWS community encourages communication, values respect, embraces diversity and promotes social inclusion. It practices direct democracy in its weekly mandatory Town Meeting, where each member has a direct vote and voice in the decision-making. Student committees steer the community, hire and evaluate staff, run Town Meeting, review membership, and work to make SWS vibrant as well as diverse. SWS encourages the development of open-minded, creative, vocal and receptive thinkers. Due to its democratic nature, School Within a School is an ever changing, fluid community, and thus is as strong as its members make it.

