STEM BUSINESS PLAN
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STEM Business Plan – Draft 1.2

STEM meets the need to educate each and every student in the literacy of Science, Technology, Engineering and Mathematics. The pervasive influence of these fields in every workplace, every home, and in civic life requires a working and voting citizenry able to solve the complex social, environmental, and technical problems we face.
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Executive Summary

The San Juan Island School District (SJISD) is committed to implementing a STEM curriculum K-12. STEM programs address the well-established incongruity between American public schools and the American technological workplace and increasingly technical civic sphere. The District commitment has been recognized by significant grants and awards within the public sector. Yet fully implementing this change with the exclusive use of public funds will be accomplished with a time line extending beyond ten years. In consideration for the needs of our currently enrolled students, this proposal offers a compressed time-line for implementation funded through the generosity of donors equally committed to STEM education. The proposal funds proven strategies using methodologies which have been successfully applied by high enrollment districts able to afford a full time development staff. The following needs are addressed:

Bringing STEM to Every Student - Through the immediate support of clubs and extracurricular classes, and later by careful integration into the school day, every student will learn STEM concepts and processes.

STEM Class Development and Delivery - By identifying and cloning the best existing STEM curriculum and classes, SJISD STEM classes will be effective and sound.

Curriculum Innovation - In addition to the clubs and classes noted above, this proposal calls for exploiting new opportunities provided by the State and SJISD Board to create credit paths that break out of the traditional seat time age/grade model. Designed to make school structure congruent with the modern technical workplace, these include but are not limited to allowing students to challenge class content for credit, cross disciplinary classrooms utilizing collaborative learning teams, contract credit, and extended time blocks. Through these innovations the critical role of the Arts and Humanities in a technical society will be powerfully integrated into STEM and emphasized. Technical leaders have appropriately noted that technology is neither good nor evil. Its value is dependent on how it is used and limited. Today's children must be prepared to defend civil liberty and the quality of human life in an era of pervasive surveillance and digital algorithms of immense power. There has never been a more important era for students to be grounded in the Arts and Humanities, thus effective STEM programs are indistinguishable from effective Arts and Humanities programs.
Training - It is clear that the San Juan Island School District is highly successful by any traditional measure. Yet effective STEM lessons provide students with high level thinking challenges that cannot be accomplished through traditional lessons. This plan calls for educators to be trained in the techniques of collaborative learning, critical self-assessment, and other learning strategies employed by successful STEM educators. This training will be delivered peer to peer, via college level classes, and participation in regional STEM conferences. Further, District administrators will need to learn to recognize the attributes of effective STEM teachers to insure professional assessment supports accountability for STEM implementation.

STEM Program Management – The District Superintendent is responsible for overall Program Management of the District’s STEM initiative. The Superintendent will monitor and adjust implementation to insure budget, timelines and objectives are met and accountability is maintained.

Institutional Change - To insure that these changes become a permanent part of school culture, the Board must review and update relevant Board policies in support of the STEM initiative

This plan is bold, expensive, and innovative. Yet it relies on strategies, tactics and systems of accountability already proven by innovative schools nationwide. It begins the critical process of bringing the industrial school system of 1900 into alignment with the digital workplace of this century. For our students, and for our Republic, there is no more important work.
1.0 STEM Chair
The STEM Chair is a foundational element of our initiative. As we have stated, our goal is to embed STEM in every building and every classroom, and to educate in every classroom at the highest level of critical thinking skills. The Chair is responsible for both of these objectives.

1.1 STEM in Every Building and Classroom
We have already established Robotics and Automation as a district-wide STEM theme. The Chair will build on this by training staff for delivery of STEM content, creating and improving content for all classes, and building student proficiency and enthusiasm for STEM.
A starting point for these activities will be the formation of a new high school student organization, the Technology Student Association (TSA). This club, part of a nationally recognized and well respected student leadership organization, will be the focal point for outreach to other students, promotion of STEM in all buildings, and training of staff (see below). The Chair and TSA students will support and help promote the Robotics Clubs in every building by assisting the Club’s Advisors, creating promotional media, making presentations in advisories or in assemblies, and providing technical expertise. They will also work toward integrating other related activities into the robotics mission. For example, they will assist the Programming Club in the Club’s support of robotics and they will seek ways for our automation classes (otherwise known as Computer Integrated Manufacturing) to participate in the construction of robots. The Chair and TSA students will also ensure that every club participates in at least one ‘high stakes’ competitive event each year. These events make the club’s work relevant and increase the opportunity for publicity and promotion.
In a related activity, the Chair and his TSA students will promote, organize, and supervise an annual STEM Expo in each building. The Expo will evolve from the existing Science Fairs in the middle school and elementary school. At the high school, the Expo will be built upon Exhibitions night, the evening event where student work and projects are presented to the community. The Chair will continually examine the content of existing and proposed STEM classes to ensure the highest level of rigor is present while meeting appropriate industry standards. One way this will be accomplished is by pushing equipment and curricula down to lower grades from above. For example, next year our high school programming club will be working with Visual Basic. Once we are successful in the development of curricular material and student achievement, we will create a middle school programming club to focus on Visual Basic while the
high school club moves on to C++ language. We will also migrate equipment
down to younger students; we currently have a CNC mill suitable for a middle
school manufacturing class.
As our STEM clubs mature the Chair will explore creating a class to support the
club’s mission. For example, the Programming Club will become a Programming
Class when there are at least 20 committed and proficient participating students.
Finally, and vital to our long term goals, the Chair and TSA students will create a
training program for all teachers. Starting with the elementary school, they will:
- Expand and increase the rigor of robotics in all classes, grades K-6
- Assist in creating curricula for other grades around use of the 6th grade
  outdoor biology lab
- Explore use of a STEM theme, Island Sustainability as a vehicle for
delivery of additional STEM content
The Chair and the building principal would identify a STEM Teacher Leader who
would take a lead in assisting all other teachers in STEM integration. The Teacher
Leader would be supported by a stipend. The Chair, Teacher Leader, and
principal will also identify training packages and speakers who could further this
initiative. These will be deployed as appropriate.
1.2 Creating Learners with the Highest Levels of Critical Thinking Skills
To reach the top of the pyramid requires the highest level of critical thinking and
problem solving skills. The Chair will imbed this environment in his/her own
classes (below) and also in other classes through training instructors/teachers how
to recreate content for a STEM classroom.
The Chair, or a designee, will develop and teach the following classes:
SY 2014-15 21st Century Design (STEM Foundations I)
SY 2015-16 STEM Foundations II
SY 2015-16 Digital Images and Their STEM Applications
SY 2016-17 Intro to Tech (MS)
SY 2016-17 Digital Animation and Film Applications to STEM
SY 2017-18 Advanced Robotics and STEM Foundations III
SY 2018-19 STEM Foundations IV via Internships
Each of these classes will involve project-based learning. The projects will never
have a ‘right’ answer but will instead require an exploration of options,
alternatives, and innovations via an inquiry-based approach. The instructors will
teach through the process of guiding the students in inquiry and discovery. The students’ questions will most often result in another question from the instructor, not an answer. The students will quickly acquire the skills of independent learners. Key in this process will be critical self-assessment which requires students to issue and defend a self-determined grade to the educator(s) with grading authority. The skill of critical self-assessment is perhaps the most important skill for the modern workplace that schools are currently not providing.

This process will demonstrate to all staff and students the value of the inquiry-based approach via student demonstrations, student presentations, and student exhibits. The STEM students will visit each Advisory to personalize this interaction through presentation. By SY 2015-16 the Chair will start engaging specific teachers and coaching them in techniques to increase the level of inquiry. In SY 2016-17 the Chair will coordinate the first Friday Harbor High School Sustainability Week. During this week the entire school addresses one issue vital to our Island’s sustainability. Topics include Food, Waste, Water, Transportation, Energy, and Housing. Using “Food” as an illustration, the school would address the art of food, the cost of food, the carbon footprint of food, the energetics of food, the mythology of food, the science of agriculture (including GMO crops), and the history of food (perhaps relating to our genetic makeup). On the last day there is a symposium of presentations and analyses. Eventually, as the quality of Sustainability Week grows, the results are published online with video and are also made available on our local cable channel.

The expectation is that inquiry-based learning becomes the norm in each classroom by SY 2017-18 because of the demonstrable success in the Chair’s classes and the success of Sustainability Week. To ensure this level of success, there will be substantial staff training each year; this is reported separately under the Section: Training. In addition, there will be administrative expectations of staff acceptance and accomplishments in these areas. These are covered in the Section: Institutional Change.

1.3 STEM Chair Administrative Responsibilities
The Chair has significant responsibilities outside the classrooms. They include:

- Public Outreach/Communication
- Monthly press releases
- Maintenance of a website, Facebook page, and/or blogs
• Presentations/demonstrations at the Knowledge Bowl, the County Fair, and other large public events
• Creation and maintenance of a running, five year STEM Master Plan
• Coordination with Skagit Valley College for jointly offered classes
• Exploration of additional sources of funding including state and federal grants, corporate grants, and donations. Also exploration of significant fundraising opportunities, like manufacturing and selling a unique product
• An annual presentation to the donor groups followed by a written report detailing accomplishments and next year goals including anticipated budget requirements
• Development of ‘shoulder classes’, a small group of students studying a STEM topic independently, but shouldered against another class – for example Technical Writing shouldered against an English class
• Mining the vast human resources available in our community and a constant openness to including these resources in our educational programs

2.0 Cultural Changes

The Cultural Change described in the Executive Summary requires administrative support (described in the Section: Program Management) and training of staff (described in the Section: Training). This section will describe the third leg that supports the overall cultural change - curricular changes. Curriculum is the content being taught, but it also relates to the credit earned. We believe the latter is ready for reform and the following provides structure for this change.

2.1 Extra Curricular

We use the extra curricular option to explore student interest in new classes. We currently have extracurricular robotics clubs in every building and the intent is, as interest grows, the clubs will convert to classes. Similarly, we are launching a computer programming club in SY 2013-14 for which we have a similar plan. Other STEM-related clubs will follow. Candidate clubs include film making, animation, video game design, and 3D art. The challenge with clubs, however, is their limited entry; students with other after school activities (such as sports) often cannot participate. This is why we seek to move the activity to the school day as soon as practicable.
2.2 Curricular Content
As mentioned elsewhere, inquiry-based education is our overarching goal. This will require a significant change in the content and the delivery. Training for the adjusted delivery is presented in the Section: Training. The STEM Chair will be responsible for assisting the teachers in adjusting their content to inquiry-based, as described in the Section: STEM Chair.

2.3 Credit
STEM dictates there should be substantially more flexibility in how students earn credit. The idea that students only earn credit after there is a record they sat in the class for 90 hours is so archaic that it can’t be defended. Instead, we will develop a credit system that honors their accomplishments and proven attainments. Students should be allowed to challenge for credit by taking a test, submitting best work, or presenting an oral defense. A defense panel, much like a thesis defense in graduate school, would be assembled to view the evidence and make a decision. The goal should NOT to be to keep a student in school for 12 years but to help them move on and move up as quickly as possible. The fact that there are financial implications to a school district’s funding is unfortunate, but no excuse. Students should have the ability (if they desire) to create their own, custom classes that meet their personal goals. Basically, each student should have an individualized education plan that incorporates classrooms, online instruction, internships, and custom classes. A panel of teachers, administrators, and students would review and approve these classes. Can you imagine how cool Senior Exhibitions could be?!

2.4 Cross Crediting
As we develop STEM classes of increasing sophistication and depth, the STEM Chair will explore with other departments the concept of allowing the STEM classes to meet graduation requirements other than elective. For example, a CAD class, perhaps with some added requirements, could meet a math graduation requirement. A manufacturing CNC class could possibly meet a science credit. This ‘cross crediting’ might also require the cross credit students to do some additional study and pass some additional testing. Again, the goal is knowledge and skill, not seat time.

2.5 Joint Classes
Sometimes called team teaching, this concept would allow two classes to work together on joint projects. This would be a valuable addition to our inquiry-based
approach in that it represents the beginning of a truly interdisciplinary approach to education. For example, the calculus and physics classes could jointly pursue the application of centroids to sailboat design. They could even build models and test them in our wind tunnel.

3.0 Training
STEM Training will drive the transformational change required to bring the classroom experience of the student in line with the contemporary technology rich cooperative workplace and public sphere. Through training, STEM is embedded in the methodologies of every teacher, teacher evaluator, and paraprofessional. The change in how learning is delivered will be profound and essential to reaching our goals.

3.1 Technical Fluency
SJISD educators range from enthusiastic technology experts to hesitant beginners. We have a good and growing inventory of technical learning tools. In order for STEM learning to succeed, every educator must be confident in the use of the same technology their students will use. This includes understanding the basic function, troubleshooting, maintenance and safety.

3.2 STEM Methodology
A traditional methodology supports individual students working alone and silently in competition with fellow learners. A STEM methodology supports students working on learning products cooperatively in teams - sometimes in competition against other groups. A STEM lesson will be filled with the murmur of productive dialogue.

A traditional methodology supports learning through teacher centered delivery of content and processes and predetermined questions and outcomes. Student success is measured through performance on predetermined assessments with single correct answers. Assessment tools are often secure in that students do not know ahead of time exactly what the assessment will be. By its nature, traditional methodology cannot support or reward higher level thinking. STEM methodology supports student centered learning by engaging high level challenges to which multiple correct answers are possible. In a STEM lesson risk taking is valued. Students can, through critical self-assessment, outline what was learned and justify a high grade through a failed attempt at problem solving.
Conversely, a team of students who are successful but cannot critically self-assess the concepts and processes synthesized and applied may find they have a lower grade.

Many SJISD educators will need significant support in learning how to lead a STEM lesson. Every teacher should know:

- How to set up and manage learning groups of various sizes
- How to teach students the roles and responsibilities of learning group members
- How to manage a classroom in which students are talking to each other and freely moving while engaged in problem solving
- How to lead students in reflection and critical self-assessment

3.3 STEM Teacher Evaluation

A teacher evaluator observing a STEM lesson will need to learn and apply a completely different rubric for excellent teaching. Traditional clinical evaluation calls for the evaluator to write in great detail the exact behavior of the teacher. Yet, on day two of a stellar STEM lesson, the teacher may spend almost all the time in silence, simply moving about monitoring the cooperative groups engaged in their work. At the same time, the student noise level, while less than a lunchroom will be more than a traditional lesson. Students will occasionally get out of their seats without permission and move about, checking with other groups or getting materials. By the standards of traditional clinical observation, this is a failing teacher not doing anything. A teacher evaluator in a STEM classroom will not be able to observe and assess discrete content delivery as STEM lessons are cross disciplinary. The evaluator will simultaneously observe students applying artistic values, math concepts, scientific processes, and historical lessons. Speaking, listening, writing, reading and calculating will be fluid and constant.

Teacher evaluators will need to learn how to assess a STEM lesson including:

- How to focus on student engagement and performance rather than teacher behavior
- How successful STEM classroom management skills allow the teacher to step back out of the way
- How to engage the teacher in critical formative self-assessment of the STEM lesson
- How a successful or deficient STEM teacher would be recorded in the state required paperwork
3.4 Delivery
Delivering training to SJISD staff will require application of multiple strategies:

- Identification and utilization of in-house experts in tools of technology, cooperative learning and cross disciplinary teaching for peer to peer training
- Use of outside experts in providing mandatory on-island training and providing attendees with clock hours or credit
- Follow up through assessment to insure the new skills are being applied
- Funding attendance at STEM regional professional conferences for all certificated staff

3.5 Timeline
During the initial five years, training costs will be high and then drop off significantly as all staff become fluent in STEM literacy. After the initial training is complete, needs will be reduced to supporting those new hires not already STEM fluent and funding attendance at the STEM conference in Wenatchee. The five year plan funds in each year:

- Three certificated in house experts to train certificated and paraprofessional educators, to orient other district staff to the STEM initiative, and guide student to student cross age teaching and learning
- A university level class for every certificated teacher every year covering methodology for cooperative learning, critical student self-assessment, high level project based learning, and strategies for performance based credit rather than seat time based credit
- Time and support every year for district administrators to consult with proficient STEM administrators regarding professional assessment and accountability for STEM teachers
- Funding every year for ten certificated staff to attend the annual Washington State STEM Conference in Wenatchee

4.0 Program Management
The long term viability, quality and sustainability of any organization is rooted in its ability to continually change, grow and reinvent- or in a single word adapt. In the case of STEM, we are asking our entire school district to adapt its educational processes to the current marketplace. Although to a person, everyone would agree moving to a STEM based curriculum is an imperative, change is often hard and does not happen by itself. These changes will require both the commitment
of District’s board, administration and teaching staff. In many cases our teachers will not know how to make these changes on their own, nor will all implementations will go smoothly or yield the desired results. Imbedding long term program management oversight into the STEM program will ensure the investments made in years 1 through 5 of the initiative will not be lost to due to a lack of root cause analysis, corrective action plans and best practice integration. The two truest phrases ever uttered in support of program management are: 1) you get what you inspect, and 2) if you budget for it, you value it.

Overall Program Management of the STEM Initiative within SJISD will lie with the District’s Superintendent. This individual will be held accountable to the District’s board on all aspects of the business plan/project plan.

Program Management of the STEM initiative will include, but not be limited to the following:

- Public Outreach/Communication Plan – Apply various methods to educate all stakeholders including students, parents, community, government/legislative agencies
- Educational Partnerships – Develop and grow both public and private partnership within the educational, business, and government/legislative communities at a local, regional, state and national level
- Funding – Work to ensure all viable grants and funding avenues are explored to continue to support and grow the STEM program
- Sustainability Planning – Develop and maintain Master STEM Strategic Plan
- 5, 10, 15 year rolling plan
- Develop survey/review processes to evaluate quality and effectiveness of training, curriculum and communication delivered to all stakeholders
- Develop Root Cause Analysis/Corrective Action Plan reviews of successes and failures
- Best Practice Integration – Import “Best Practices” in curriculum, training, technology through networking with mainland STEM programs on a regional, state and national level
- Accountability/Program Guidance
- Regular status reports/program reviews to the SJISD Board
- Develop method to survey SJISD alumni on STEM curriculum skills in the post-graduation workplace and/or higher education
- Ensure STEM integration into new teacher review process
• Intellectual Property – Package curriculum, training and communication as SJISD intellectual property when appropriate

Long-term success and sustainability of STEM will be driven by the District’s Superintendent. The STEM Chair, School Board, Principals and CTE Director will play significant supporting roles. In the final analysis the District’s Superintendent will own STEM as a primary job responsibility.

Success and sustainability of the STEM program will be the result of a dynamic plan comprised of actionable tasks and measurable results guided by the program management mantra – plan, do, check, adjust.

5.0 Institutional Changes in Support of STEM and Sustainability

Institutional change is defined as assessment and modification of the controlling institutional documents and practices that direct our behaviors as citizens and professionals. They include a wide variety of federal, state, and local constitutions, laws, policies, procedures, and practices. While federal and state institutional changes to educational law and practice are critical to the success of the STEM initiative, the focus of this document will be the San Juan Island School District. Further, this document addresses only those policies and practices germane to the implementation of the business plan. The budget impact of these policy and procedure changes will appear in other sections of this plan. They are included here as a reference to the work the SJISD Board should do in support of the STEM initiative.

Our current school system has remained essentially unchanged since about 1907, and there is immense inertia to overcome in moving schools into the current century. There is a strong impulse for successful reform initiatives to revert to the industrial school model when key people leave or funding disappears. It is clear that formalizing the San Juan Island School District commitment to permanently implementing STEM and its associated high level learning is critical for the long term success of the initiative. Through policy, STEM and its associated reforms will become part of the District identity and could only be abandoned through modification of Board policies and procedures in a public meeting.
Areas for policy and procedure modification include but are not limited to:

5.1 Revised Credit Policies

Board policies in support of the recent State directive to allow students to challenge high school classes for credit can be a significant tool in providing high school students time and space in their education for immersion in STEM learning. Policies and procedures for expanded project based learning for credit will insure that this significant change will maintain the high standards and expectations at Friday Harbor High School. Policies and procedures for cross disciplinary credit classes will allow innovative combinations of students and teachers impossible to implement at this time.

5.2 Assessment and Evaluation

Policies should define how student accountability will be maintained K-12 when learning through high level challenges. Specifically, Critical Student Self-Assessment must be used when there are many possible outcomes to the learning. Policies should direct administrative staff to clearly define criteria for teachers to meet when being evaluated while teaching high level STEM lessons. Specifically, what should the classroom look like, sound like, and what student and teacher behaviors should be seen?

Policies should be developed to allow the hiring, through personal services contracts, of island based STEM professionals as guest teachers under the direct supervision of certificated staff. The board should examine procedures and support for using existing state provisions regarding certification of teachers as highly qualified, especially National Board Certification in STEM fields.

5.3 Curriculum

Policies and procedures should be developed to allow teams of educators to propose and have considered innovative modifications of times and spaces for STEM learning. While maintaining student accountability for critical concepts and processes, these innovations should result in a school space that looks and feels more like the modern work place with students simultaneously involved in a broad range of disciplines in the presence of teachers from different fields and organized in work teams that resemble those in the modern workplace. Policies and procedures should be written to support project based learning K-12.
The board should direct staff to include STEM learning in current efforts to align the K-12 curriculum. Work based learning, currently used by only about 10% of high school students, should be promoted by board resolutions affirming the importance of work based learning for students committed to professional specialization.

5.4 Partnerships
As it has been noted throughout this document, partnerships are an important component to the success the STEM initiative. To support and foster external partnerships the District’s board should:

- Evaluate the utility of interagency agreements with other educational institutions to maximize STEM opportunities for our students. These would include but not be limited to Skagit Valley College and surrounding school districts
- Develop policies and procedures to define for island service clubs how to form permanent partnerships with the District in support of STEM
- Develop policies and procedures to define for island corporations how to form permanent partnerships with the District in support of STEM
- Support aggressive grant writing through the district budget
- Develop policies and procedures for implementing a strong public relations initiative for STEM and the District