A MAKERSPACE DEVELOPMENT PLAN TO EXPAND, ENHANCE AND SUPPORT 21st CENTURY JEWISH EDUCATION.

JCDS MAKERSPACE DEVELOPMENT PLAN

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ABSTRACT

Jewish Community Day School (JCDS) is a pluralistic Jewish day school in the Boston area welcoming children of families from all Jewish traditions and backgrounds. JCDS cultivates knowledgeable, passionate Jewish learners with the capacity and confidence to question, listen, understand, and change the world. JCDS nurtures each student's capacity for intellectual discovery and decision-making while giving our graduates the ability to create their futures informed by Jewish values, texts and culture, and to make a difference in their communities and in the world. In this spirit we are embarking on a new initiative that will establish a “Makerspace” at JCDS with a focus on the development of new mindsets and skill sets in the areas of computing, science and engineering. The initiative will also develop and support teacher capacity to deliver new Makerspace activities such as computer coding, electronics, engineering design, robotics and more in their classrooms.

A Makerspace is a place that allows children and adults to create, develop, discover, investigate, pursue and understand new ideas and skills through coding, making, inventing and tinkering with computers, tools and machines.[1] “Making” can make complicated engineering, math and science concepts understandable to younger children and introduce older children to previously unknown topics or careers.[2] The JCDS Makerspace will feature a variety of computers, computer-aided machines, materials, high/low tech tools and other resources focused on developing a wide variety of knowledge and skills. Students will use computers for coding and design, including generating ideas, testing theories, collecting data, creating innovative artifacts and/or solving authentic problems. New applications and environments for using computers together with a variety of resources and tools can ensure students develop the knowledge and skills needed to succeed in the world of tomorrow. Transferable skills such as communication, collaboration, creativity, computational thinking, design, invention and problem solving will be developed through a variety of Makerspace project activities. In the JCDS Makerspace students will be able to pursue projects across a broad range of topics based on both curriculum-related and personal interests while developing transferable skills that will foster better understanding across the curriculum in Jewish Studies, Humanities, Math, Science, Art, Music and more.

Initial funding for the JCDS MakerSpace initiative is being provided through a legacy gift from Rose-Jane Sulman in honor of her husband David Lear Sulman. David was an electrical engineer who studied at the Massachusetts Institute of Technology for many years including doctoral course work after earning a master of science degree in electrical engineering in 1969. He spent his entire career at Teradyne Inc., a leading supplier of automation equipment used to test data storage, semiconductors, wireless products and complex electronic systems for consumer, industrial, and government applications. David was also a patent holder who viewed his work as a creative endeavor in the design and development of processes and systems for testing semiconductors. In keeping with the legacy of David Sulman, JCDS is embarking on a unique Makerspace initiative in the context of Jewish Education. Through this initiative we hope to better prepare our students to meet the challenges and opportunities of the future so that they too can become leaders of our 21st century technological society.

JCDS MAKERSPACE MOTIVATING RATIONALE

According to recent reports from both the National Academy of Sciences and the World Economic Forum, humankind is in the midst of an industrial revolution that is unlike any previous revolution in scale, scope and complexity. This “Fourth Industrial Revolution” is evolving at an exponential rather than a linear rate as it builds on digital technologies in a transformative way while impacting whole systems across countries, organizations and societies. The convergence of new technologies and systems across biological, digital and physical domains is already having a broad and disruptive impact on existing businesses while creating whole new industries and sectors. Evidence of disruption can already be seen in automotive, bioscience, education, data science, finance, hospitality, manufacturing, medicine, privacy, communications and more. As advances in Fourth Revolution technologies such as Artificial Intelligence, Autonomous Vehicles, Genetic Engineering, Additive Manufacturing, Advanced Robotics and Augmented Reality become more widely accessible, disruption and opportunities are also becoming more widespread.[3] At the same time, students and teachers now have mobile computer devices in their pockets that would have been considered “supercomputers” just a few years ago.[4] Together with the Internet and the World Wide Web (WWW), computers and mobile devices have “connected” more than half of the world while bringing rich digital content and engaging media to our fingertips.[5] Education and learning opportunities are no longer limited to the classroom or school as individuals and organizations of all types develop and deliver rich learning opportunities both in person and online.[6]

The JCDS Kindergarten Class of 2023 will be the high school graduating class of 2035 and these same students will reach their 30’s by the early 2050’s. What will the world of 2035 or even 2050 have to offer these students, what new problems, human needs and technologies will greet these students and their families. Based on what we know about the 4th Industrial Revolution and the emerging technologies of today, we can be certain that the world of 2050 will be very different from the world of today. As emerging technologies proliferate across the physical and biological realms, their impact on life and our planet will increasingly require humans to confront significant ethical and moral dilemmas. What knowledge, skills and abilities will students need to succeed and prosper as contributing members of the Jewish and global community of 2050? There is wide consensus amongst a variety of education, government and business leaders that the 21st century will require skills and abilities beyond the 20th century skills of reading, writing and arithmetic. Competencies such as creativity, critical thinking, communication and collaboration have been identified as essential skills of the 21st century.[7] Along with these new skills new learning environments are needed to extend teaching and learning while providing opportunities for students to explore and utilize a variety of traditional and emerging technologies. A JCDS education has always provided a historical Jewish context and Jewish Community for developing 21st century skills together with an ethical and moral foundation. As students navigate the world ahead of them it will be increasingly important for them to draw guidance, inspiration and understanding from their Jewish education as they confront the challenges and opportunities of the future that awaits them.

JCDS MAKERSPACE PEDAGOGY & PHILOSOPHY

The major outcome of the Makerspace initiative will be the establishment of a new Makerspace and project-based learning laboratory at JCDS. JCDS students and teachers will have access to the Makerspace throughout the day and after school including both scheduled and free time to work on class assignments or independent projects of choice. Project based learning will be the primary instructional strategy employed in the Makerspace. Project based learning is a research based strategy for engaging students in inquiry and problem solving while creating work that is substantial, meaningful and shareable.[8] Project based learning can also connect classroom curriculum topics to activities in the Makerspace so that students gain deeper understanding or explore a topic further based on their own particular interests or skills. The Makerspace will be a vibrant laboratory for the exploration of computing, physical science and engineering while giving both students and teachers opportunities for deeper levels of teaching and learning than are typically possible in the regular classroom.

The JCDS Makerspace will feature a variety of computers, computer-aided machines, materials, high/low tech tools and other resources focused on developing knowledge and skills across broad areas of computer science, physical science and engineering. In the spirit of a Makerspace students will be able to pursue projects across a broad range of CSE topics based on both curriculum-related and personal interests. A “makerspace” is a place that allows children and adults to create, develop, discover, investigate, pursue and understand new ideas and skills through coding, making, inventing and tinkering with computers, tools and machines. “Making” can also make complicated engineering, math and science concepts understandable to younger children and introduce older children to previously unknown topics or careers.[9] In the JCDS Makerspace students will use computers for coding and design, including generating ideas, testing theories, collecting data, creating innovative artifacts with media and/or solving authentic problems.[10] Students will have access to new computer assisted machines and processes such as 3D printing, 3D precision laser cutting/shaping, 3D scanning, and computer controlled machining. Additional resources will include Arduino programmable electronics prototyping boards, soldering stations and a variety of electronic components for creating robots, programmable devices and wearable electronics. To facilitate teaching and learning in some of the targeted physical science and engineering subjects, comprehensive curriculum resource packages such as LEGO© Robotics, Kinderlab© KiBo, Thimble© and/or other science/technology kits that include materials, parts, computer components, instructional materials will be available for use in the lab and/or for use in the classroom.

An important aspect of the JCDS Makerspace is the use of alternative assessment practices such as Badges and Portfolios to recognize student achievement and document student skill development. A Makerspace Badge will be an indicator of an accomplishment or skill attainment that can be displayed, accessed and verified both in digital and physical form. Digital Badges are one form of digital credentials such as certificates, diplomas, or any other form of paper credential in a digital format.[11] Digital badges are increasingly being used across a spectrum of industries and education institutions for students, teachers and employees. Physical badges can also be created using simple badge making tools to create badges that can be pinned to

backpacks or clothing. Physical badges can also be made using more complex technology such as computer controlled embroidery sewing machines that can sew multi-colored badge images onto different types of fabric, garments or accessories. Portfolios are another form of alternative assessment that can be used to document skill development and compile an ongoing record of student projects. Google workspace provides a number of options for the development of student portfolios. From a Google site or simply a Google drive folder students can create a photo and video record of the projects they have completed in the Makerspace. JCDS Makerspace Badges and Portfolios will be used to validate student achievement and demonstrate skill attainment across grade levels and projects in the JCDS Makerspace.

JCDS MAKERSPACE FACILITY

Recent research suggests that the interaction of Pedagogy, Space and Technology constitutes an “Active Learning Ecosystem” that can address and support learners in a classroom space. Active Learning Ecosystem is a holistic approach to the classroom environment that requires consideration of teaching, classroom layout, furniture, learning modalities and technologies for teaching and learning.[12] A Makerspace can embody the principles of an Active Learning Ecosystem unlike any other classroom space in a school. Makerspaces typically encompass a variety of spaces to facilitate the use of both traditional tools and digital technologies. Makerspaces also require various spaces to facilitate the phases of student projects from conception to design and fabrication. The JCDS Makerspace will encompass the following areas to facilitate Project Based Learning from design to fabrication. Table 1 below describes the Makerspace areas and their use for individual and group projects.

TABLE 1: JCDS MAKERSPACE FACILITY AREA DESIGNATIONS & DESCRIPTION

AREA	DESCRIPTION
Design & Planning	A design and planning area where students can work individually or in small groups can be incorporated into the instructional area or set apart away from the larger instructional area. Comfortable chairs, whiteboard and tablets or computers can also be integrated into the design and planning area for student use.
Electronic Assembly	Electronic assembly and soldering stations should be considered to facilitate ease of use and fume extraction. Typically these types of workstations utilize taller benches with stools as opposed to chairs and tables, and also provide access to electronic assembly tools and soldering equipment with fume filtering systems..
Fabrication Area	An area with sturdy workbenches is needed for fabrication and assembly of student work. The benches should be stable and adjustable in height so that they can be adjusted as needed for students from different grades.
Instructional Area	An instructional area for class and small group lessons made up of

	small tables or a large conference table together with a screen, whiteboard and projector are needed to facilitate both teacher lessons and student presentations.
Machine Area	The machine area is where the stationary power tools and CNC machines should be located. It should incorporate electrical connections with an emergency shut off switch that would cut power to all machines in the event of an emergency. Vacuum systems, first aid stations and safety systems should also be considered as appropriate.
CNC Machine Area	A variety of Computer Controlled Machines (CNC) such as a 3D Printer, Laser Cutter, Vinyl Cutter and CNC Router can all be utilized in a Makerspace. Budget, space, student age and project requirements should all be considered when determining which CNC machines are appropriate for the JCDS Makerspace.
Project Storage	Storage for projects both small and large is needed in the Makerspace. Each student should have a container for storage of small project components and personal items such as safety glasses, pencils and sketch books. Larger projects can be stored in a communal area that is accessible to students either in cabinets or on open shelves either in or adjacent to the Makerspace.
Supply Storage	A variety of open and closed shelving and cabinet units should be considered for storage of student project supplies. Some supplies may need to be kept in secure storage to limit student access and others can be left on open shelving or cabinets that students can access as needed.
Tool Storage	A variety of tool storage options should be considered for the JCDS Makerspace. Some tools can be stored in the open on a pegboard or in a cabinet near where they will be used. Other tools will require secure storage if these tools are intended for older students or if they must be used with teacher supervision. Mobile storage carts are also a good solution for tool storage in that they can be moved around the Makerspace to different areas as needed.
Safety	To ensure a healthy and safe Makerspace requires a number of considerations. In particular the issue of air quality and fire or safety hazards need to be considered. Items such as air filtration, fire extinguishers, vacuum systems and emergency shut off of the electrical system should all be considered when planning the makerspace.

JCDS PROFESSIONAL DEVELOPMENT

A key element for the success of the JCDS Makerspace initiative is a comprehensive professional development (PD) and support plan that is intensive, ongoing and connected to the teaching of Makerspace related content.[13] Research suggests that PD is most effective when it focuses on learning specific subject matter and allows teachers to do the “hands on” work required to build content knowledge and teaching expertise.[14] Teachers will learn to use a variety of computing devices, APPS, tools, materials and machines in the context of Project Based Learning to facilitate student work in the Makerspace. Summer professional development sessions will introduce teachers to new Makerspace related topics and practices in the context of the applications and resources that they will be using in the Makerspace with students. Teachers will be engaged in activities such as coding, creating, design, programming and tinkering with a variety of devices, materials and tools so that they gain a deeper understanding of how to teach these skills to students. The sessions will be tailored to the subject specific interests according to the needs of the different grade levels. Monthly ongoing sessions can also provide teachers with additional support including mentoring and modeling as they implement new instructional practices and engage students in the new learning environment the Makerspace. Monthly ongoing coaching sessions can provide teachers with additional support as they implement new instructional practices and engage students in the new learning environments. Coaching is one of the most powerful and effective methods of transforming teacher practice. In addition, coaches that support teachers in using technology for student learning can lead to increased impactful use of technology by students and increased student engagement and learning.[15] The JCDS Makerspace can create an effective teacher community of practice while also developing teaching content knowledge and Makerspace related pedagogy skills. As a result of participation teachers will develop confidence and capacity with new instructional resources in the Makerspace to enhance teaching and learning and to support one another throughout the school.

JCDS MAKERSPACE DEVELOPMENT GOALS & ACTIVITIES

Over the next two years JCDS will develop and implement a comprehensive Makerspace development plan that will provide the environment, devices, resources and systems to develop 21st Century skills across all grade levels. A multifaceted plan is proposed that will facilitate the development of the Makerspace environment together with the implementation of new instructional content in Computer Science, Physical Science and Engineering and with the professional development of teachers that will facilitate a project-based model in the Makerspace. CSE related subjects and activities will be identified and incorporated over a two year period in accordance with the Development and Timeline that are identified in Table 2.

TABLE 2: JCDS MAKERSPACE DEVELOPMENT & RELATED ACTIVITIES	'22	'23
1. Development & Planning: Develop and implement a plan to create the JCDS Makerspace and integrate it into the daily activities of JCDS students and teachers.		
● Create the JCDS Makerspace Development Plan to facilitate the development and implementation of the Makerspace at JCDS.	X	
● Form a JCDS Makerspace Development team including administrators and teacher representatives from lower and upper grades across academic disciplines and grade levels to guide the MAkerspace development.	X	
● Create a Makerspace Development Budget to outline costs associated with the conversion of the cafeteria, the purchase of furniture and equipment, and the professional development of teachers.	X	X
2. Makerspace Facility: Reimagine and redesign the existing cafeteria space into a Makerspace to support 21st century project based learning.		
● Develop a floor plan for conversion of an existing cafeteria space into the JCDS Makerspace and project based learning environment.	X	
● Remodel cafeteria space to accommodate/include air filtration, additional electrical outlets, storage, safety and .	X	
● Identify and purchase appropriate student furniture to accommodate individual, small group and whole class project work and instruction.	X	
● Identify and purchase appropriate storage furniture to accommodate storage of supplies and student projects.	X	
3. Makerspace Resources: Identify, purchase and deploy a variety of machines, tools and resources needed to populate the JCDS Makerspace.		
● Identify and purchase appropriate hand and power tools, and equipment to accommodate a variety of materials and processes.	X	
● Identify and purchase appropriate computer coding/robotics platforms such as LEGO© WeDo, Mindstorms, Thimble© , Kinderlab© KiBo or other kits that can be used both in the lab and classroom by students and teachers.	X	X
● Identify and purchase Computer Controlled Machines such as 3D Printer, Laser Printer, Vinyl Cutter and others as appropriate.	X	
● Research and Identify grade level appropriate Computer Science, Physical Science and Engineering related topics, activities, projects, technologies and practices that can be delivered/supported in the Makerspace.	X	X

4. Makerspace Assessment: Develop Digital/Physical Badge assessment system for implementation in the JCDS Makerspace program.		
● Design a Makerspace Badge prototype that will serve as the “Badge Master” for all Makerspace Badges.	**X**	
● Identify various Makerspace activities that are appropriate for designation as Makerspace Badge Activities.	**X**	
● Develop the first iteration of the JCDS Makerspace Badges for piloting during the ‘22/’23 school year.	**X**	
● Modify JCDS Makerspace badges based on pilot results.		**X**
5. Professional Development: Provide summer and school year professional development opportunities and ongoing support for teachers and staff.		
● Develop and deliver summer institute to participating teachers and staff in Makerspace technology related pedagogy to build teacher capacity in project based learning for the new Makerspace.	**X**	**X**
● Provide ongoing monthly professional development and support both online and in the classroom throughout the academic year in the use of various Makerspace technologies for teaching and learning.	**X**	**X**
● Identify and provide specific subject/grade level professional development opportunities for participating teachers and staff.	**X**	**X**
6. Makerspace Evaluation: Embed assessment and evaluation activities into development and implementation process to measure initiative effectiveness and modify proposed plans to ensure satisfaction and success for students, teachers and parents.		
● Identify measures of assessments such as student subject matter interests and achievement to serve as benchmark comparisons for pre-post initiative implementation.	**X**	
● Develop and implement pre-post surveys and focus groups with students, teachers and parents to measure satisfaction with Makerspace Activities..	**X**	**X**
● Review and Modify JCDS Makerspace plan based on feedback and evaluation results.	**X**	**X**

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