Lake Washington Schools Foundation

ENRICH ENGAGE EMPOWER

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Reaching for Success Grant Application 2014-2015

To ensure ANONYMITY during the selection process, do not include the name of your school, teachers, principal, school mascot, or any other identifying information in this part of the application.

PROJECT DESCRIPTION

Grant Title (8 words or less): 3D Printer for Design and Modeling Curriculum support

1. Summary

As part of the new Gateway to Technology "Design and Modeling" curriculum, students learn how to design and create three-dimensional (3D) models in classroom computers. By incorporating 3D printers into the classroom students would be able to not only imagine and design 3D models on their computer, but to achieve a higher level quality of work, creating structurally sound designs that correctly translate to the real world.

The production of physical models allows students to experience the complete engineering design process, from sketching and planning, to 3D modeling on the computer, to creating real life object and then testing them against their designs.

Student learning is increased when they can see and feel the consequences of their designs, and how what they designed is translated to real world objects.

Estimated number of students participating/affected 240 Grade level(s) 7 and 8

2. Continuous Improvement Process (CIP) Goal

CIP GOAL: Support math goals by demonstrating the need for applied mathematics when trying to achieve collaboration goals. Allow students to see the need for accurate dimensioning and calculations so that the design may be accurately assessed in order to complete their collaboration process. Without accurate designing, dimensionin, and calculations, student would not be able to make a proper assessment.

Printing their design would allow students to self-evaluate their design, as a three-dimensional model would clearly show the accuracy of their engineering process from initial designs and sketches, to mathematical calculations and use of measurements in a way that cannot be fully appreciated in a two-dimensional display such as a computer screen or a drawing. In addition students see applications for 3D modeling in the engineering process outside of the computer, from manufacturing, to structural design, and artistry.

3. Project Description

The Design and Model class is new to our middle school this year. We intend to evolve the class over time and grant students greater access to advanced skills like printing their 3D models that are created on the computer. Some curriculum must be changed to better accommodate the 3D printing process.

In order to fully realize the engineering and design process, students should be able to see their projects come to life. By using a 3D printer students can see and physically exam their designs, thereby improving their design process and design accuracy over time. Instead of only creating 1 or 2 large projects over the course of a semester as the class is currently structured, with a 3D printer, students can create smaller projects, print them, then improve their design and reprint them in order to compare them to the original. Basic calculation errors which may otherwise be obscured by the computer design process will be made obvious when the object is printed.

The development of engineering and design skills are a key element in preparing students for college and careers in science, technology, engineering and math. These hands-on experiences help better engage students who may otherwise may be less engaged with a purely computer generated model, and students can see connections between computer generated design and careers that depend on this iterative design process of printing a model, improve the design, then reprinting a model.

4. Project Significance

The Puget Sound area is rich in career opportunities that increasingly reward a higher level of computer skills. An increasing number of companies in the manufacturing, medical and game industries rely on 3D Designs for their projects. Everything from toy manufacturing, to wing integrity on an airplane, to the artistic feel of a computer mouse, make use of three-dimensional modeling and printing today. Introducing and familiarizing our scholars from a young age to the engineering process will encourage them to later on pursue careers in STEM (Science, Technology, Engineering and Mathematics) areas, spark the entrepreneurial spirit in knowing it is possible to bring their vision and design to a physical object, and provide our local industry with qualified workforce in high-skilled jobs.

5. Project Resources

The use of a 3D printer, vs traditional models, would allow students to create more complex designs, which due to time constrains, would not be possible otherwise, thus making a better use of instruction time.

The printer model selected is part of the equipment approved by the district, and will be supported and maintained accordingly.

Beyond purchase and install of the equipment, the school will need to fund plastic filament stock for the printing of models which is expected to be covered by the school and associated lab fees for the class, year over year.

Both our school and our PTSA have scholarship funds to cover lab fees for those students that cannot afford them, so that every student in grades 7 and 8 will have access to these classes, regardless of ability to pay.

6. Project Evaluation

3D printing will be integrated into the curriculum over time. In the first year, at least one project by the students will be printed on the 3D printer, with additional printings opportunities made available as the curriculum is evolved.

The first measure will be done by student feedback via a survey after each printing to evaluate the effectiveness of seeing their 3D model printed.

Questions will include:
How close was your computer design to the results obtained when printing your 3D model?
Very close/Somewhat Close/Not even close
How would you improve your design based on the result of your 3D printed model?

In the second measure success will be determined by the quality of the designs that students produce after their first experience with the 3D printer. Subsequent projects in 3D modeling on the computer should show greater accuracy in measure and form, and realism in design after seeing how critical those steps are to producing a viable printed model. This will be evaluated by tracking Student competencies against the design rubrics in subsequent projects.

7. Community Awareness of the Lake Washington Schools Foundation

The school will recognize the Foundation by doing the following:

- Written acknowledgement to the Foundation for their funding of this program, sent to all parents along with Foundation fundraising materials in the Fall.
- Press release, sent to our school community via newsletter and local newspaper.
- Public acknowledgement of the Foundation during Curriculum Night in the Fall.
- Mounting an exhibit of 3D Models at the end of each semester, prominently displaying the Foundation's Logo and their role in making 3D models possible.
- A selection of 3D Models could also be made available for display at the annual Foundation Luncheon.

8. Instructional Materials and Technology Requests

If you are requesting curriculum materials, have these materials already received Instructional Materials Committee (IMC) approval? (if repeat grant, prior approval?) Yes ☐ No ☐ N/A ☒ Pending ☐

If you are requesting software with curriculum content, has this software already received IMC approval? Yes ☐ No ☐ N/A ☒ Pending ☐

If you are requesting software for production purposes only, has this software been approved by LWSD Technology Support? Yes ☐ No ☐ N/A ☒ Pending ☐

If you are requesting hardware such as a digital or video camera for use with a specific project, have you confirmed that the hardware has been approved for use with the LWSD computer system and that technical support is available for that item? Yes ☒ No ☐ N/A ☐ Pending ☐

9. Project Personnel

[redacted], Computer Applications teacher

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TIMELINE

STEP	DATE
Submit Disbursement of Funds Request	07/01/2014
Equipment and supplies purchase order placed	07/01/2014
Equipment installation and testing start, completion before school year begins	08/01/2014
Lesson plans to include 3D model making and testing update completed	09/01/2014
First quarter project design, evaluation and testing completed	11/05/2014
Second quarter project design, evaluation and testing completed	01/20/2015
First semester projects display in school library	01/25/2015
Third quarter project design, evaluation and testing completed	03/01/2015
Fourth quarter project design, evaluation and testing completed	05/28/2015
Second semester projects display in school library	06/01/2015
Complete and submit project evaluation to the Lake Washington Schools Foundation office.	06/08/2015

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BUDGET REQUIREMENTS

ITEM	COST	FUNDING SOURCES Lake Washington Schools Foundation, LWSD, PTSA, Building, etc.
MakerBot Replicator 2X and MakerCare Repair Kit *(www.makerbot.com/replicator2x)*	**$ 2,808.00**	Lake Washington Schools Foundation
Plastic filament for 600 models	**$ 602.00**	• Lab fees paid by parents • Fee scholarships from school/PTSA scholarships funds available
Sales Tax, if applicable	x **338.02**	Equipment - PTSA: $274.29 Consumables - school: $63.73
Shipping Costs, if applicable	x **129.08**	Equipment – LWSF: $79.30 Consumables – school: $49.78
Total Cost of Project:	**$ 3,877.10**	
Total Amount Requested From The Foundation:	**$ 2,887.30**	

Please check your numbers and make sure all totals are correct.

CIP Goals

- Support practical application of writing recipe directions in procedural steps, food products and preparations are evaluated following each lab in food preparation
- Support practical application of science in creating foods by combining ingredients in procedural steps to produce a food product by adding heat or cold to the mixture.
- 8th-Science-small/simple labs with easilyt manipulated bariable
- Lots of formative assessments-written, Haiku, questions of the day, quizlets, word wall.
- PACE intervention, 1XL, safety net, after school study hour, common formative/summative assessment, co-teaching programs Retake/Reteaching opportunities.
- Questioning techniques-use analytical & synthetical (from Bloom's)
- Reading about artists, skills & techniques & elements & principles!
- The music department plans to support reading goals through the use of rhythmic understanding. Students must understand rhythmic vocabulary, decode, understand and use rhythmic patterns in their music literature & sight reading skills
- Drama: Using strategies that will allow students to access content specific vocabulary (such as the Frayer Model).
- Explicit reading strategy instruction
- Non-fiction/Fiction practice with active reading
- Modeling what good readers do
- Drama-Vocabulary Development: Students will be taught strategies that will allow them to access content specific vocabulary. These strategies (such as the Frayer Model, Meaningful Sentences, etc.)are high impact strategies in any content area
- Provide practice of small chunks of writing
- Peer editing & revision
- Continuous feedback aligned to CFA's.
- Many formative assessments to identify needs and progress.
- Gateway to Technology: plans to support math goals by demonstrating the need for applied mathematics when trying to achieve collaboration goals. In order for students to have a clear understanding of all designs being evaluated, each design must be accurately drawn to scale, and dimensioned in an orthographic diagram, and possibly an isometric diagram. Applied mathematics would allow students to see the need for accurate dimensioning and calculations so that the design may be accurately assessed in order to complete their collaboration process. Without accurate designing, dimensioning, and calculations, student would not be able to make a proper assessment as to the possible performance of the proposed object.

Highlight use of technology to improve student learning:

- Multimedia presentations to help convey information,
- Collaborative sites like Wiki Project, discussion boards, and blogs create opportunities for students to gain insight from their peers and post their findings.
- SS is using Laptops and internet sources for them to research sources to provide text evidence to support claims.
- Videos-Cornell note taking

- Haiku-access to documents and asssessments
- Dropbox
- Using Pedometers to collect data and analyze health
- Using computer for research and extending learning
- Students use microwave ovens to complete food prep steps and produce final food products.
- Students research and report on careers in foods & food service.
- Students research and compose daily food menus balancing recommended serving and key nutrients.
- 8th-Science-Interactive Simulations on line
- Active studio, IXL, online textbooks, Haiku for questions, reading packets (digital magazines) worksheets w/reading notes (main ideas) done on netbook & turn in digitally via Haiku dropbox.
- Recording music in music program
- Snap & Read (electronic reader), Guided research (non-fiction sources online), Haiku discussions boards, ActivInspire, Vocabulary work, Make beliefcomix.com
- Leadership students use video & video editing to produce informational & entertaining presentations to our school community. JE-Homeless Information Videos, Spirit Week, Veterans Day, Backpack Do's & Don'ts, etc.
- Gateway to Technology Course: Students would continue their understanding of applied mathematics by using the approved design, and recreating it in a 3D digital environment using AutoCAD type software known as Autodesk Inventor.

Highlight steps to involve of staff, students, parents, families, and community:

- Dropbox
- Parent access to Haiki
- Parent emails as needed
- Include parents in field trip
- Partnering with special Ed and Ell teachers
- Community volunteers via PTSA and Links
- Collaborate w/school librarian about having art related reading resources available to students.
- Message Center in Skyward
- Test Prep Record to track at home study
- Culture project (language exposure outside of class)
- Staff collaboration w/at-risk students
- Our collaboration around CFA'S.
- Collaboration between non blocked ELA/SS classes (8th) for cross –curriculum planning

Learning that works for Washington CTE™

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Lake Washington School District Gateway to Technology		
Course: Name of Course PLTW Gateway to Technology		**Total Framework Hours up to: 90**
CIP Code: 149995	☒Exploratory ☐Preparatory	**Date Last Modified: April 2013**
Career Cluster: STEM		**Cluster Pathway: Science and Math**

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Lesson 1.1 What is Engineering?

Explain the relationship between science, technology, engineering and math.

- Describe engineering and explain how engineers participate in or contribute to the invention and innovation of
- Describe impacts that technology has had on society.
- Distinguish between invention and innovation.
- Assemble an engineering notebook and a portfolio.

Lesson 1.2 Design Process

Describe the design process and how it is used to aid in problem solving.

- Use the design process to solve a technical problem.
- Recognize design criteria and constraints.
- Describe the purpose and importance of working in a team.
- Explain a design brief and apply the concept when using the design process.
- Describe the elements of design and apply this concept to the design process.
- Use a decision matrix to select the best solution to a design problem.

Lesson 1.3 Measurement

Demonstrate the ability to measure accurately with different devices and scales.

- Explain how to measure in different contexts.
- Measure using both the English and Metric systems.

Lesson 1.4 Sketching and Dimensioning Techniques

Summarize the reasoning for using sketching as a communication tool.

- Use visualization, spatial reasoning, and geometric shapes to sketch two and three dimensional shapes. Recognize and create thumbnail, perspective, isometric, and orthographic sketches.
- Recognize and accurately interpret one and two point perspective drawings.
- Communicate ideas for a design using various sketching methods, notes, and drafting views.

• Dimension an orthographic sketch following the guidelines of dimensioning.

Lesson 1.5 Designing For Production

Create a three-dimensional (3D) model of an object.

• Apply geometric and dimension constraints to design CAD-modeled parts.

• Assemble the product using the CAD modeling program.

• Demonstrate the ability to produce various annotated working drawings of a 3D model.

• Identify the difference between a prototype, a model and a mock-up and analyze what circumstances call for the use of each.

• Explain why teams of people are used to solve problems.

• Brainstorm and sketch possible solutions to an existing design problem.

• Create a decision-making matrix.

• Select an approach that meets or satisfies the constraints given in a design brief.

Leadership Alignment:

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Think Creatively: Use a wide range of idea creation techniques (such as brainstorming)

Think Creatively: Create new and worthwhile ideas (both incremental and radical concepts)

Think Creatively: Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others: Develop, implement and communicate new ideas to others effectively.

Work Creatively with Others: Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the

Work Creatively with Others: Demonstrate originality and inventiveness in work and understand the real world limits to adopting new i

Work Creatively with Others: View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical p frequent mistakes.

Implement Innovations: Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur.

Reason Effectively: Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking: Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Collaborate with Others: Demonstrate ability to work effectively and respectfully with diverse teams.

Collaborate with Others: Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common

Collaborate with Others: Assume shared responsibility for collaborative work, and value the individual contributions made by each tea

Apply Technology Effectively: Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.

Manage Goals and Time: Utilize time and manage workload efficiently.

Work Independently: Monitor, define, prioritize and complete tasks without direct oversight.

Be Self-directed Learners: Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportu

Manage Projects: Set and meet goals, even in the face of obstacles and competing pressures.

Manage Projects: Prioritize, plan and manage work to achieve the intended result.

Standards and Competencies

Standard/Unit: 1 Design and Modeling (DM)
In this unit, students begin to recognize the value of an engineering notebook to document and capture their ideas. They are introduced to and use the design process to solve problems and understand the influence that creative and innovative design has on our lives. Students use industry standard 3D modeling software to create a virtual image of their designs and produce a portfolio to showcase their creative solutions.

Competencies	Total Lea

Lesson 1.1 What is Engineering? (7 days)
Concepts
1. Science is the study of the natural world, while technology is the study of how humans develop new products to meet needs and wants.
2. Teams of people can accomplish more than one individual working alone.
3. Technological change is seen through inventions, innovations, and the evolution of technological artifacts, processes, and systems.
4. Technology can have positive and negative social, cultural, economical, political, and environmental consequences.
5. Engineers, designers, and engineering technologists are needed in high demand for the development of future technology to meet societal needs and wants.
6. An engineering notebook is used to record original ideas or designs.
- 7. A portfolio is an organized collection of best works.

Lesson 1.2 Design Process (5 days)
Concepts
1. Many different design processes are used to guide people in developing solutions to problems.
2. Design teams use brainstorming techniques to generate large numbers of ideas in a short amount of time, striving for quantity, not quality.
3. The design brief is a tool for defining the problem; it is an agreement between the engineer and client.
4. Engineers use design briefs to explain the problem, identify solution expectations, and establish project constraints.
5. A decision matrix is a tool used to compare solution ideas to the criteria so that you can select the best solution.

Lesson 1.3 Measurement (5 days)
Concepts
1. In the United States, we use both English and Metric systems of measurement.
2. Being able to measure accurately is important at school and at home, at work and when pursuing hobbies.

3. Precision measuring tools are needed for accuracy, but tools must be used correctly to ensure accurate measurements are taken.
4. Quality workmanship and accurate measurements with precise instruments are necessary to successfully solve problems.

Lesson 1.4 Sketching and Dimensioning Techniques (6 days)

Concepts

1. The ability to create a rapid, accurate sketch is an important skill to communicate ideas.
2. Orthographic drawings of an object are used to provide information that a perspective drawing may not be able to show.
3. Engineers apply dimensions to drawings to communicate size information.

Lesson 1.5 Designing For Production (22 days)

ncepts

1. Simple geometric shapes are combined and joined to create a representation of an object.
2. Engineers use computer-aided design (CAD) modeling systems to quickly generate and annotate working drawings.
3. Three-dimensional computer modeling uses descriptive geometry, geometric relationships, and dimensions to communicate an idea or solution to a technological problem.
4. As individual objects are assembled together, their degrees of freedom are systematically removed.
5. Engineers use a design process to create solutions to existing problems.
6. Teamwork requires constant communication to achieve the goal at hand.
7. The fabrication of a prototype is the opportunity for the designer to see the product as a three-dimensional object.

	Aligned Washington State Standards
Art	
Communications	2. Integrate and evaluate information presented in diverse media and formats, including visually quantitatively, and orally. (AS.SL.2) 4. Present information, findings, and supporting evidence such that listeners can follow the line organization, development, and style are appropriate to task, purpose, and audience. (AS.SL.4) 5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. (AS.SL.5) 1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. (AS.SL.1)

	2. Integrate and evaluate information presented in diverse media and formats, including visuall quantitatively, and orally. (AS.SL.2)
Educational Technology	**Students will develop an understanding of the characteristics and scope of technology.** 6-8 F. New products and systems can be developed to solve problems or to help do things that cou not be done without the help of technology. (1.6-8.F) G. The development of technology is a human activity and is the result of individual and collect needs and the ability to be creative. (1.6-8.G) H. Technology is closely linked to creativity, which has resulted in innovation. (1.6-8.H) D. Technological systems often interact with one another. (3.6-8.D) F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems. (3.6-8.F) **Students will develop an understanding of the cultural, social, economic, and political effects of technology.** 6-8 D. The use of technology affects humans in various ways, including their safety, comfort, choic and attitudes about technology's development and use. (4.6-8.D) F. The development and use of technology poses ethical issues. (4.6-8.F) G. Economic, political, and cultural issues are influenced by the development and use of techn (4.6-8.G) **Students will develop an understanding of the role of society in the development and us technology.** 6-8 D. Throughout history, new technologies have resulted from the demands, values, and interest individuals, businesses, industries, and societies. (6.6-8.D) E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants. (6.6-8.E) **Students will develop an understanding of the attributes of design.** 6-8 E. Design is a creative planning process that leads to useful products and systems. (8.6-8.E) F. There is no perfect design. (8.6-8.F) G. Requirements for design are made up of criteria and constraints. (8.6-8.G) **Students will develop an understanding of engineering design.** 6-8 F. Design involves a set of steps, which can be performed in different sequences and repeated needed. (9.6-8.F) G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (9.6-8.G) **Students will develop the abilities to apply the design process.** 6-8 H. Apply a design process to solve problems in and beyond the laboratory-classroom. (11.6-8.H

	I. Specify criteria and constraints for the design. (11.6-8.I) **Students will develop an understanding of the role of society in the development and us technology.** 6-8 D. Throughout history, new technologies have resulted from the demands, values, and interest individuals, businesses, industries, and societies. (6.6-8.D) E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants. (6.6-8.E) **Students will develop an understanding of the influence of technology on history.** 6-8 D. The specialization of function has been at the heart of many technological improvements. (7.6-8-D) E. The design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of sp relationships. (7.6-8-E) **Students will develop the abilities to use and maintain technological products and syste** 6-8 H. Use information provided in manuals, protocols, or by experienced people to see and under how things work. (12.6-8.H) **Students will develop the abilities to assess the impact of products and systems.** 6-8 F. Design and use instruments to gather data. (13.6-8.F) **Students will develop the abilities to apply the design process.** 6-8 J. Make two-dimensional and three-dimensional representations of the designed solution. (11.6 **Students will develop an understanding of and be able to select and use information and communication technologies.** 6-8 K. The use of symbols, measurements, and drawings promotes a clear communication by prov a common language to express ideas. (17.6-8.K) **Students will develop an understanding of the attributes of design.** 6-8 G. Requirements for design are made up of criteria and constraints. (8.6-8.G) **Students will develop an understanding of engineering design.** 6-8 F. Design involves a set of steps, which can be performed in different sequences and repeated needed. (9.6-8.F) G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (9.6-8.G) H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical soluti **Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.**

)	6-8 F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. (10.6-8.F) G. Invention is a process of turning ideas and imagination into devices and systems. Innovation the process of modifying an existing product or system to improve it. (10.6-8.G) H. Some technological problems are best solved through experimentation. (10.6-8.H) **Students will develop the abilities to apply the design process.** 6-8 H. Apply a design process to solve problems in and beyond the laboratory-classroom. (11.6-8.H I. Specify criteria and constraints for the design. (11.6-8.I) J. Make two-dimensional and three-dimensional representations of the designed solution. (11.6 K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (11.6-8.K) L. Make a product or system and document the solution. (11.6-8.L) **Students will develop the abilities to use and maintain technological products and syste** 6-8 H. Use information provided in manuals, protocols, or by experienced people to see and unders how things work. (12.6-8.H) J. Use computers and calculators in various applications. (12.6-8.J) **Students will develop an understanding of and be able to select and use information and communication technologies.** 6-8 H. Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human. (17.6-8.H) K. The use of symbols, measurements, and drawings promotes a clear communication by provi a common language to express ideas. (17.6-8.K)
Health and Fitness	
) **Math**	**Grade 7** Ratios and Proportional Relationships -Analyze proportional relationships and use them to solve real-world and mathematical problem 1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in ea 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.* (7.RP.1) The Number System -Apply and extend previous understandings of operations with fractions to add, subtract, multipl and divide rational numbers. 1. Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. (7.NS.1) 1.b. Understand p + q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite h

	a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. (7.NS.1.b) 3. Solve real-world and mathematical problems involving the four operations with rational num 1Computations with rational numbers extend the rules for manipulating fractions to complex fractions. (7.NS.3) **Grade 7** Ratios and Proportional Relationships -Analyze proportional relationships and use them to solve real-world and mathematical proble 1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in e 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 mile per hour.* (7.RP.1) The Number System -Apply and extend previous understandings of operations with fractions to add, subtract, multi and divide rational numbers. 1. Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. (7.NS.1) 1.b. Understand p + q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. (7.NS.1.b) 3. Solve real-world and mathematical problems involving the four operations with rational num 1Computations with rational numbers extend the rules for manipulating fractions to complex fractions. (7.NS.3) **Grade 8** Geometry -Understand congruence and similarity using physical models, transparencies, or geometry so 1. Verify experimentally the properties of rotations, reflections, and translations: (8.G.1) 1.a. Lines are taken to lines, and line segments to line segments of the same length. (8.G.1.a) 1.c. Parallel lines are taken to parallel lines. (8.G.1.c) **Grade 7** Geometry -Draw, construct, and describe geometrical figures and describe the relationships between the 1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. (2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing w the conditions determine a unique triangle, more than one triangle, or no triangle. (7.G.2) 3. Describe the two-dimensional figures that result from slicing three dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. (7.G.3) -Solve real-life and mathematical problems involving angle measure, area, surface area, and v

	4. Know the formulas for the area and circumference of a circle and use them to solve problem give an informal derivation of the relationship between the circumference and area of a circle. (7.G.4) 6. Solve real-world and mathematical problems involving area, volume and surface area of two three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right pri (7.G.6) **Grade 8** Geometry -Understand congruence and similarity using physical models, transparencies, or geometry sof 1. Verify experimentally the properties of rotations, reflections, and translations: (8.G.1) 1.a. Lines are taken to lines, and line segments to line segments of the same length. (8.G.1.a) 1.b. Angles are taken to angles of the same measure. (8.G.1.b) 1.c. Parallel lines are taken to parallel lines. (8.G.1.c) 2. Understand that a two-dimensional figure is congruent to another if the second can be obtai from the first by a sequence of rotations, reflections, and translations; given two congruent figu describe a sequence that exhibits the congruence between them. (8.G.2) 3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional fig using coordinates. (8.G.3) 4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two simila two dimensional figures, describe a sequence that exhibits the similarity between them. (8.G.4)

LEARNING & INNOVATION	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER
Creativity and Innovation ☒Think Creatively ☒Work Creatively with Others ☒Implement Innovations **itical Thinking and Problem Solving** ☒Reason Effectively ☒Use Systems Thinking ☒Make Judgments and Decisions ☒Solve Problems **Communication and Collaboration** ☒Communicate Clearly ☒Collaborate with Others	**Information Literacy** ☒Access and /evaluate Information ☒Use and Manage Information **Media Literacy** ☐Analyze Media ☐Create Media Products **Information, Communications and Technology (ICT Literacy)** ☒Apply Technology Effectively	**Flexibility and Ad** ☒Adapt to Chang ☒Be Flexible **Initiative and Sel** ☒Manage Goals ☒Work Independ ☒Be Self-Directe **Social and Cross** ☒Interact Effectiv ☒Work Effectively **Productivity and** ☐Manage Project ☒Produce Result **Leadership and R** ☒Guide and Lead ☒Be Responsible

3. Precision measuring tools are needed for accuracy, but tools must be used correctly to ensure accurate measurements are taken.
4. Quality workmanship and accurate measurements with precise instruments are necessary to successfully solve problems.

Lesson 1.4 Sketching and Dimensioning Techniques (6 days)

Concepts

1. The ability to create a rapid, accurate sketch is an important skill to communicate ideas.
2. Orthographic drawings of an object are used to provide information that a perspective drawing may not be able to show.
3. Engineers apply dimensions to drawings to communicate size information.

Lesson 1.5 Designing For Production (22 days)

Concepts

1. Simple geometric shapes are combined and joined to create a representation of an object.
2. Engineers use computer-aided design (CAD) modeling systems to quickly generate and annotate working drawings.
3. Three-dimensional computer modeling uses descriptive geometry, geometric relationships, and dimensions to communicate an idea or solution to a technological problem.
4. As individual objects are assembled together, their degrees of freedom are systematically removed.
5. Engineers use a design process to create solutions to existing problems.
6. Teamwork requires constant communication to achieve the goal at hand.
7. The fabrication of a prototype is the opportunity for the designer to see the product as a three-dimensional object.

	Aligned Washington State Standards
Art	
Communications	2. Integrate and evaluate information presented in diverse media and formats, including visually quantitatively, and orally. (AS.SL.2) 4. Present information, findings, and supporting evidence such that listeners can follow the line organization, development, and style are appropriate to task, purpose, and audience. (AS.SL.4) 5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. (AS.SL.5) 1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. (AS.SL.1)