Newport-Mesa Unified School District
Office of Secondary Curriculum and Instruction
High School Course of Study

Course Title	*Mathematics, Engineering, Science Achievement 3*	**Course Code**	*[Office use only]*

Transcript Title:	***MESA 3AB***	**Grades Levels:**	***11-12***	**Board Adoption Date:**	
Content Area:	***Interdisciplinary***	**GPA Scale:**	***4.0***	**Date Course Submitted:**	***3-24-21***
Credential Required:	***Single Subject Secondary Math or Science Credential***	**Graduation Subject Areas:**	***Applied Skills/ Electives***	***CalPads Code:***	
UC/CSU "A-G" Area Approvals:	***g***		**School Site/person that wrote and submitted the course:**	***Early College High School***	
Recommend Skills:	***MESA 2, Algebra 1 (Math I) and Geometry (Math II)***				
Next course(s):	***MESA 4***				
Textbook to be used:	*MESA is not a textbook based course. There are multiple resources the teacher will use as indicated in the unit studies.*				

<u>COURSE DESCRIPTION</u> *(catalog summary)***:**

In this year-long college-preparatory course, students will explore the fundamentals of drafting and design, as they apply to MESA Engineering projects. These projects promote critical thinking, communication, collaboration, creativity and provide a foundation for data collection, analysis, reflection, presentations and technical writing skills. Each unit also introduces students to the real-world application of the skills and principles and highlights how they relate to possible careers in STEM fields. By successfully completing the course students will be better prepared to succeed in college level science and engineering courses.

<u>GOALS</u> *(expected performance outcomes for students)***:**

MESA is funded by the State of California and is administered by the University of California, with funding allocated from UC and the California Community College Chancellor's Office. MESA also pursues additional financial and resource support from private and public sources. MESA functions with a partnership of all the major public and private education systems in California.

MESA helps underserved and underrepresented students to achieve success in STEM studies and careers. Most MESA students are the first in their families to go to college. Most students are from low-income households and/or attend Title I funded schools. With MESA's support these students excel in science, technology, engineering and math—some of the most difficult academic subjects. California's students excel in STEM pathways, from elementary to graduate school and into careers where they accelerate and build the Golden State's leadership in research, industry, and service.

a. Follow MESA-developed guidelines (reinforcing California State Math and Science Standards) to build hands-on projects, which will be entered into rigorous local, regional, and in some cases state and national contests.

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b. Learn and apply effective study skills techniques for academic success
c. Enter at least one project in the MESA Day preliminary competition • https://mesa.ucop.edu/staff/mesa-day-rules/
d. Compete in at least 1 virtual project • http://mesa.ucop.edu/our-programs/mesa-statewide-virtual-computer-sciencecontest/
e. Attend one MESA Saturday Academies at UCI (not sure yet) • http://mesa.eng.uci.edu/resources-students.html

CALIFORNIA CONTENT STANDARDS *(how the course aligns with California and/or national curriculum standards)***:**

MESA provides rigorous academic development that includes math and science curriculum based on the California Math and Science Standards. MESA also offers individualized academic planning, study skills training, peer group learning techniques, career exploration, parent involvement, professional development, transfer assistance, and special orientation classes and services for students in high school, community college and four-year institutions.

EVALUATION *(how the effectiveness of the course will be monitored and assessed)***:**

MESA measures success by helping students who are traditionally underrepresented in higher education become college- and career-ready. MESA students succeed with:

- *Academic support based on high standards*
- *Individual counseling to ensure that college prerequisites and transfer/college graduation requirements are met*
- *Industry involvement in activities including mentoring, shadow days and speakers*
- *Reinforcement of California math and science standards through hands-on projects, group learning and constantly evolving curriculum*
- *Supportive student communities based on academic success*
- *Professional development for math and science teachers in low-performing schools*
- *Networks of parents, educators and industry leaders and community resources to support students*
- *Regional MESA center alliances that further smooth the educational pathway*

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Unit 1	**Length of Unit … 9 Weeks**			
	Key Vocabulary	**Standards (referenced)**	**Model Tasks**	**Tools / Texts**
Introduction to Design	Technical Sketch Technical Draw Design Design Process Drawing Views Projections Isometric Oblique Perspective Orthographic	**Next Generation Science –** HS-ETS1.1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1.2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1.3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1.4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **CSTA K-12 Computer Science –** 3A-CS-01 Explain how abstractions hide the underlying implementation details of computing	**BACKGROUND:** The goal of this unit is for students to develop an understanding of the purpose and practice of visual representations and communication within engineering in the form of technical sketching and drawing. Students build skill and gain experience in representing three-dimensional objects in two dimensions. Students will create various technical representations used in visualization, exploring, communicating, and documenting design ideas throughout the design process, and they will understand the appropriate use of specific drawing views (including isometric, oblique, perspective, and orthographic projections). They progress from creating free hand sketches using a pencil and paper to developing engineering drawings according to accepted standards and practices that allow for universal interpretation of their design. Students will maintain a portfolio to document the progression of their skills. **KEY ASSIGNMENT:** Students will produce a 3-view drawing of a random, given object. The student will need to apply what they learned about sketches and basic drawing conventions to complete this assignment. The three view drawing is a common and acceptable drafting convention for accurately and concisely representing an object. By producing a drawing with these specific conventions, students will	*UC Irvine MESA Google Drive* *UC Riverside MESA Google Drive* *MESA Day Rules and Lab Book Requirement* *MESA DAY Curriculum* *a. Composition notebook to be used as a MESA journal exclusively for this class.* *b. Several sharp pencils with erasers (mechanical pencils with lead refills work nicely)* *c. Sticky notes or book tabs* *d. Ruler and/or protractor* *e. Colored pencils*

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		systems embedded in everyday objects. 3A-CS-02 Compare levels of abstraction and interactions between application software, system software, and hardware layers. 3A-CS-03 Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors. **ELA/Literacy –** RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3) RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3) RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1),(HS-ETS1-3)	have learned a widely accepted way of representing objects they can apply in a myriad of settings and situations in their future careers.	

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		Mathematics – MP.2 Reason abstractly and quantitatively. (HS-ETS1-1),(HS-ETS1-3),(HS-ETS1-4) MP.4 Model with mathematics. (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)		
Differentiation	**Support -- for students who are struggling with the content**	Content: *All materials are provided with scaffolding and differentiation modalities to be utilized by the teacher as needed.* Process: *All lessons are constructed with scaffolding and differentiation embedded for English Learners and struggling learners.* Product: *All assignments can be completed in a modified format to accommodate English Learners and students who struggle with the content.*		
	Extension – for high achieving students.	Content: *All materials are provided with enrichment modalities to be utilized by the teacher as needed.* Process: *All lessons are constructed with enrichment embedded for high achieving students.* Product: *All assignments can be completed in a modified format to accommodate high achieving students.*		
Evaluation	***Formative Assessments** (ongoing & mid-lesson):* • Complete Journal Entries • Group Discussions • Group Projects • Group Presentations			

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	Summative Assessments *(unit final evaluation):* • MESA Notebook with rubric scoring • Final Project with rubric scoring • Video of Project construction (optional)

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Unit 2	**Length of Unit … 9 Weeks**			
	Key Vocabulary	**Standards (referenced)**	**Model Tasks**	**Tools / Texts**
Computer Aided Design	Computer Aided Design (CAD) AutoCad Fusion 360 Freeform Design Prototype Design Physical Model	**Next Generation Science –** HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	**BACKGROUND:** In this unit, students will build upon their skills with hand drawn sketches and begin to utilize computer aided design (CAD). Students will learn how to transfer their two dimensional drawings to the computer using programs like AutoCad and Fusion 360. They will model basic and detailed 3D parts and will be introduced to sculpting tools to model freeform designs. The unit will teach students to document and generate technical drawings and views for manufacturing and to render photo-realistic images of prototype designs. They will be able to create simulation studies to analyze the structural integrity of a design before it is manufactured. For the culmination of this unit, students will create a physical model of their design to test and evaluate and compare with the simulated tests. The creation of the physical model can be done by hand, using a 3D printer or other means of creation. **KEY ASSIGNMENT:** Create a 3D model of a simulated two-fingered prosthetic arm. Students will complete this assignment by taking a basic design of their own for a simulated lower arm, creating a CAD drawing from it, and from that, using Fusion 360 to produce a physical model. This assignment will teach students how to effectively use Fusion 360 while creating an object for a MESA Engineering project (prosthetic arm challenge)	*UC Irvine MESA Google Drive* *UC Riverside MESA Google Drive* *MESA Day Rules and Lab Book Requirement* *MESA DAY Curriculum* *a. Composition notebook to be used as a MESA journal exclusively for this class.* *b. Several sharp pencils with erasers (mechanical pencils with lead refills work nicely)* *c. Sticky notes or book tabs* *d. Ruler and/or protractor* *e. Colored pencils*

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		HS-ETS1.1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1.2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1.3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1.4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **CSTA K-12 Computer Science –** 3A-CS-01 Explain how abstractions hide the underlying implementation details of computing systems embedded in everyday objects. 3A-CS-02 Compare levels of abstraction and interactions between	with a real world application.	

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		application software, system software, and hardware layers. 3A-CS-03 Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors. **ELA/Literacy –** RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS2-1) RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS2-1) WHST.9–12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS2-3),(HS-PS2-5) WHST.11-12.8 Gather relevant information from multiple authoritative		

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		print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS2-5) WHST.9–12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-1),(HS-PS2-5) **Mathematics –** MP.2 Reason abstractly and quantitatively. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4) MP.4 Model with mathematics. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4) N-Q.1-3 Reason quantitatively and use units to solve problems. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4),(HS-PS2-5) A-SSE.1.a,b Interpret expressions that represent a quantity in terms of its context. (HS-PS2-1),(HS-PS2-4) A-SSE.3.a-c Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-1),(HS-PS2-4)		

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		A-CED.1 Create equations and inequalities in one variable including ones with absolute value and use them to solve problems. (HS-PS2-1),(HS-PS2-2) A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS-PS2-1),(HS-PS2-2) A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS2-1),(HS-PS2-2) F-IF.7.a-e Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. (HS-PS2-1) S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). (HS-PS2-1)		
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		Product: *All assignments can be completed in a modified format to accommodate English Learners and students who struggle with the content.*
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Evaluation	***Formative Assessments*** *(ongoing & mid-lesson):* • Complete Journal Entries • Group Discussions • Group Projects • Group Presentations	
	Summative Assessments *(unit final evaluation):* • MESA Notebook with rubric scoring • Final Project with rubric scoring • Video of Project construction (optional)	

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Unit 3	**Length of Unit … 9 Weeks**			
	Key Vocabulary	**Standards (referenced)**	**Model Tasks**	**Tools / Texts**
Advanced CAD: Autodesk Inventor	Assembly View Dimensional Constraint Motion Constraint Autodesk Inventor VEX Robot	**Next Generation Science –** HS-ETS1.1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1.2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1.3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1.4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **CSTA K-12 Computer Science –** 3A-AP-13 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.	**BACKGROUND:** In this unit students will learn advanced 3D computer modeling skills. These advanced skills include creating animated assembly views of multi-part products and using mathematical functions to represent relationships to enforce dimensional and motion constraints. Students will use the skills and knowledge previously built in the course to develop and document the solution to a design challenge using an iterative design process. Students participating in the VEX robotics competition will utilize Inventor to design their robot and integrate the various components. Inventor will allow students to analyze the structural integrity and strength of their designs in a virtual environment prior to constructing their device. It will allow them to better manage workflow and efficiency. Culmination of this unit will either be the creation of a functional VEX robot based on their Inventor plans or the creation of another project, such as a prosthetic hand, which incorporates multiple complicated, integrated components. **KEY ASSIGNMENT:** Producing a functional VEX robot. Students will develop plans on Autodesk Inventor as the basis for the building of their competition ready robot. By doing so, students will have demonstrated a high level of competency with Autodesk, while learning	*UC Irvine MESA Google Drive* *UC Riverside MESA Google Drive* *MESA Day Rules and Lab Book Requirement* *MESA DAY Curriculum* *a. Composition notebook to be used as a MESA journal exclusively for this class.* *b. Several sharp pencils with erasers (mechanical pencils with lead refills work nicely)* *c. Sticky notes or book tabs* *d. Ruler and/or protractor* *e. Colored pencils*

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		3A-AP-14 Use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables. 3A-AP-15 Justify the selection of specific control structures when tradeoffs involve implementation, readability, and program performance, and explain the benefits and drawbacks of choices made. 3A-AP-16 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. 3A-AP-18 Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. 3A-AP-19 Systematically design and develop programs for broad audiences by incorporating feedback from users. 3A-AP-20 Evaluate licenses that limit or restrict use of computational	to use the program towards an application (eg: a VEX robot that can engage in a challenge) with a very palpable and practical end.	

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		artifacts when using resources such as libraries. 3A-AP-21 Evaluate and refine computational artifacts to make them more usable and accessible. 3A-AP-22 Design and develop computational artifacts working in team roles using collaborative tools. 3A-AP-23 Document design decisions using text, graphics, presentations, and/or demonstrations in the development of complex programs. **ELA/Literacy –** RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3) RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3) RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process,		

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		phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1),(HS-ETS1-3) **Mathematics –** MP.2 Reason abstractly and quantitatively. (HS-ETS1-1),(HS-ETS1-3),(HS-ETS1-4) MP.4 Model with mathematics. (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)		
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	Summative Assessments *(unit final evaluation):* • MESA Notebook with rubric scoring • Final Project with rubric scoring • Video of Project construction (optional)

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Unit 4	**Length of Unit … 9 Weeks**			
	Key Vocabulary	**Standards (referenced)**	**Model Tasks**	**Tools / Texts**
Civil Engineering and Architecture: Revvit	Civil Engineering Building Information Modeling (BIM) Building Element Building Envelope Curtain System Interior Circulation Family Home Design Energy Efficiency Autodesk Revvit	**Next Generation Science –** HS-ETS1.1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1.2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1.3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1.4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. HS-ESS2-2. Analyze geoscience data to make the claim that one changes to Earth's surface can create feedbacks that cause changes to other Earth systems.	**BACKGROUND:** This unit of study will introduce students to Building Information Modeling (BIM), which is an intelligent model-based process that provides insight for creating and managing building projects faster, more economically, and with less environmental impact. Students will learn basic techniques for creating building information models, including: building elements, building envelope, curtain systems, interiors and circulation, and creating families. This unit provides an opportunity for students to develop a small single family home design that incorporates sustainable design practices as well as universal design features. Students will be introduced to building codes and their impact on design as well as common wood-framed residential construction techniques and practices. Students also will investigate the cost of construction and the significant impact of the choice of construction materials and practices on the ongoing cost of energy for heating and cooling. They will apply this knowledge to the design of a small, affordable, energy efficient home utilizing software, such as Autodesk Revvit. Culmination of this unit will be a presentation of their unique home. **KEY ASSIGNMENT:** Creation of a design for a small, tiny and energy efficient home. Students will complete the assignment by applying all they have learned from the	*UC Irvine MESA Google Drive* *UC Riverside MESA Google Drive* *MESA Day Rules and Lab Book Requirement* *MESA DAY Curriculum* *a. Composition notebook to be used as a MESA journal exclusively for this class.* *b. Several sharp pencils with erasers (mechanical pencils with lead refills work nicely)* *c. Sticky notes or book tabs* *d. Ruler and/or protractor* *e. Colored pencils*

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		HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. **CSTA K-12 Computer Science –** 3A-CS-01 Explain how abstractions hide the underlying implementation details of computing systems embedded in everyday objects. 3A-CS-02 Compare levels of abstraction and interactions between application software, system software, and hardware layers. 3A-CS-03 Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.	Revvit Building Information Modeling program towards a home of their own design. This culminating project will teach students a powerful tool used in the construction industry, while also teaching them about the actual and practical environmental and energy considerations inherent in most residential constructions.	

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		ELA/Literacy – RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3) RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3) RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1),(HS-ETS1-3) **Mathematics –** MP.2 Reason abstractly and quantitatively. (HS-ETS1-1),(HS-ETS1-3),(HS-ETS1-4) MP.4 Model with mathematics. (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)		
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	***Summative Assessments** (unit final evaluation):* • MESA Notebook with rubric scoring • Final Project with rubric scoring • Video of Project construction (optional)	