Computational Thinking Framework Alignment to EbD Course: Engineering Design			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Learning Cycle 4: Robot Ball**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students are introduced to a problem scenario that provides context for their engineering design challenge. Then students are required to use the engineering design process to identify the problems they are tasked with completing. Students use the computer, literature, and devices to extend their knowledge on the design problem and begin working on ways to solve those problems.	Students design and build a robot that performs consistently and meets all the design requirements. Students test their robots and programming to make sure it can complete each challenge. Students compete against each other for the fastest time in the figure 8 challenge and the most points in the "Robot Ball" Challenge. Students work collaboratively and groups while using materials, tools, and equipment safely.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students organize their data using their STEM notebooks. They provide detailed instruction on what their designs will look like as well as document their process in a logical way so that others can follow their steps to be able to create their design. After simulations and tests are completed on the students' prototypes, the students analyze their data by creating graphs, comparisons to other team designs and then identify which design was the most efficient.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students use the data they acquired from testing their robot to document and represent their data in a logical way using a spreadsheet software that creates graphs and charts.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students begin documenting their algorithmic thinking in their STEM Notebooks by following the design process. Then the students use their designs to create automated solutions that follow the steps they initially created. Student write code to have their robot follow a set of directions.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** From the very beginning of the lesson, students are required to use the engineering design process to identify, analyze, and implement possible solutions for their given task. Students are tasked to design and construct the most efficient and effective combination of steps and resources in their engineering notebooks and then construct their prototype accordingly.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** The Engineering Design course is designed to have students practice transferring and generalizing the knowledge they learned from previous lessons and apply them to their given design challenges. For example, students are expected to identify the problem and then analyze what a solution to the problem will be solving. Then students construct a plan for solving the problem and begin solving it. They test their designs, optimize and communicate their results.	

Computational Thinking Framework Alignment to EbD Course: Technological Design			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 6 – NASA Engineering Design**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students are given an open-ended design challenge and from that topic, are expected to formulate their own problems and questions that drive their research on that topic. Students use computers, literature, interviews with experts and other devices to help them solve their problems.	Students work in a team to design and construct the subsystems necessary for a Lunar Plant Growth Chamber. Students must adhere to the criteria and constraints and work together to solve this problem. Students are expected to present their designs to the class as a presentation.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students logically organize and analyze data in their STEM notebooks. Students craft their designs to include drawings and/or pictures with dimensions, graphs, charts, and other visual aids they feel are necessary.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students use the data they collected to create presentations that describe their models, prototypes, and simulations. Students use word processing software as well as spreadsheet/database software to document and represent their data.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students document their automated solutions and algorithmic thinking in their STEM notebooks and then use that to build their prototypes.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students begin by identifying the problem and independently creating their own designs. Then they come together as a team to identify which designs might be more efficient and effective in solving the problem. Students use a combination of each other's steps and resources to choose the best design for this design challenge.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem solving process to a wide variety of problems?** Throughout the Technological Design course, students build off of what they are previously taught in the course. Students use the specific problem solving-skills that they learn at the beginning of the course all throughout the rest of the course. Students use the elements of the engineering design process to go about solving problems in a variety of different scenarios.	

Computational Thinking Framework Alignment to EbD Course: Advanced Technological Applications			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 5 - Robotics: Soft Actuators**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open-ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Within the design challenges in each of the units, students use computers, scientific instruments, and sketching tools to help them solve problems such as using 3D modeling to create an ADA-ompliant park or integrating biotechnological resources to create a hydroponic system.	Students work on complex programming by using the four elements of computational thinking to simplify solving a problem. Students use soft actuators to design and construct a soft robotic gripper.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students create flow charts as well as graphs, charts, and other means of visual communication such as presentations, posters, and animations. Students also analyze the data collected in their engineering journals.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students create many different models and simulations throughout this course from sketching orthographic and multiview projections to representing data through 3D computer aided drafting.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students create automated solutions using algorithmic thinking in many of the design challenges by applying their data modeling skills to solve scenarios such as traffic congestion using Excel or creating and programming a soft robotic gripper that helps with agriculture or assisting people with hand disabilities.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** In each of the design challenges and unit introductions, students are required to identify problems, analyze the scenario and situation, and then use their research and ideas to implement possible solutions that solve the proposed problem or design challenge.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students gather, select, evaluate, and utilize diverse data to make informed decisions about a specific design or solution by communicating their analysis to a wide audience. Students are expected to apply the problem-solving process throughout the entire course, especially since the Informed Design Process is one of the first topics introduced.	

Computational Thinking Framework Alignment to EbD Course: Technology and Society			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 3 - Change by Design**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open-ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students use the engineering design process to identify and research various problems regarding technological impacts on society and the environment. Then students are expected to use a computer and other scientific tools or instruments to solve those problems.	Students use the engineering design process to design and build a model of a "green" town. Students focus on sustainability and environmental implications.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students use their engineering design journals to design and document their solutions. Students use this journal to organize and analyze the data they collected from their product evaluation trials.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students represent data through hands-on modeling and design scenarios where students create their own models or simulations to communicate their findings.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students create automated solutions by documenting their algorithmic thinking for how to build a specific design using their engineering design journals.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students work in design teams to work through the engineering design process to identify the problems in the design brief, construct a solution, and analyze that solution to ensure efficiency in both steps and resources. Students develop remediation plans for addressing the specific problems.	
Generalizing and transferring this problem solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students generalize and transfer their problem-solving skills throughout each of the unit design challenges because each of those challenges build off of each other to address and develop specific problem-solving tasks/skills.	

Computational Thinking Framework Alignment to EbD Course: Foundations of Technology			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 5 - NASA Integrated Transportation Systems**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open-ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students formulate problems in a way that enables them to use a computer and other tools to help solve problems by learning how to troubleshoot and analyze systems to determine which tools would be most beneficial to helping them address their problem.	Students apply what they learned regarding the engineering design process to design an intermodal transportation system for space exploration. Students focus on decision-making and management skills as well as the integration of technological systems.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students logically organize and analyze data using their engineering design journals. Students also create audio/visual presentations and work in teams to analyze and communicate their data.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students represent data by creating models and simulations that use the universal systems model to address various problems.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students create automated solutions through algorithmic thinking by documenting their design process in their engineering design journals.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** In using the universal systems model to identify various technological components, students identify what the problem is, design and construct a model, and then analyze the evaluative results from that model to ensure that the design is as efficient as it could be from their documentation of steps and the amount of resources required.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students transfer what they learned throughout each lesson to each of the engineering design challenges because they build off of each other. Students generalize what they learned about the engineering design process and technological system design within their Technology Student Association competitions (if offered by their school).	

Computational Thinking Framework Alignment to EbD Course: Technological Systems			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 4 - Lesson 1- Power and Energy Systems**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** In the Technological Systems course, students learn about how technological systems work and their impacts on the environment. Students use the engineering design process to help them formulate problems by guiding them on what type of research they need and which tools will help them answer their questions.	Students use their knowledge of siege machines and apply their knowledge of potential and kinetic energy to design and construct a catapult that adheres to the criteria and constraints of that design challenge.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students logically organize and analyze their data using their engineering design journals where they keep a running log of their ideas and data they collected from their experiments. Students display their data using spreadsheets, graphs, tables, and charts. Students also create multimedia presentations to organize and communicate their results.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students are given multiple opportunities to design and construct models and simulations through each of the engineering design challenges within each unit. Students use these models to explain various manufacturing processes used such as their design, development, production and service.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students create automated solutions by documenting their algorithmic thinking in their engineering design journals. Students work in teams and learn about the importance of keeping detailed directions for building their solution.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students are given many engineering design challenges that require them to identify the problem, design and construct a product, analyze that product, and optimize their designs by making it the most efficient design. Students are also given a rubric to make sure they address each of the different areas of evaluation.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Since students learn about various technological systems and subsystems, they are able to apply what they learned about the manufacturing process and the engineering design process to generalize and transfer what they learned to new situations and problems. Each of these design challenges have the students use skills that have been previously taught in the course.	

Computational Thinking Framework Alignment to EbD Course: Invention and Innovation			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 4 - Rube Goldberg Entertainment**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open-ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** In the Invention and Innovation course, students learn about the engineering design process and learn how to use various tools and equipment in the classroom to help them in their future problem solving endeavors. In knowing about the engineering design process and which tools are used to perform specific tasks students are able to make informed decisions regarding which tools to use help them solve their engineering design challenges.	Students use their creativity and innovation to work through the engineering design process to create their own Rube Goldberg contraption.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students organize and analyze their data using their engineering design journal.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students create mini models that represent their designs. Students are able to draw their own sketches or use computer-aided design to assist them with their models.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Particularly in their Rube Goldberg engineering design challenge, students must organize their algorithmic thinking in their engineering design journals and then use those steps to create their automated solution.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students learn about many inventions and innovations of the past and identify how technology can have positive and negative impacts. Students use what they learned from the mini lessons to adhere to the criteria and constraints given to them from their design briefs. Students identify what their tasks are, design and construct their solutions, and then analyze their effectiveness. Students may go through multiple iterations in order to achieve an efficient and effective design.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students generalize and transfer what they learned from the iterative engineering design process and use that set of phases to help them solve a variety of different problems and design challenges.	

Computational Thinking Framework Alignment to EbD Course: Exploring Technology			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 2 - Transportation Challenge**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students learn about all areas of technology and develop their understanding of how to choose various technologies or tools to solve specific societal problems. Students use computers, scientific journals/websites and scientific instruments to help them research and analyse their solutions.	Students are introduced to the types of transportation subsystems and they are given a choice to complete one of three transportation challenges. Students use their engineering design journals to document their ideation, building, and evaluation processes and then use that information to create a presentation for their class about their solution to the challenge.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students learn about the engineering design process and use it to document their ideas and analyze their data. Students use use computer aided design (CAD) to design technical sketches as well as videography to create a multimedia presentation that organizes their process and analyzes their data with graphs and charts.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students progress through each of the unit challenges by designing and constructing their own solutions to the challenge.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** In many of the engineering design challenges, students learn how to document their steps for constructing the solutions in their engineering design journals with technical sketches and detailed explanations.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** In working in teams, discussing various solutions and using evidence to support their design solutions, students are able to identify their solution through a design matrix where they list all possible designs and materials. Then, after they choose their design, construct it, and test it, they analyze its effectiveness. Students might go through multiple iterations of a design in order to make it efficient and cost-effective. Students analyze their engineering design journals and modify areas that can be simplified or further explained.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** In learning about all the different areas of technology, students are able to engage in many different engineering design challenges that allows them to reflect and explain their ideas or solutions to a problem. Students are taught how to research to find better selections of materials for their designs and learn how to use STEM concepts to a variety of problems.	

Computational Thinking Framework Alignment to EbD Course: EbD-TEEMS Grades 3-6			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Grade 6 - Lesson 16 Hiccup**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open-ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** An elementary version of the engineering design process is introduced and students learn how to work through the EDP to formulate solutions to problems. Students are introduced to using a computer and other scientific instruments and tools to solve problems such as rulers, beakers, thermometers, scales, etc.	Students are introduced to Scratch and Hummingbird boards to practice creating programs and to operate and control the devices. Students use basic programming and algorithmic thinking to create sequences that allow for various sensors to operate such as a speaker, motor or light. Students document their entire design process in their STEM notebooks.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Many graphic organizers are used to help the students organize and analyze their data. Student learn how to use their STEM notebooks to document their ideas, research, designs, evaluations, and iterations.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students have many opportunities to create models as a means of representing data. Some examples include: making a building that survives an earthquake (shake table) in third grade, a model of a solar-powered greenhouse in fourth grade, a pet wash design to conserve water in fifth grade, and an animated simulation using Scratch and a Hummingbird Board in sixth grade.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students document their algorithmic thinking in their STEM notebooks and through graphic organizers. They also learn basic computational thinking, circuitry, and programming in the EbD TEEMS courses.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students work through the engineering design process to identify their design brief problems, create a model/design, analyze its effectiveness by testing it out and working with their team to identify ways of making it more efficient whether it is from their directions or resources they are using. Students create bar graphs and multimedia presentations to communicate their results.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students transfer their knowledge from one lesson to the other because the lessons are designed to build off of the last one. Students can also generalize their knowledge by using their STEM notebooks in other situations/scenarios or other courses.	

Computational Thinking Framework Alignment to EbD Course: EbD-TEEMS PK-2			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Grade 2 - Lesson 09**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open- ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** An elementary version of the engineering design process is introduced and students learn how to work through the EDP to formulate solutions to problems. Students are introduced to using a computer and scientific instruments and tools to solve problems such as rulers, beakers, thermometers, scales, etc.	Students use their STEM Notebooks and the engineering design process to use biomimicry to create a tool that they can use in their home or school. Students need to also create an advertisement to explain how it works and from what animal/plant it comes from.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Many graphic organizers are used to help the students organize and analyze their data. Student learn how to use their STEM notebooks to document their ideas, research, designs, evaluations, and iterations.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students have many opportunities to create models as a means of representing data. Some examples include: models of caterpillars/cocoons/butterflies in preschool, animal ecosystems in kindergarten, models of how to make vibrations using a set of materials in first grade, and a seed dispersal model to show how animals move seeds around in second grade.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students document their algorithmic thinking in their STEM notebooks and through graphic organizers.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students work through the engineering design process to identify their design brief problems, create a model/design, analyze its effectiveness by testing it out, and working with their team to identify ways of making it more efficient whether it is from their directions or resources they are using.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students transfer their knowledge from one lesson to the other because the lessons are designed to build off of the last one. Students can also generalize their knowledge by using their STEM notebooks in other situations/scenarios or other courses.	

Computational Thinking Framework Alignment to EbD Course: Game Art Design			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 7 - Game Production**
Formulating problems in a way that enables us to use computer and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open-ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students first learn about the history of game design and identify what the game industry requires of their employees and then use that information to design and construct their own game design using the computer and other tools and resources.	Students are tasked to create an original 2D game by including a storyboard, 2D simulation of the game, and a critique of the game.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students use print materials as well as Microsoft PowerPoint to organize and analyze their data. Students can use other audiovisual materials to help them in their sketching and storyboard creation. Students must launch their game and evaluate its effectiveness.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students begin representing their data through technical sketches, flow charts, storyboards, and computer simulations that they create. Students present their data using audiovisual presentations and 3D Modeling.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** In order to create an original game idea, students must document their entire design process using algorithmic thinking so that if someone else would like to recreate their game, that user would be able to have a comprehensive list of directions.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students identify what type of game they would like to create and analyze information from other games in that genre. Once the research is completed, the student will create a plan detailing how their game will be created. Students must evaluate their game design to ensure it is efficient and effective through the directions and resources available.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students transfer their problem-solving skills throughout all the lessons of this course. From learning 2D animated sprites to 3D environments and character design, students use their problem-solving processes in all of the design challenges. In addition, they can generalize their knowledge to the Game Art Design Technology Student Association competition (if offered by their school).	

Computational Thinking Framework Alignment to EbD Course: Advanced Design Applications			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 2- Lesson 3- Energy Transfer**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students are exposed to many different types of technological systems such as SeaPerch, Arduinos, control sensors, and much more. Students are taught how to use various technological items to help them solve problems in addition to using a computer for research, data collection, surveying, geographic mapping, etc.	In this lesson, students apply their knowledge of mechanical advantage and simple machines to design and construct a solar powered race car. Students document their algorithmic thinking and problem solving in their engineering design notebooks.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students use their engineering design journals to organize and analyze their data. Students also communicate their findings in multimedia presentations.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students in this course have the opportunity to create many models and simulations for each of their engineering design challenges. Students represent data through diagrams, charts, tables, flow charts, graphs and technical drawings (both hand drawn or computer aided design).	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students document their algorithmic thinking in their engineering design journals. These journals are very important because they keep the students' work organized and act as a culminating portfolio for each of the design challenges in the course. Students create automated solutions by creating "green" houses, wind turbines, solar powered vehicles, and underwater robots. Students learn how electrical relays work and how they can also be used in fabricating their own design solutions.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** Students identify the problem of each of the design brief and problem solve to design it the most efficient and effective way possible. In some of the challenges, students are given a budget and set of criteria they need to include in their design.	
Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem solving process to a wide variety of problems?** As students learn about the engineering design process, they use it within all of their unit lessons to document what they learned and what their designs are. Students generalize and transfer what they learned to other design challenges and even to their Technology Student Association competitions (if their school offers it).	

Computational Thinking Framework Alignment to EbD Course: Engineering for All			
Computational Thinking Characteristic	**Computational Thinking Skills/Dispositions**	**What will be used to teach this Computational Thinking Characteristic?**	**Course Exemplar Unit 1- Lesson 3- Hydroponics Laboratory**
Formulating problems in a way that enables us to use computers and other tools to help solve them	Confidence in dealing with complexity Persistence in working with difficult problems Tolerance for ambiguity The ability to deal with open ended problems The ability to communicate and work with others to achieve a common goal or solution.	**How do students formulate problems in a way that enables them to use a computer and other tools to help solve those problems?** Students are introduced to global problems such as the food and water crisis around the world. Students must research these issues and apply their research skills while using a computer and other scientific instruments (hydroponic/aeroponic systems, sensors, turbidity water sample tubes, etc.). Students also model using computer aided design software to create a solution that addresses the problem that they are given. By using their student companion supporting documents, students are able to deconstruct a problem into manageable segments that they can research using information technologies.	Students design, build, and maintain aeroponic and hydroponic systems that can be operated as a closed system. Students document their building process with a series of steps for constructing their design.
Logically organizing and analyzing data		**How do students logically organize and analyze data?** Students document their ideas and data that they collected in their design journals and then test their designs. As they test their designs, students measure various items such as the turbidity of their water samples. Then they use the data they collected to create visual representations that graph and display their analyzed data. Students are also expected to communicate their results and data to the class.	
Representing data through abstractions such as models and simulations		**How do students represent data through abstractions such as models and simulations?** Students represent their data through abstractions such as technical exploded view drawings/sketches and models that are designed using a computer aided design software. Students use the data that they collected from each design challenge to create a simulation of their design and a model that analyzes their results in a visual representation.	
Automating solutions through algorithmic thinking (a series of ordered steps)		**How do students create automated solutions through algorithmic thinking (a series of ordered steps)?** Students begin at a basic level of documenting their algorithmic thinking in their design journals and then transferring it to build their design solutions in a more complex design environment through the use of computer aided design where they need to create each of the subsystem components and then assemble them within the drawing.	
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources		**How do students identify, analyze, and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources?** In Engineering for All, students are introduced to fresh food engineers and the issue of clean water around the world. Students identify the imminent need and analyze the situation while making informed decisions for possible solutions that address the problem in an efficient and effective way. For example, students identify potential pollutants in water and research how to go about purifying water to make it suitable for drinking it. Students document the steps of their design thinking and references/resources they used to develop their solution(s) in their design journals.	

Generalizing and transferring this problem-solving process to a wide variety of problems		**How do students generalize and transfer a specific problem-solving process to a wide variety of problems?** Students transfer each of the phases of the engineering design process to develop their solutions. Students apply their knowledge of technological systems to create an aeroponics and hydroponic system that can be maintained remotely as well as create water filters that remove pollutants from water. Each of the lessons in these units teach students valuable problem-solving skills that the students can use to apply them to different situations and scenarios.	