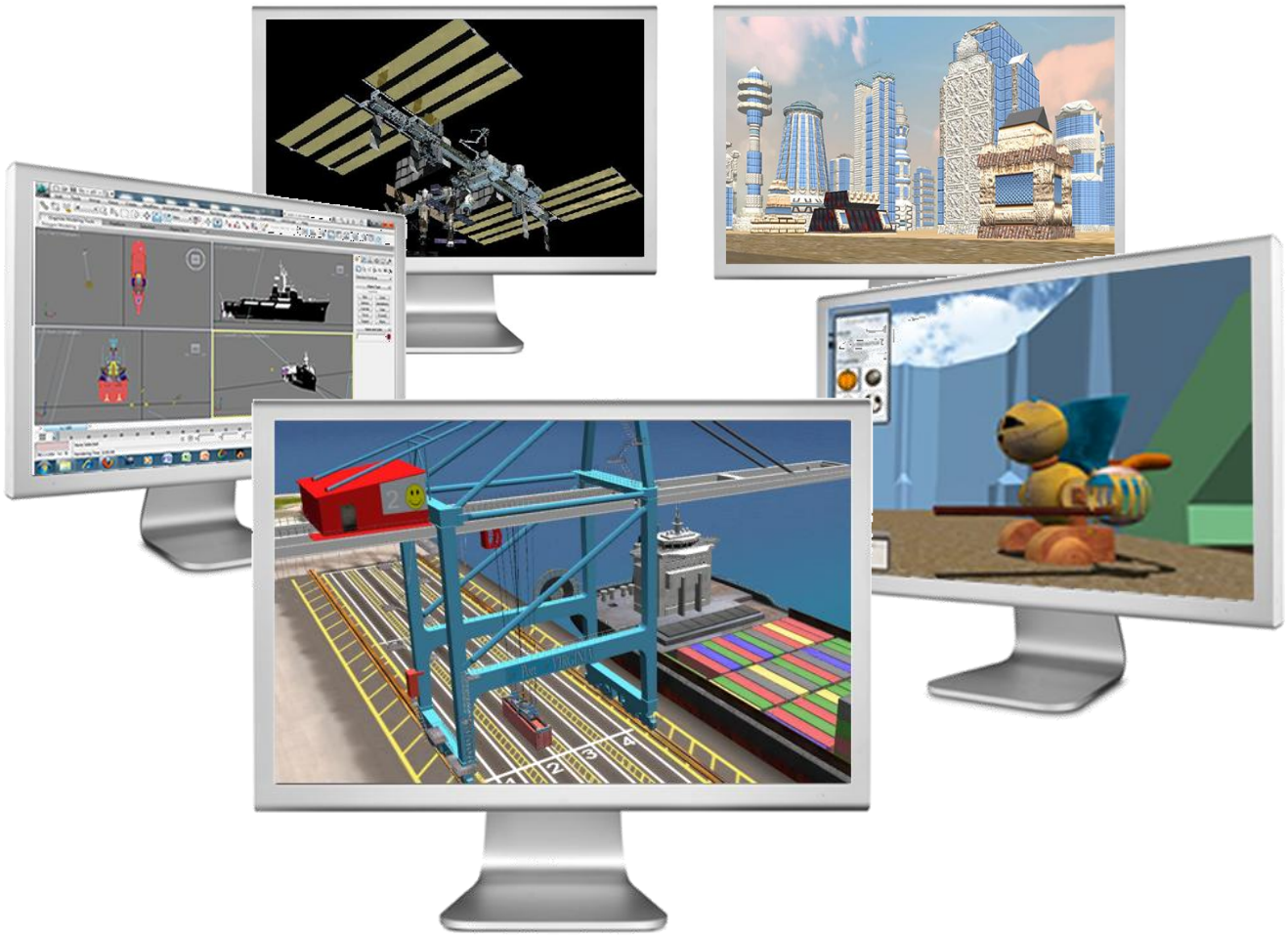
Modeling and Simulation

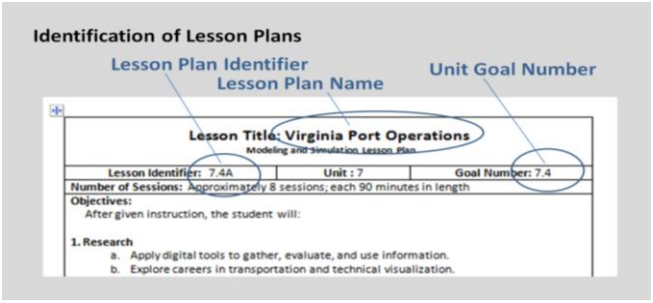
A Model High School Curriculum

LESSON PLANS



These Lesson Plans Complement the Modeling and Simulation Curriculum

These lesson plans are designed for use in the *Modeling and Simulation Model High School Curriculum* (2009). Each lesson plan is identified by a "lesson identifier" number. This number is located at the top left of the lesson plan and not only identifies the lesson, but shows which unit of the main curriculum the lesson supports (see diagram below).



For example, lesson *7.4A Virginia Port Operations* (above), supports unit goal 7.4 in the main curriculum. Since some unit goals are supported by more than one lesson plan, the lesson plans also have a letter that identifies its place in the curriculum.

How to Use This Lesson Plan Booklet

This booklet contains all of the lesson plans that support the main curriculum, it is provided as a separate document for your convenience. All of these lesson plans are also contained in the main curriculum. And, these same lesson plans are provided online as part of the units they support. It is hoped that providing these same lesson plans several different ways will be a help to you.

Lesson Plan Order (Each lesson plan has its own page numbering)

LP Identifier	Lesson Plan Name	Supports Unit Goal#
1.3A	Parametric Modeling	1.3
3.8A	Monte Carlo Simulation	3.8
3.8B	Wind Turbine Simulation	3.8
4.1A	Animation	4.1
5.3A	Agent-Epidemiology	5.3
5.3B	Agent-Predator/Prey	5.3
7.2A	Stonehenge Simulation	7.2
7.2B	International Space Station Simulation	7.2
7.2C	Sustainability Simulation	7.2
7.2D	Virginia Port Operations Simulation	7.2

Lesson Title: Parametric Modeling/Animated Design

Modeling and Simulation Lesson Plan

Lesson Identifier: 1.3A	**Unit :** 1	**Goal Number:** 1.3

Number of Sessions: Approximately 8 sessions

Objectives:

After given instruction, the student will:

1. Design

a. Edit an assembly component.
b. Apply appropriate constraints to an assembly.
c. Drive constraints to animate an assembly.
d. Check for interferences.
e. Generate a report of interferences using diagnostic tools.
f. Make design corrections to fix any interferences.
g. Review/change physical properties as needed.
h. Detect points of collision

2. Model

a. Render a model.
b. Animate a model.
c. Generate a detailed assembly drawing.
d. Create various sectional views to show internal operations.
e. Create parts drawing with BOM/Parts Listing
f. Compile/render an animation file.

3. Develop 21st Century Skills - 21st Century Skills Culture at High Tech High
(Show students this video and discuss their reaction prior to beginning instruction)

a. Use flexibility and adaptability as they evaluate their work throughout the project process.
b. Become self-directed learners as they produce quality products.
c. Work in diverse teams to complete projects on time.
d. Develop leadership, responsibility, social skills, collaboration skills, and cultural awareness.

Materials/Technology Integration: **Texts:** Baker, S. 1988 High Lift Scissor Jack US PATENT 4718519; Tampa Fl. Autodesk 2009 "Education and Instructor"; www.Autodesk.com *Autodesk Inventor 2009 Essentials 8th Edition*, Publisher; Cengage J. Larkin*, Practical Problems in Mathematics for Drafting and CAD 3rd ;* Larkin C. Jenson, *Interpreting Engineering Drawings 7th.*; Thomas, Delmar Learning	**Internet Resources:** **Internet Resources:** www.autodesk.com **Electronics** Computers with Internet Access Inventor or Solid Works Software Multimedia Projector **Design Brief** Modeling and Simulation (Parametric Modeling/Animated Design)

Anticipatory Set:
Review High Lift Scissor Jack US Patent 4718519 and Modeling and Simulation (Parametric Modeling/Animated Design)

Estimated Time: 5 minutes

Modeling and Simulation Competencies
Exploring Modeling and Simulation: 1.1, 1.2
Demonstrating Computer Skills: 2.1, 2.2, 2.3, 2.6
Exhibiting Mathematical Skills: 3.2, 3.7, 3.8
Understanding Problem Analysis: 4.4
Demonstrating Programming: 5.1, 5.2 5.3
Investigating Modeling and Simulation: 6.1, 6.3, 6.5
Demonstrating Visualization: 7.1, 7.2

Correlation with Virginia Standards of Learning:

English: 9.4, 9.6, 9.8, 10.4, 10.11, 11.4, 11.10, 12.4,
History and Social Science: GOVT.1, GOVT.9, GOVT.17, WHII.15, VUS.14,
Mathematics: COM.6, COM.7, COM.8, COM.13, COM.16, DM.5, G.2, G.12 MA.6, PS.12, PS.13
Science: CH.1, ES.1, ES.3, PH.1, PH.2, PH.4

Evaluation: Evaluation of key elements throughout project. **Estimated Time:** 20-30 Minutes	**Closure:**
Homework: None	**Reflections:**

Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
PROJECT 1	
Project #1: Review Patent and Design Drawings with students. **Estimated Time:** 15-20 minutes	**Project #1:** Copy Patent and Design Drawings onto your flash drive or into your personal folder. Read patent and review drawings **Estimated Time:** 15-20
PROJECT 2	
Project #2: Assign Tutorial "Working with Assembly Constraints" **Estimated Time:** 25-30 minutes	**Project #2:** Complete Tutorial "Working with Assembly Constraints" **Estimated Time:** 25-30 minutes
PROJECT 3	
Project #3: Assign students (Part One) to create assembly of "High Lift Scissor Jack" using Component files and Fasteners. Note if using Inventor open High Lift Scissor Jack.ipj before beginning. Use STL files if using Solid-works or Pro Engineering **Estimated Time:** 90-120 minutes	**Project #3:** Create assembly of "High Lift Scissor Jack" using Component files and Fasteners. Note if using Inventor open High Lift Scissor Jack.ipj before beginning. Use STL files if using Solid-works or Pro Engineering **Estimated Time:** 90-120 minutes
PROJECT 4	
Project #4: Assign Tutorials Applying Drive Constraints Analyze an Assembly **Estimated Time:** 75-90 minutes	**Project #4:** Complete Tutorials Applying Drive Constraints Analyze an Assembly **Estimated Time:** 75-90 minutes
PROJECT 5	
Project #5: Assign (Part Two) apply drive constraints and analyze the completed assembly **Estimated Time:** 75-90 minutes	**Project #5:** Using assembly created in Project 3 complete (Part Two) applying drive constraints and analyzing the assembly. Make adjustments to assembly; record all changes to correct problems in report. Complete and submit all report. **Estimated Time:** 75-90 minutes

PROJECT 6	
Project #6: Assign Tutorials Animate Constraints Create Rendered Images **Estimated Time:** 75-90 minutes	**Project #6:** Assign Tutorials Animate Constraints Create Rendered Images **Estimated Time:** 75-90 minutes
PROJECT 7	
Project #7: Assign (Part Three) create an animation of the preliminary prototype High Lift Scissor Jack **Estimated Time:** 90-120 minutes	**Project #7:** Using constrained assembly of High Lift Scissor Jack created in Project 5 complete (Part Three) create an animation of the preliminary prototype **Estimated Time:** 75-90 minutes
PROJECT 8	
Project #8: Assign Tutorials Create Multi-View Drawings Create Section, Auxiliary and Detail Views Create Assembly Views Create a Parts List Create Presentation Views **Estimated Time:** 90-120 minutes	**Project #8:** Complete Tutorials Create Multi-View Drawings Create Section, Auxiliary and Detail Views Create Assembly Views Create a Parts List Create Presentation Views **Estimated Time:** 90-120 minutes
PROJECT 9	
Project #9: Assign (Part Four) produce drawings needed for the new Patent for the High Lift Scissor Jack. **Estimated Time:** 90-120 minutes	**Project #9:** Assign (Part Four) produce drawings needed for the new Patent for the High Lift Scissor Jack. **Estimated Time:** 90-120 minutes
PROJECT 10	
Project #10: Assign Tutorials (Extra Credit) (Extra credit) Using Dynamic Simulation **Estimated Time:** 75-90 minutes	**Project #10:** Complete Tutorial (Extra Credit) (Extra credit) Using Dynamic Simulation **Estimated Time:** 75-90 minutes
PROJECT 11	
Project #11: Assign (Extra Credit) Create a dynamic Simulation of High Lift Scissor Jack **Estimated Time:** 90-120 minutes	**Project #11:** Assign (Extra Credit) Create a dynamic Simulation of High Lift Scissor Jack **Estimated Time:** 90-120 minutes

Lesson Title: A Monte Carlo Simulation of Pi

Modeling and Simulation Lesson Plan

Lesson Identifier: 3.8A	**Unit :** 3	**Goal Number:** 3.8

Number of Sessions: One

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Understand the basics of a Monte Carlo simulation
c. Define modeling and simulation terms.

2. Model

a. Analyze and modify an existing computer program.
b. Create a spreadsheet simulation

3. Present

a. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.

Materials/Technology Integration:

Text:

· Word processing software
· Acrobat Reader
· Computer with Internet access and a web browser that is Java –enabled
· Spreadsheet software

Anticipatory Set: *Monte Carlo is a popular vacation destination in Monaco, Europe, famous not only for its sweeping views of the Mediterranean but also for its casino and gambling. Because of its association with games of chance, Monte Carlo is used to describe a style of simulations in which the outcomes of the simulation depend entirely on repeated, random samples taken from a particular probability distribution. In this way, Monte Carlo methods often simulate "rolling dice", "drawing a card from a deck", or similar analogy. As the number of "draws" rises higher and higher, a Monte Carlo method usually points to a progressively better estimate or solution. In this lesson, you are going to "throw darts" at random toward a virtual dartboard and then determine from their position on the dartboard an estimated value for the mathematical constant, pi.*

Estimated Time: 5 – 10 Minutes

<table>
<tr><td colspan="2">Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: COM.1, COM.12,A.1, A.3, A.5, G.7, G.10, G.13, G.14, C/T9-12.6, 9-12.7, 9-12.8, 9-12.9 PS1, PS13, PS15
Science: PH.2
History and Social Science:</td></tr>
<tr><td>Evaluation: Assigned Activities
1. Students successfully answer 75% of the post test questions.
2. Student spreadsheets.
3. Student answers from reflection questions.
4. Student reports/presentations on the historical development of a value for pi. (Optional)

Estimated Time: As Noted</td><td>Closure:</td></tr>
<tr><td>Homework: None</td><td>Reflections:</td></tr>
<tr><td>Procedure: Guided Practice (Instructional Strategies)</td><td>Procedure: Independent Practice</td></tr>
<tr><td colspan="2">PROJECT 1</td></tr>
<tr><td>Project #1: Discuss the meaning of the term Monte Carlo simulation. Discuss what is meant by “random” and “pseudo-random.” Refresh/instruct students on the properties of a circle and a square to include calculation of area. Work with students through the first two pages of the student instructions to ensure students follow the mathematical reasoning that supports the intended simulation. Point out to students the web resources available for them, as given in the student instructions.

Estimated Time: 20 Minutes</td><td>Project #1: Read the Student Instructions along with the instructor. When asked to do so, open Excel and follow the procedures outlined on page 3 and 4 to perform the simulation.

Estimated Time: 40 Minutes</td></tr>
<tr><td colspan="2">PROJECT 2</td></tr>
<tr><td>Project #2: Monitor students as they use Excel to perform the simulation.

Estimated Time: 40 Minutes</td><td>Project #2: Confirm your results with the instructor. Experiment by changing the number of simulation “throws” – how does this affect the accuracy of the estimate? Answer the reflection questions provided on page 4 of the student instructions.

Estimated Time: 20 Minutes</td></tr>
<tr><td colspan="2">Additional Resources</td></tr>
<tr><td colspan="2">All required resources are provided in the student instructions.</td></tr>
</table>

Lesson Title: Energy and Power-Wind Turbines

Modeling and Simulation Lesson Plan

Lesson Identifier: 3.8B	**Unit :** 3	**Goal Number:** 3.8B

Number of Sessions: Approximately 18 sessions; each 45 minutes in length, or 9 sessions; each 90 minutes in length.

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Investigate windmill technology.
c. Conduct an environmental analysis.
d. Review economic feasibility.

2. Design

a. Create a rough sketch.
b. Plan a model windmill farm based on desired kilowatt output.
c. Develop and analyze a storyboard.

3. Model

a. Generate the mathematical model that shows how much power a wind driven generator will create.
b. Create a model computer network to monitor and manage a wind turbine farm.
c. Create a model of a wind turbine farm.
d. Incorporate environmental factors into the wind turbine model such as ocean waves and currents.

4. Develop 21st Century Skills - 21st Century Skills Culture at High Tech High
(Show students this video and discuss their reaction prior to beginning instruction)

a. Use flexibility and adaptability as they evaluate their work throughout the project process.
b. Become self-directed learners as they produce quality products.
c. Work in diverse teams to complete projects on time.
d. Develop leadership, responsibility, social skills, collaboration skills, and cultural awareness.

Materials/Technology Integration:

Text:

· Computer with Internet access and a web browser.
· Word processing software.
· Presentation software.
· Spreadsheet Software
· **Storyboard template (Word Doc)**
· 3D modeling software (i.e. Inventor, 3D Studio Max)
· Mapping Software (i.e. Google Earth)
· Multimedia Projector

Anticipatory Set: Our country and planet have begun taking large steps to become more "green". This stems from many areas including wise use of resources to reducing the emissions that contribute to global warming. The problem with this is that the earth's population keeps growing as does the demand for energy. Electrical power is continuously examined as a clean alternative to fossil fuels. A plan has been proposed within the Commonwealth of Virginia to build an off-shore wind driven turbine farm to generate electrical power to supplement the needs of the state and help reduce the burning of fossil fuels.

Estimated Time: 5 Minutes

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2
Science: PH.1, PH.2
History and Social Science: WHII.1, WHII.6, WHII.8
The overall goal of these activities is to empower students to use 21st century tools in a learning process that requires critical and creative thinking, collaboration, and problem solving. The immediate goal is to engage students in hands-on, less abstract learning. The ultimate goal is preparing students for work and life in a changing economy that demands participants who are creative and innovative thinkers in addition to being skilled digital-age workers.

Evaluation: Assigned Activities
Students successfully answer 75% of the post test questions.

1. Review storyboard for staging, camera angles, and correctness.
2. Students mathematically model the kilowatt output of a windmill.
3. Students complete an animated model of a windmill farm.
4. Present completed model to the class for peer critique.

Estimated Time: As Noted

Closure:

Homework: Windmill and environmental research.	**Reflections:**
Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
PROJECT 1	
Project #1: View video *21st Century Skills: How Dow We Get There?* **Estimated Time:** 20 Minutes	**Project #1:** You and your teammate must answer the questions on the worksheet (word doc)after you view the video. **Estimated Time:** 20 Minutes
PROJECT 2	
Project #2: Review the handout *Modeling & Simulation Case Study: Off Shore Wind Turbine Farm*. (Word Doc)Assign students into teams of two. **Estimated Time:** 20 Minutes	**Project #2:** You and your teammate need to discuss the questions in the case study and set up an electronic portfolio using word processing software with the following sections: · Research · Feasibility · Models o Mathematical model o Three-dimensional model **Estimated Time:** 20 Minutes
PROJECT 3	
Project #3: Review the handout *Feasibility Study* (Word Doc) and have the students research each question for their portfolio. **Estimated Time:** 20 Minutes	**Project #3:** You and your teammate will have 4 classes (or 2 block periods) to research the feasibility of a windmill farm off the coast of Virginia. **Estimated Time:** 180 Minutes
PROJECT 4	
Project #4: Review the handout *Impact Study* (Word Doc) and have the students research each question for their portfolio. **Estimated Time:** 20 Minutes	**Project #4:** You and your teammate will have 4 classes (or 2 block periods) to research the environmental and economic impacts of a windmill farm off the coast of Virginia. **Estimated Time:** 180 Minutes
PROJECT 5	
Project #5: Demonstrate the purpose and process of using a storyboard. Be sure student work is copyright friendly and permission is obtained to distribute their work following the Acceptable Use Policies (AUP) within your school district. Use the following	**Project #5:** Develop a storyboard to model a windmill farm off the coast of Virginia. **Estimated Time:** 40 Minutes

as a guide: Adobe Storyboards PDF (Full PDF) Show video from Disney: The Art of Storyboarding http://filmmakeriq.com /pre-production/storyboarding/disney-the-artof-storyboarding.html Direct student teams to organize, plan, and design a modeled windmill farm based on their research. **Estimated Time:** 40 Minutes	
PROJECT 6	
Project #6: Student teams will create a three-dimensional model of a windmill farm off the Virginia coast. Students will have 8 classes (or 4 block periods). **Estimated Time:** 360 Minutes	**Project #6:** You and your teammate will model an offshore windmill farm. Use your research, storyboard, and other portfolio materials to create a scale model. Make sure you focus on the materials, lights, and cameras. Your model must include motion. You will have 8 classes (or 4 block periods) for this assignment. **Estimated Time:** 360 Minutes

Lesson Title: Fundamentals of Animation

Modeling and Simulation Lesson Plan

Lesson Identifier: 4.1A	**Unit :** 4	**Goal Number:** 4.1

Number of Sessions: Six

Objectives:

After given instruction, the student will:

1. Describe

a. State the basic principles of animation and persistent vision.
b. Describe flipbooks and computer animation.

Materials/Technology Integration:

Texts:

1. Furniss, M. 2008. *The Animation Bible; A practical Guide to the Art of Animation, from Flipbooks to Flash*. HNA Inc. New York, NY
2. Williams, R. 2001. *The Animator's Survival Kit; A Manual of Methods, Principles and Formulas,* Faber and Faber Ltd. New York, NY

· Computer with Internet access and a web browser.
· MS Paint.
· Movie 13 software.
· Multimedia Projector

Design Brief(s)

· *Phenakistoscope*
· *Flipbooks and Computer Animation*

Internet Resources

http://joshuamosley.com/UPenn/courses/Ani/AnimationHistory.html
http://www.animazing.com/gallery/pages/history.html
http://www.animazing.com/gallery/pages/artterms.html

Anticipatory Set: What is persistence of vision?

Estimated Time: 5 Minutes

Correlation with Virginia Standards of Learning:

English: 9.4, 9.6, 9.8, 10.4, 10.11, 11.4, 11.10, 12.4,
History and Social Science: GOVT.1, GOVT.9, GOVT.17, WHII.15, VUS.14,
Mathematics: COM.6, COM.7, COM.8, COM.13, COM.16, DM.5, G.2, G.12 MA.6, PS.12, PS.13
Science: CH.1, ES.1, ES.3, PH.1, PH.2, PH.4

Evaluation:	**Closure:**
Homework: None	**Reflections:**
Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
PROJECT 1	
Project #1: Introduce the concepts of the appearance of motion. Assign the *Phenakistoscope* project. **Estimated Time:** 15-20 Minutes	**Project #1:** Complete the *Phenakistoscope* project. **Estimated Time:** 15-20 Minutes
PROJECT 2	
Project #2: Review the historical aspects, terms and methods of simulating motion. **Estimated Time:** 15-20 Minutes	**Project #2:** Student research historical aspects, terms and methods of simulating motion. Create a historical timeline of animation. Chose one historical person associated with animation and write a brief bio on them. **Estimated Time:** 45-90 Minutes
PROJECT 3	
Project #3: Have student research Persistence of Vision. Is it myth or fact? **Estimated Time:** 5-10 Minutes	**Project #3:** Students write a brief (150-250 word in three to five paragraphs) paper on "Persistence of Vision" and its application in animation. Are the statements in the previous project true? Use the internet to research this topic. **Estimated Time:** 90-120 minutes
PROJECT 4	
Project #4: Introduce design brief Flipbooks and Computer Animation**.** **Estimated Time:** 5-10 Minutes	**Project #4:** Complete elements of design brief Flipbooks and Computer Animation**.** **Estimated Time:** 5-10 Minutes

Lesson Title: Agent Based Simulation of Epidemiology

Modeling and Simulation Lesson Plan

Lesson Identifier: 5.3A	**Unit :** 5	**Goal Number:** 5.3

Number of Sessions: Four

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Explore careers in programming, modeling and simulation.
c. Understand the basics of SIR, SEIR and other epidemiology models.
d. Define modeling and simulation terms.

2. Design

a. Plan and manage activities to develop a solution or complete a project.
b. Design a flowchart to document the step-by-step workings of an agent-based computer program.
c. Demonstrate creative thinking, construct knowledge, and develop innovative products and processes.
d. Work as a member of a design team.

3. Model

a. Analyze and modify an existing computer program.
b. Propose extensions to the basic model and design additional agents that can extend the model's behavior.
c. Create visualizations using basic design skills, graphing, image processing, 2D and 3D modeling, animation and simulation.

4. Present

a. Demonstrate a basic understanding of agent based simulations and how the behavior of the group is distributed among the individual agents.
b. Apply existing knowledge to generate new ideas, products, or processes. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.
c. Use computer data input and output devices that handle audio, video, static graphic, and alphanumeric-based information.
d. Create and deliver multimedia presentations.

Materials/Technology Integration:

· Word processing software
· Spreadsheet software
· Computer with Internet access and a web browser that is Java –enabled
· Game maker (v7.0, or greater)

Anticipatory Set: *With the onset of the virus H1N1, newfound interest is being placed in epidemiological models – those that help scientists monitor, predict, and plan responses to the spread of an infectious disease within a population. What do you know about H1N1 or other widespread diseases? How do you believe these diseases are spread? Are there any ways to prevent the spread of infection? What if you were in charge of protecting the students in your school from becoming ill? What steps would you take to ensure their safety?*

Estimated Time: 5 – 10 Minutes

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2, PS1, PS2, PS3, PS5, PS8, PS15
Science: BIO.1, BIO.2, BIO.9, PH.1, PH.2, PH.3, ES.1, ES.2
History and Social Science:

Evaluation: Assigned Activities

1. Students successfully answer 70% of the post test questions.
2. Students complete a flow chart that captures the decision-making rules carried out by agents in the existing SIR and SEIR models.
3. Students present an analysis of factors related to the spread of infectious disease.
3. Students successfully extend the basic model (provided) to capture or illustrate additional factors that might relate to the spread of disease.
4. Students analyze the results of their adapted model and present their findings to the class for peer critique.

Estimated Time: As Noted

Closure:

Homework: None

Reflections:

Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
PROJECT 1	
Project #1: Discuss the nature of infectious diseases (H1N1, chicken pox, tuberculosis, etc.). Walk students through the basic SIR (Susceptible, Infectious, Recovered) model. **Estimated Time:** 20 Minutes	**Project #1:** Research the SIR and SEIR models for epidemiology online. Describe how members of the population move between each of the different compartments. **Estimated Time:** 20 Minutes
PROJECT 2	
Project #2: Show students the operation of the SickSim model. Guide students through an interpretation of the symbols used to represent and data gathered from the simulation. **Estimated Time:** 10 Minutes	**Project #2:** Students take the SickSim tool and perform additional simulation runs. Have students adjust each of the initial starting parameters and interpret the different results. [For this and project #3, students should leave Chance of Recovery at 0%.] **Estimated Time:** 10 Minutes
PROJECT 3	
Project #3: Show students the text file used to record the simulation data. Show and discuss the Excel spreadsheet used to plot the data. Guide students through the interpretation of the S-plot exhibited by the data set. Walk students through the process of importing data from a text file and graphing it in Excel (Note: the Edit Text Import feature of Excel can be used to "refresh" the data and draw a revised plot following each simulation run.) **Estimated Time:** 20 Minutes	**Project #3:** Students make three additional runs using the SickSim simulation tool. After each run, save the data to a unique file name. Using Excel, import the three data sets and compare results. [As with Project #2, students should leave Chance of Recovery at 0%.] **Estimated Time:** 30 Minutes
PROJECT 4	
Project #4: Guide students through the operation of the SickSim2 simulation tool. Explain how each of the different values requested of the user at the start of the simulation affects the spread of disease. Ask students to predict the effect of a marked change in any of the factors. **Estimated Time:** 15 Minutes	**Project #4:** Student exploration of the SickSim simulation tool when Recovery is made possible. As before, students should establish a baseline data record and then compare the baseline to results received when adjustments are made to the initial parameters. **Estimated Time:** 30-40 Minutes

PROJECT 5	
Project #5: None	**Project #5:** Students analyze graphs of the baseline data and compare them to graphs from each of the adjusted runs. Students or student teams compile their findings and present their conclusions using overhead presentation software. **Estimated Time:** 40 Minutes
PROJECT 6	
Project #6: Open the SickSim.gmk file to show students how the simulation was constructed. Help students identify the objects used to represent the individual agents, as well as the scripts which the objects executed in order to carry out their behavior. A complete script PDF is included. **Estimated Time:** 25 Minutes	**Project #6:** Students prepare a flow chart showing the decisions made by each of the agents (susceptible, exposed, infected, recovered) during the running of the simulation. **Estimated Time:** 25 Minutes
PROJECT 7	
Project #7: Ask students to research other additional models using the Internet. What other factors could be used when simulating the spread of disease? How might each of these be worked into the existing program? **Estimated Time:** 20 Minutes	**Project #7:** Identify one factor that you think would affect the spread of the disease. Propose changes to the original Game Maker file that would illustrate the effects of such a change. Incorporate this feature into the model. Plot and analyze its impact. **Estimated Time:** 60 - 90 Minutes
PROJECT 8	
Project #8: Provide students the link to the Systems Dynamics model referenced below. Instruct students in operation of the tool. Highlight differences between agent-based modeling and the systems dynamics approach seen here. **Estimated Time:** 10 Minutes	**Project #8:** Work through the H1N1 Stella model screen by screen. How does it compare with the agent-based simulation used in this lesson? What strengths can you identify in each approach? **Estimated Time:** 20 Minutes

Additional Resources
Game Maker Website http://www.yoyogames.com/make **Epidemiological Models** http://en.wikipedia.org/wiki/Compartmental_models_in_epidemiology **Agent based modeling** http://en.wikipedia.org/wiki/Agent_based **A Stella System Dynamics simulation of H1N1 model, for comparison** http://forio.com/service/netsims/netsim/h1n1/index.html

Lesson Title: Agent Based Simulation of Predator-Prey

Modeling and Simulation Lesson Plan

Lesson Identifier: 5.3B	**Unit :** 5	**Goal Number:** 5.3

Number of Sessions: Four

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Explore careers in programming, modeling and simulation.
c. Understand the basics of predator-prey biological models.
d. Define modeling and simulation terms.

2. Design

a. Plan and manage activities to develop a solution or complete a project.
b. Design a flowchart to document the step-by-step workings of an agent-based computer program.
c. Demonstrate creative thinking, construct knowledge, and develop innovative products and processes.
d. Work as a member of a design team.

3. Model

a. Analyze and modify an existing computer program.
b. Propose extensions to the basic model and design additional agents that can extend the model's behavior.
c. Create visualizations using basic design skills, graphing, image processing, 2D and 3D modeling, animation and simulation.

4. Present

a. Demonstrate a basic understanding of agent based simulations and how the behavior of the group is distributed among the individual agents.
b. Apply existing knowledge to generate new ideas, products, or processes. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.
c. Use computer data input and output devices that handle audio, video, static graphic, and alphanumeric-based information.
d. Create and deliver multimedia presentations.

Materials/Technology Integration:

· Word processing software
· Spreadsheet software
· Computer with Internet access and a web browser that is Java –enabled
· Game maker (v7.0, or greater)

Anticipatory Set: *The Butterfly Effect is a term used to describe the sensitivity of a dynamic system to small changes in initial conditions. A movie based upon the metaphor was released in 2004. For some systems, a small change in a single variable can have drastically different consequences or outcomes over time. The butterfly effect proposes that the seemingly insignificant flutter from a butterfly's wings can contribute to small changes in air currents that might then combine with other factors to result in a large scale variations in weather patterns that are oceans away. In this unit, you will evaluate models that depend greatly on the initial values of certain factors, as well as on probabilistic events.*

Estimated Time: 5 – 10 Minutes

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2, PS1, PS2, PS3, PS5, PS8, PS15
Science: BIO.1, BIO.2, BIO.9, PH.1, PH.2, PH.3, ES.1, ES.2, ENV.1, ENV.2, ENV.5, ENV.6
History and Social Science:

Evaluation: Assigned Activities

1. Students complete a flow chart that captures the decision-making rules carried out by agents in the predator-prey "Chickens and Foxes" simulation.
2. Students present an analysis of factors related to the relationship between the chickens and the foxes.
3. Students successfully extend the basic model (provided) to capture or illustrate additional behaviors.
4. Students analyze the results of their adapted model and present their findings to the class for peer critique.

Estimated Time: As Noted

Closure:

Homework: None

Reflections:

Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
PROJECT 1	
Project #1: Discuss the nature of dynamic models, in general, and predator-prey models in particular. **Estimated Time:** 20 Minutes	**Project #1:** Research predator-prey models on the Internet. What factors might be of concern when considering a model of how predator-prey relationships behave? **Estimated Time:** 20 Minutes
PROJECT 2	
Project #2: Show students the operation of the Fox and Chickens model. Guide students through an interpretation of the symbols used to represent the agents and the data gathered from the simulation. Instruct students in the nature of random data and how a "random seed" can be used in simulations to ensure repeatable outcomes of data runs. **Estimated Time:** 10 Minutes	**Project #2:** Students take the Fox and Chickens tool and perform additional simulation runs. Have students start with one of the random "seed" numbers provided and characterize the results. Students then adjust one of the initial starting parameters by just a little bit (299 chickens instead of 300, for example) and interpret the different results – in what ways does this model demonstrate sensitive dependence to initial conditions? Could the new behavior of the system have been predicted from the adjustment that was made? **Estimated Time:** 20 Minutes
PROJECT 3	
Project #3: Show students the text file used to record the simulation data. Show and discuss the Excel spreadsheet used to plot the data. Guide students through the interpretation of the S-plot exhibited by the data set. Walk students through the process of importing data from a text file and graphing it in Excel (Note: the Edit Text Import feature of Excel can be used to "refresh" the data and draw a revised plot following each simulation run.) **Estimated Time:** 20 Minutes	**Project #3:** Students make three additional runs using the Fox and Chickens simulation tool. After each run, save the data to a unique file name. Using Excel, import the three data sets and compare results. **Estimated Time:** 30 Minutes

PROJECT 4	
Project #4: Review the accompanying file that contains scripts from the simulation. Help students construct a flow chart of events by considering the "chicken strategy" and the "fox_strategy" that the agents execute during a turn. Ensure that students connect the logical rules that describe the behavior with their representation in the code. **Estimated Time:** 25 Minutes	**Project #4:** Student challenge – is it possible to choose initial conditions such that the system displays long term stability? Why or why not? What role does setting the random seed play in the process? **Estimated Time:** 30-40 Minutes
PROJECT 5	
Project #5: Ask students to research other additional models using the Internet. What other factors could be used when simulating the predator-prey relationship using an agent-based simulation? How might each of these be worked into the existing program? (Suggestions: fox waits after eating, chickens move faster when being chased, adjusting size of the environment, etc.) **Estimated Time:** 20 Minutes	**Project #5:** Identify one additional factor that you think could contribute to a more stable model. Propose changes to the original Game Maker file that would incorporate such a change. Incorporate this feature into the model. Plot and analyze its impact. **Estimated Time:** 60 - 90 Minutes

Additional Resources

Game Maker Website
http://www.yoyogames.com/make

Predator-Prey Relationships
http://en.wikipedia.org/wiki/Lotka%E2%80%93Volterra_equation

http://www.globalchange.umich.edu/globalchange1/current/lectures/predation/predation.html

http://www.tpwd.state.tx.us/publications/nonpwdpubs/young_naturalist/animals/predator_prey_relationship/index.phtml

The Butterfly Effect
http://en.wikipedia.org/wiki/Butterfly_effect

Lesson Title: From Stonehenge to Modern Monuments

Modeling and Simulation Lesson Plan

Lesson Identifier: 7.2A	**Unit :** 7	**Goal Number:** 7.2

Number of Sessions: Approximately 7 sessions; each 90 minutes in length

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Explore careers in engineering and architectural restoration/preservation technology.
c. Understand the basics of the history of ancient society and national monuments.
d. Define Stonehenge terms.

2. Design

a. Plan and manage activities to develop a solution or complete a project.
b. Develop and analyze a storyboard.
c. Demonstrate creative thinking, construct knowledge, and develop innovative products and processes.
d. Work as a member of a design team.

3. Model

a. Model the Stonehenge monolith or possible building process employed by its builders.
b. Create visualizations using basic design skills, graphing, image processing, 2D and 3D modeling, animation and simulation.

4. Present

a. Demonstrate a basic understanding of ancient technology concepts, and systems in historical architecture
b. Apply existing knowledge to generate new ideas, products, or processes.
c. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.
d. Use computer data input and output devices that handle audio, video, static graphic, and alphanumeric-based information.
e. Create and deliver multimedia presentations.

5. Develop 21st Century Skills - 21st Century Skills Culture at High Tech High
(Show students this video and discuss their reaction prior to beginning instruction)

a. Use flexibility and adaptability as they evaluate their work throughout the project process.
b. Become self-directed learners as they produce quality products.
c. Work in diverse teams to complete projects on time.
d. Develop leadership, responsibility, social skills, collaboration skills, and cultural awareness.

Materials/Technology Integration:

Text:

· Word processing software
· Presentation software (e.g. Movie maker, Photo Story)
· Computer with Internet access and a web browser that is Java –enabled
· Electronic Portfolio
· Storyboard template
· Multimedia Projector
· Mapping software e.g. Google Earth
· Graph paper
· Computer with appropriate graphical software
· Pencil and paper

Anticipatory Set: Stonehenge is a prehistoric monument located in the English county of Wiltshire, about 3.2 kilometers (2.0 mi) west of Amesbury and 13 kilometers (8.1 mi) north of Salisbury. One of the most famous sites in the world, Stonehenge is composed of earthworks surrounding a circular setting of large standing stones and sits at the center of the densest complex of Neolithic and Bronze Age monuments in England, including several hundred burial mounds. Archaeologists have worked for many years to solve the questions of Stonehenge: When and why was the prehistoric monument built?

Ask students: What are some of the local monuments that are present in their community? Allow students the opportunity to verbalize their understanding of monuments impact on their community as well as on others outside of their community.

Estimated Time: 5 Minutes

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2
Science: PH.1, PH.2
History and Social Science: WHII.1, WHII.6, WHII.8

The overall goal of these activities is to empower students to use 21st century tools in a learning process that requires critical and creative thinking, collaboration, and problem solving. The immediate goal is to engage students in hands-on, less abstract learning. The ultimate goal is preparing students for work and life in a changing economy that demands participants who are creative and innovative thinkers in addition to being skilled digital-age workers.

Evaluation: Assigned Activities 1. Students successfully answer 75% of the post test questions. 2. Review storyboard for staging, camera angles, and correctness. 3. Students complete an animated model of Stonehenge or its possible technological building process. 4. Students present their portion of the project to their team and the other members of the class. 5. Present completed model to the class for peer critique. **Estimated Time:** As Noted	**Closure:**
Homework: None	**Reflections:**
Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
Teacher's Note: View video: *21st Century Skills: How Do We Get There?*	
PROJECT 1	
Project #1: Administer Pre Test to students. Explain that The results on this test will help identify their understanding and learning needs. **Estimated Time:** 20 Minutes	**Project #1:** Answer to the best of your ability the Pre Test questions. The results on this test will help identify your understanding and learning needs. **Estimated Time:** 20 Minutes

PROJECT 2	
Project #2: Show students video "New View on Stonehenge Burials" and discuss the location of Stonehenge, materials used, and tools available at the time of its construction. **Estimated Time:** 10 Minutes	**Project #2:** After watching video "New View on Stonehenge Burials". Discuss the location of Stonehenge, materials used and tools potentially available at the time of its construction. **Estimated Time:** 10 Minutes
PROJECT 3	
Project #3: Show and discuss Stonehenge ppt **Estimated Time:** 20 Minutes	**Project #3:** Watch and discuss Stonehenge ppt. Look for new information that you don't know. Make connections to the facts you already know about Stonehenge. Be an active learner. **Estimated Time:** 20 Minutes
PROJECT 4	
Project #4: Assign students the activity of defining the terms on Terminology worksheet and use them in context. This can be a team assignment where one member defines and the other team member uses the word in a context driven sentence. **Estimated Time:** 20 Minutes	**Project #4:** Define the terms on Terminology worksheet and use them in context as directed by your teacher. **Estimated Time:** 20 Minutes
PROJECT 5	
Project #5: Invite guest speaker to discuss Historical Monuments with students. E.g. Family/friends working in the field, museum curators, History teacher or others. (Students can be assigned the responsibility to soliciting guest speakers) **Estimated Time:** 35 Minutes	**Project #5:** Listen to guest speaker presentation on Historical Monuments and complete the guest speaker note taking sheet and hand in to teacher. **Estimated Time:** 35 Minutes

PROJECT 6	
Project #6: Discuss the historical timeline of significant historical monuments. Show students some British History Timeline example of timelines, in textbooks, and online etc. **Estimated Time:** 15 Minutes	**Project #6:** You and your team will make a historical timeline of significant historical monuments. Use your imagination to depict a graphical representation of the monuments size, materials used, building techniques and historical significance to society. **Estimated Time:** 55 Minutes
PROJECT 7	
Project #7: Have students develop and present a PowerPoint presentation on a US monument of their choice. Then discuss their presentation with the class. US Monument PowerPoint. *Extra credit: Students may model their monument, render and save as a jpeg then add to their ppt.* **Estimated Time:** 20 Minutes	**Project #7:** Develop and present a PowerPoint presentation on a US monument of your choice. Then discuss your presentation with the class. US Monument PowerPoint. *Extra credit: You may model your monument, render and save as a Jpeg then add to your ppt.*
PROJECT 8	
Project #8: Use Google Earth to map spot Stonehenge. Have students observe and discuss the 360 degree panoramic view of Stonehenge. Additionally students can map spot the monument of your choosing from Project #7 using Google Earth. **Estimated Time:** 5 Minutes	**Project #8:** Use Google Earth to map spot Stonehenge. Observe and discuss the 360 degree panoramic view of Stonehenge. Also map spot the monument of your choosing from Project #7 using Google Earth. **Estimated Time:** 20 Minutes
PROJECT 9	
Project #9: Demonstrate the purpose and process of using a storyboard. Be sure student work is copyright friendly and permission is obtained to distribute their work following the Acceptable Use Policies (AUP) within your school district. Use the following lesson as a guide. http://www.adobe.com/education/instruction/adsc/pdf/storyboards.pdf	**Project #9:** Develop a storyboard for modeling Stonehenge/ e.g. walk through, season changing, day to night, or guest passage under highway. Watch video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/ **Estimated Time:** 55 Minutes

Show video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/ Direct student teams to organize, plan, and design a modeled scene of Stonehenge of their choosing. E.g. walk through, seasons changing, day to night, or guest passage under highway. **Estimated Time:** 35 Minutes	
PROJECT 10	
Project #10: Organize students in teams to model Stonehenge to scale, add materials, lights, and cameras. *Optional: Animate some moving aspect then render the environment.* Use the scale drawing to assist in model development. **Estimated Time:** 360 Minutes	**Project #10:** You and your team members will model Stonehenge to scale, add materials, lights, and cameras. *Optional:* *Animate some moving aspect then render the environment.* Use the scale drawing to assist in model development. **Estimated Time:** 360 Minutes
Additional Resources	
Stonehenge http://www.sacredsites.com/europe/england/stonehenge.html **National Mall** http://www.nps.gov/nama/ http://washington-landmarks.com/mall.html http://www.cr.nps.gov/nr/travel/wash/natmallmap.htm http://dcpages.ari.net/Hwdc/mall.html **The Pentagon** http://pentagon.afis.osd.mil/ http://www.greatbuildings.com/buildings/The_Pentagon.html **The Lincoln Memorial** http://www.nps.gov/linc/index.htm http://www.cr.nps.gov/nr/travel/wash/dc71.htm http://washington-landmarks.com/lincoln_memorial.html **The Washington Monument** http://www.nps.gov/wamo/ http://www.cr.nps.gov/nr/travel/wash/dc72.htm http://washington-landmarks.com/washington_monument.html http://www.greatbuildings.com/buildings/Washington_Monument.html	

The White House
http://www.whitehouse.gov/history/life/
http://www.whitehousehistory.org/
http://washington-landmarks.com/white_house.html
http://www.greatbuildings.com/buildings/The_White_House.html
http://www.beyondbooks.com/gop00/3a.asp
The Capital Building
http://www.aoc.gov/
http://washington-landmarks.com/united_states_capitol.html
http://www.cr.nps.gov/nr/travel/wash/dc76.htm

Lesson Title: International Space Station

Modeling and Simulation Lesson Plan

Lesson Identifier: 7.2B	**Unit :** 7	**Goal Number:** 7.2

Number of Sessions: Approximately 10 sessions; each 90 minutes in length

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Explore careers in space and technical visualization.
c. Understand the basics of the ISS program
d. Define modeling and simulation terms.

2. Design

a. Plan and manage activities to develop a solution or complete a project.
b. Develop and analyze a storyboard.
c. Demonstrate creative thinking, construct knowledge, and develop innovative products and processes.
d. Work as a member of a design team.

3. Model

a. Model a space station facility.
b. Create visualizations using basic design skills, graphing, image processing, 2D and 3D modeling, animation and simulation.

4. Present

a. Demonstrate a basic understanding of technology concepts, and systems in the ISS.
b. Apply existing knowledge to generate new ideas, products, or processes.
c. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.
d. Use computer data input and output devices that handle audio, video, static graphic, and alphanumeric-based information.
e. Create and deliver multimedia presentations.

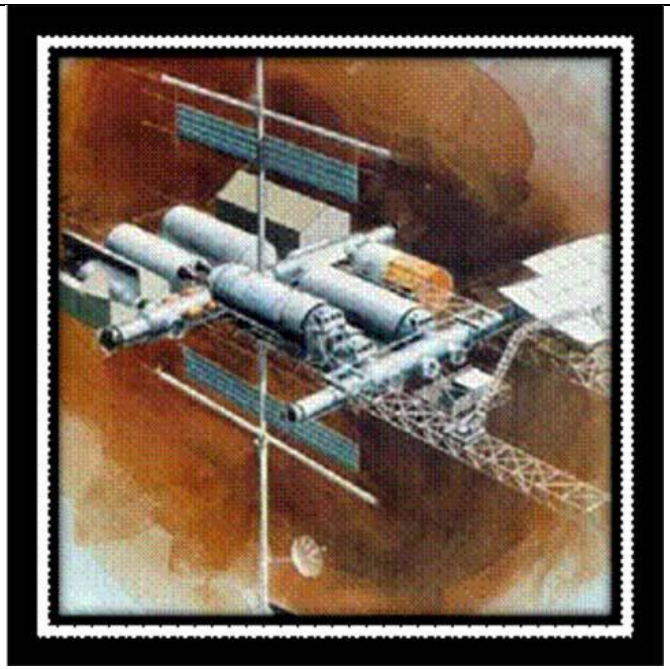
5. Develop 21st Century Skills - 21st Century Skills Culture at High Tech High
(Show students this video and discuss their reaction prior to beginning instruction)

a. Use flexibility and adaptability as they evaluate their work throughout the project process.
b. Become self-directed learners as they produce quality products.
c. Work in diverse teams to complete projects on time.
d. Develop leadership, responsibility, social skills, collaboration skills, and cultural awareness.

Materials/Technology Integration:

Text:

- · Word processing software
- · Presentation software (e.g. Movie maker, Photo Story)
- · Computer with Internet access and a web browser that is Java –enabled
- · Electronic Portfolio
- · Storyboard template
- · Multimedia Projector
- · Mapping software e.g. Google Earth
- · Graph paper
- · Computer with appropriate graphical software
- · Pencil and paper



Anticipatory Set: The International Space Station is a partnership of the US, Russian, European, Japanese, and Canadian Space Agencies. The station has been continuously occupied by humans since Nov 2, 2000. Orbiting 16 times per day at 17,500 miles per hour 250 miles above the ground, it passes over 90% of the world's surface. In 2010 when complete, it will weigh over 800,000 pounds and have a crew of 6 conducting research and preparing for future exploration to the moon and beyond. Your design firm has been contracted to model and animate the components of the ISS for an instructional video to train future engineers and scientists. It is your team's mission to first become knowledgeable about the ISS structure and its research and then complete the challenge below.

Ask students: *What are some benefits they see in society as a result of space exploration? Allow students the opportunity to discuss their understanding of the economic and human resources needed for space exploration.*

Estimated Time: 10 Minutes.

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2
Science: PH.1, PH.2
History and Social Science: WHII.1, WHII.6, WHII.8

The overall goal of these activities is to empower students to use 21st century tools in a learning process that requires critical and creative thinking, collaboration, and problem solving. The immediate goal is to engage students in hands-on, less abstract learning. The ultimate goal is preparing students for work and life in a changing economy that demands participants who are creative and innovative thinkers in addition to being skilled digital-age workers.

Evaluation: Assigned Activities 1. Students successfully answer 75% of the post test questions. 2. Review storyboard for staging, camera angles, and correctness. 3. Students complete an animated model of the ISS. 4. Students present their portion of the project to their team and the other members of the class. 5. Present completed model to the class for peer critique. **Estimated Time:** As Noted	**Closure:**
Homework: None	**Reflections:**
Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice
PROJECT 1	
Project #1: Administer Pre Test to students. Explain that The results on this test will help identify their understanding and learning needs. **Estimated Time:** 5 Minutes	**Project #1:** Answer to the best of your ability the Pre Test questions. The results on this test will help identify your understanding and learning needs. **Estimated Time:** 20 Minutes

PROJECT 2	
Project #2: Show students and discuss *How the Crew Lives and Works*, and the ISS 360 video tour. http://www.nasa.gov/externalflash/ISSRG/ **Estimated Time:** 20 Minutes	**Project #2:** Watch video and discuss *How the Crew Lives and Works*, and the ISS 360 video tour. http://www.nasa.gov/externalflash/ISSRG/ **Estimated Time:** 20 Minutes
PROJECT 3	
Project #3: Show and discuss ISS ppt and the ISS animated assembly. Show the ISS come together over the years at http://www.usatoday.com/tech/science/space/2008-11-19-issassembly_N.htm **Estimated Time:** 40 Minutes	**Project #3:** Show and discuss ISS ppt and the ISS animated assembly. Show the ISS come together over the years at http://www.usatoday.com/tech/science/space/2008-11-19-issassembly_N.htm **Estimated Time:** 40 Minutes
PROJECT 4	
Project #4: Assign students the activity of defining the terms on Terminology worksheet and use them in context. This can be a team assignment where one member defines and the other team member using the word in context. **Estimated Time:** 5 Minutes	**Project #4:** Define the terms on Terminology worksheet and use them in context as directed by your teacher. **Estimated Time:** 25 Minutes
PROJECT 5	
Project #5: Discuss with students the general history of space exploration and NASA. Have them view the 1959 Press Conference introducing the first US astronauts and discuss its relevance to the ISS mission. http://www.nasa.gov/externalflash/50th_announcement/ **Estimated Time:** 25 Minutes	**Project #5:** Discuss the general history of space exploration and NASA. View the 1959 Press Conference introducing the first US astronauts and discuss its relevance to the ISS mission. Identify 3 things in the press conference that seem different by todays standards. http://www.nasa.gov/externalflash/50th_announcement/ **Estimated Time:** 25 Minutes

PROJECT 6

Project #6: Have students view the NASA ISS Photosynth site and study the components of the ISS close-up. This can be a team or individual activity.
http://www.nasa.gov/externalflash/photosynth/index.html

Estimated Time: 5 Minutes

PROJECT 7

Project #7: Have students read and discuss the Architecture Design Evolution Reference guide. Assign students to write a (3) paragraph report on: How the design process impacts them in developing their 3d model objects and scenes.

Estimated Time: 10 Minutes

PROJECT 8

Project #8: Show and discuss the Integrated Truss Assembly this will allow students to observe the scale and location of the ISS components.
http://www.nasa.gov/externalflash/ISSRG/pdfs/integrated.pdf

Estimated Time: 20 Minutes

PROJECT 9

Project #9: Demonstrate the purpose and process of using a storyboard. Be sure student work is copyright friendly and permission is obtained to distribute their work following the Acceptable Use Policies (AUP) within your school district. Use may want to refer to the following Adobe online lesson as a guide.
http://www.adobe.com/education/instruction/adsc/pdf/storyboards.pdf
Show video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/
Direct student teams to Develop a storyboard for an ISS operation e.g. Transload, docking, assembly, or lifting.

Estimated Time: 50 Minutes

PROJECT 10

Project #10: Organize students in teams to model individual modules of the ISS, add materials, lights, cameras, and animate some moving aspect, then render the totally assembled ISS in its space environment. Use the scale drawing to assist in model development. Students will need assistance with reading scaled drawings. Consider pairing students with CAD experience with those who have none.
Example of ISS assembly process
Show students Space Shuttle Mission 2007 – Video Contest entry
Example of STS Mission
Scaled Drawings -
http://www.nasa.gov/mission_pages/station/multimedia/scalemodel/index.html

Estimated Time: 360 Minutes

PROJECT 11

Project #11: Related activity – Allow students to compete in the **NASA Art and Design Competition** at http://www6.cet.edu/copper/contest_index.php

Estimated Time: 180 Minutes

PROJECT 12

Project #12: Related activity – Allow students to play the Space walk game and answer questions on student worksheet.
Download the Spacewalk Game

Estimated Time: 10 Minutes

PROJECT 13

Project #14: Related activity – Have students Watch and Listen to HS students asking questions real time questions of the ISS crew. This will provide students with inspiration and knowledge of ISS issues. Assign student students a writing assignment: "What the ISS means to Me"

Estimated Time: 10 Minutes

Project #14: Related activity – Watch and Listen to HS students asking questions real time questions of the ISS crew. Write 3 paragraphs on: "What the ISS means to Me."

Estimated Time: 30 Minutes

Additional Resources
NASA ISS Website http://www.nasa.gov/mission_pages/station/main/index.html **Interactive Reference Guide** http://www.nasa.gov/externalflash/ISSRG/index.htm **Free 3d modeling software - Google SketchUp** http://sketchup.google.com/ **Storyboarding Information** http://www.usabilitynet.org/tools/storyboarding.htm **Autodesk Game Show Reel – a video demonstration of the games using Autodesk products for development** http://usa.autodesk.com/industries/media-entertainment/games **NASA Engineers discuss what they do in video interviews** http://www.usatoday.com/educate/NASA/videos.html

Lesson Title: Sustainability

Modeling and Simulation Lesson Plan

Lesson Identifier: 7.2C	**Unit :** 7	**Goal Number:** 7.2

Number of Sessions: Approximately 13 sessions; each 90 minutes in length

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Explore careers in sustainability initiatives and Leadership in Energy and Environmental Design (LEED) – Green Building program.
c. Understand the basics of sustainability in our society.
d. Define sustainability terms.

2. Design

a. Plan and manage activities to develop a solution or complete a project.
b. Develop and analyze a storyboard.
c. Demonstrate creative thinking, construct knowledge, and develop innovative products and processes.
d. Work as a member of a design team.

3. Model

a. Model a sustainability product, service, process or facility.
b. Create visualizations using basic design skills, graphing, image processing, 2D and 3D modeling, animation and simulation.

4. Present

a. Demonstrate a basic understanding of technology concepts, and systems in sustainability systems.
b. Apply existing knowledge to generate new ideas, products, or processes.
c. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.
d. Use computer data input and output devices that handle audio, video, static graphic, and alphanumeric-based information.
e. Create and deliver multimedia presentations.

5. Develop 21st Century Skills - 21st Century Skills Culture at High Tech High
(Show students this video and discuss their reaction prior to beginning instruction)

a. Use flexibility and adaptability as they evaluate their work throughout the project process.
b. Become self-directed learners as they produce quality products.
c. Work in diverse teams to complete projects on time.
d. Develop leadership, responsibility, social skills, collaboration skills, and cultural awareness.

Materials/Technology Integration:

· Word processing software
· Presentation software (e.g. Movie maker, Photo Story)
· Computer with Internet access and a web browser that is Java –enabled
· Electronic Portfolio
· Storyboard template
· Multimedia Projector
· Mapping software e.g. Google Earth
· Graph paper
· Computer with appropriate graphical software
· Pencil and paper

Anticipatory Set: Sustainability is broadly defined as meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. Sustainability initiatives involve everything from water conservation and energy efficiency to purchasing innovative supplies, adding bike routes and pedestrian walks, and designing buildings in a more environmentally friendly manner, just to name a few.

Ask students: What are some of the sustainability issues that are present in our community? Allow students the opportunity to verbalize their understanding of sustainability and its impact on their community. Inform students of the three pillars of sustainability—environmental, economic and social. Write on the board and discuss the meaning with students:
"We must consider our planet to be on loan from our children, rather than being a gift from our ancestors… If the long-term viability of humanity is to be ensured, we have no other choice." Gro Harlem Brundtland

Estimated Time: 10 Minutes

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2
Science: PH.1, PH.2
History and Social Science: WHII.1, WHII.6, WHII.8

The overall goal of these activities is to empower students to use 21st century tools in a learning process that requires critical and creative thinking, collaboration, and problem solving. The immediate goal is to engage students in hands-on, less abstract learning. The ultimate goal is preparing students for work and life in a changing economy that demands participants who are creative and innovative thinkers in addition to being skilled digital-age workers. *The following activities are designed to be used in order or randomly as the teacher sees fit based on student needs. The activities were developed with differentiation in mind for both product and process.*

Evaluation: Assigned Activities 1. Students successfully answer 75% of the post test questions. 2. Review storyboard for staging, camera angles, and correctness. 3. Students complete an animated model of a sustainable process or technology. 4. Students present their portion of the project to their team and the other members of the class. 5. Present completed model to the class for peer critique. **Estimated Time:** As Noted	**Closure:**
Homework: Complete the Energy Hog Scavenger Hunt worksheet for homework.	**Reflections:**
Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice

Teacher's Note: View video: *21st Century Skills: How Do We Get There?*

PROJECT 1	
Project #1: Administer Pre Test to students. Explain that The results on this test will help identify their understanding and learning needs. Explain the cost savings on utility bills and other costly impacts as a result of poor conservation efforts. Have students pair up to review and discuss Tips to Conserve Energy worksheet. **Estimated Time:** 10 Minutes	**Project #1:** Answer to the best of your ability the Pre Test questions. The results on this test will help identify your understanding and learning needs. Review and discuss Tips to Conserve Energy worksheet. Identify which conservation tips you and a partner are doing. Calculate how much you are saving in dollars annually for two of the conservation tips you and your family are doing. **Estimated Time:** 40 Minutes
PROJECT 2	
Project #2: Show students and discuss the connections between many of the major social, economic and environmental problems facing people in the world today. **Estimated Time:** 5 Minutes	**Project #2:** Discuss the connections between many of the major social, economic and environmental problems facing people in the world today…. Print this Connections diagram The diagram identifies (8) major global issues. On your print-out, draw a line between an issue and potential solutions, explain your rationale. **Estimated Time:** 20 Minutes
PROJECT 3	
Project #3: Show and discuss Sustainability ppt **Estimated Time:** 25 Minutes	**Project #3:** Observe and discuss Sustainability ppt. Look for new information that you don't already know. Make mental connections to the facts you already know on sustainability. Be an active learner. **Estimated Time:** 25 Minutes
PROJECT 4	
Project #4: Assign students the activity of defining the terms on terminology worksheet and use them in context. This can be a team assignment where one member defines and the other team member uses the word in a context driven sentence. **Estimated Time:** 20 Minutes	**Project #4: Project #4:** Define the terms on terminology worksheet and use them in context as directed by your teacher. **Estimated Time:** 20 Minutes

PROJECT 5	
Project #5: Invite guest speaker to discuss Sustainability Initiatives with students. E.g. Family/friends working in the field, Head custodian, School Division Facility Plant manager, School Transportation manager, City GIS Coordinator, Science teacher or others. (Students can be assigned the responsibility soliciting guest speakers) **Estimated Time:** 25 Minutes	**Project #5:** Listen to guest speaker's presentation on Sustainability issues and complete the guest speaker note taking sheet and hand in to teacher at the conclusion of the presentation. **Estimated Time:** 35 Minutes
PROJECT 6	
Project #6: Discuss the historical timeline of environmental awareness. Show students some examples of timelines, in textbooks, and online etc. Direct students to create a graphical historical timeline of environmental awareness events. **Estimated Time:** 15 Minutes	**Project #6:** You and your team will make a historical timeline of (local, state, national, or international) environmental awareness significant events. Use your imagination and creativity to depict a graphical representation of the significant events of environmental concerns, green technology, and sustainability initiatives. You may use any software: Word, Visio, Inspiration, etc. **Estimated Time:** 55 Minutes
PROJECT 7	
Project #7: A. Have students complete the Energy Hog Scavenger Hunt worksheet for homework. Then discuss their score in groups prior to sharing with the class. B. Use Google Earth to map spot your house. Have students observe and discuss the following: location and amount of green open space, streams, lakes, and retention ponds, location and amount of oxygen producing trees, tree shading home, etc. **Estimated Time:** 10 Minutes	**Project #7:** A. Complete the Energy Hog Scavenger Hunt worksheet for homework. Then discuss your score in teacher designated groups prior to sharing with the class. B. Use Google Earth to map spot your house. Observe and discuss the following: location and amount of green open space, streams, lakes, and retention ponds, location and amount of oxygen producing trees, tree shading home, etc. **Estimated Time:** 30 Minutes

PROJECT 8	
Project #8: Have students organize a Go Green Poster Contest at your school. Examples: Green Patriot Poster City Poster Contest **Estimated Time:** 5 Minutes	**Project #8:** You and your classmates will organize and develop a Go Green Poster Contest in your school or a neighboring elementary/middle school. Consider the following: Prizes, Sponsors, Theme, categories, judging criteria, size of entries, due date etc. Green Patriot Poster City Poster Contest. **Estimated Time:** 180 Minutes
PROJECT 9	
Project #9: Have students brainstorm ideas for innovative sustainable products or services. Outline the rules of brainstorming before breaking the class up in to brainstorming groups of 3 to 4 students. Have each group then report their finding back to the total class. Consider collaborating with Junior Achievement mentors or marketing/business classes in your school. **Estimated Time:** 10 Minutes	**Project #9:** Brainstorm ideas for innovative sustainable products or services. Follow the rules of brainstorming while in your brainstorming groups of 3 to 4 students. Each group will report their finding back to the total class. Consider collaborating with Junior Achievement mentors or marketing/business classes in your school. **Estimated Time:** 30 Minutes
PROJECT 10	
Project #10: Demonstrate the purpose and process of using a storyboard. Be sure student work is copyright friendly and permission is obtained to distribute their work following the Acceptable Use Policies (AUP) within your school district. Use the following lesson as a guide. http://www.adobe.com/education/instruction/adsc/pdf/storyboards.pdf Show video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/ Direct student teams to organize, plan, and design a modeled scene of a port operations of their choosing. **Estimated Time:** 35 Minutes	**Project #10:** Develop a storyboard for a sustainability product/process. Watch video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/ **Estimated Time:** 55 Minutes

PROJECT 11	
Project #11: Organize students in teams to model innovative sustainable products or services teams. Use brainstorming ideas from Project #9 as a starting place for product or process selection. After modeling is complete, add materials, lights, cameras, and animate some moving aspect then render and save as a video. Consider having a department or school assembly to display student work. Have a student competition and award prizes for best categories. **Estimated Time:** 10 Minutes	**Project #11:** You and your team will model innovative sustainable products/services. Use brainstorming ideas from Project #9 as a starting place for product/process selection. After modeling is complete, add materials, lights, cameras, and animate some moving aspect then render and save as a video. Show your final work to your classmates, school mates, and community and business leaders. **Estimated Time:** 360 Minutes
PROJECT 12	
Project #12: Have students read the article **Green Jobs and CTE -** http://careertech.org/uploaded_files/Green_Jobs_and_CTE_-_FINAL.pdf then reflect on potential Green careers with their partners. Organize students in teams to select and prepare a PowerPoint presentation on a selected sustainability career. (list) **Estimated Time:** 20 Minutes	**Project #12:** After reading the article **Green Jobs and CTE -** http://careertech.org/uploaded_files/Green_Jobs_and_CTE_-_FINAL.pdf reflect on potential Green careers with your partner. Select and prepare a PowerPoint presentation on a sustainability career to your classmates. Select a career from this (list). Discuss the job duties, work environment, and education/personal characteristics required to enter this field. **Estimated Time:** 90 Minutes
PROJECT 13	
Project #13: Related activity – Allow students to enter their work in various Green Competitions/Challenges: http://openarchitecturenetwork.org/competitions/challenge/2009 **Estimated Time:** 10 Minutes	**Project #13:** Related activity – Enter your project in various Green Competitions/Challenges as directed by your instructor. **Estimated Time:** 60 Minutes

PROJECT 14	
Project #14: Related activity "Power Up" video game – http://www.poweruptheGame.org/home.html Power Up is a free, online, multiplayer game that allows students to experience the diversity of modern engineering. Students work together in teams to investigate the rich, 3D game environment and learn about the environmental disasters that threaten the game world and its inhabitants. Direct students to team up and complete interactive activities to explore ways engineers design and build systems to harness renewable energy sources as alternatives to burning fossil fuels. Students will take on the role of Engineers, working together designing and building energy solutions to save the world. **Estimated Time:** 80 Minutes	**Project #14:** Related activity – You and your team member will play the Power up video game. Your mission is to explore ways engineers design and build systems to harness renewable energy sources as alternatives to burning fossil fuels. **Estimated Time:** 90 Minutes
PROJECT 15	
Project #15: Related activity – Discuss with students the significance of one's carbon footprint on our environment. Allow students to determine their Carbon Footprint using this online calculator. http://green.yahoo.com/calculator "Carbon footprint" is, and this link tells you a bit about the impact you make on the environment by calculating your footprint. **Estimated Time:** 20 Minutes	**Project #15:** Related activity – Discuss the significance of one's carbon footprint on our environment. Determine your Carbon Footprint using this online calculator. http://green.yahoo.com/calculator This link tells you a bit about the impact you make on the environment by calculating your footprint. **Estimated Time:** 20 Minutes

Additional Resources
Virginia Career and Technical Education **(CTE) Green Technology background** http://cteresource.org/featured/green_technology.html **Clean Power Now** http://cleanpowernow.org/cpn-archive.php?cpn_archive=3837 **Virginia Beach Green Schools** http://www.vbschools.com/greenschools/ **Solid Waste Activities** http://cwmi.css.cornell.edu/TrashGoesToSchool/Activities9-12.html **Eco-Cycle -** http://www.ecocycle.org/index.cfm **Your Role in the Green Environment, NCCER, 2009, Pearson publishing** **Green Jobs -** http://careertech.org/uploaded_files/Green_Jobs_and_CTE_-_FINAL.pdf **Energy Hog -** http://www.energyhog.org/adult/educators.htm **Earthday Network Education -** http://earthday.net/education **US Department of Energy Building Technology** http://www1.eere.energy.gov/buildings/energysmartschools/ **US EPA News, Games and other Resources** http://www.epa.gov/epawaste/education/teens/index.htm **EPA's website on Environmental Education -** http://www.epa.gov/enviroed/ **The North American Association for Environmental Education -** http://www.naaee.org/ **The Sierra Club's webpage on Environmental Education** http://www.sierraclub.org/education/ **Water Conservation** http://www.sscwd.org/tips.html **Solar Power Solar Wattage Calculator** http://www.bdbatteries.com/panelcalculator.php **Solar Panel Manufacturer** http://www.kyocerasolar.com/ **Solar and Wind Energy store** http://store.solar-electric.com/ **Wind Power Wind turbine output graph** http://www.windturbine.net/performance_data.htm **Biodiesel Lesson Plan** http://www1.eere.energy.gov/education/pdfs/biomass_creatingbiodiesel.pdf **Schools Sustainability Sites** **Curriculum Summary at the Willow School K-8** http://www.willowschool.org/academics/curriculum.pdf **Greening Schools** http://www.greeningschools.org/resources/view_cat_teacher.cfm?id=113 **Engineering for a Sustainable Future NC State University** http://www.youtube.com/watch?v=GZuyMUlkx-o **Alliance to Save Energy - Green Schools Compilation Video** **U.S. Green Building Council - LEED Green School Buildings**

Solid Waste Activities Cornell Waste Management Institute
http://cwmi.css.cornell.edu/TrashGoesToSchool/Activities9-12.html
Eco-Cycle- Working t build zero waste communities
http://www.ecocycle.org/hazwaste/recipes.cfm
Yahoo Green – Calculate your Carbon Footprint
http://green.yahoo.com/calculator
"Engineers Visioning a Sustainable Future"
http://tropicaldesign.org/hunterlovinstour/hl_engineering_workshop_results.pdf
Excellent Design briefs for Engineering students
http://www.naturaledgeproject.net/Whole_System_Design.aspx
Science Channel Videos – Invention Nation: Super Hybrid
http://science.discovery.com/videos/invention-nation-super-hybrid.html
Sustainability Education for HS
http://www.naturaledgeproject.net/TNEPHighSchoolEducation.aspx#SLCModule1

Lesson Title: Virginia Port Operations

Modeling and Simulation Lesson Plan

Lesson Identifier: 7.2D	**Unit :** 7	**Goal Number:** 7.2

Number of Sessions: Approximately 8 sessions; each 90 minutes in length

Objectives:

After given instruction, the student will:

1. Research

a. Apply digital tools to gather, evaluate, and use information.
b. Explore careers in transportation and technical visualization.
c. Gain mapping skills using Google Earth or other mapping software.

2. Design

a. Plan and manage activities to develop a solution or complete a project.
b. Develop and analyze a storyboard.
c. Demonstrate creative thinking, construct knowledge, and develop innovative products and processes.
d. Work as a member of a design team.

3. Model

a. Model a transportation, distribution, or warehousing process in a port facility.
b. Create visualizations using basic design skills, graphing, image processing, 2D and 3D modeling, animation and simulation.

4. Present

a. Demonstrate a sound understanding of technology concepts, and systems in port operations for commerce in the Hampton Roads area.
b. Apply existing knowledge to generate new ideas, products, or processes.
c. Manipulate and manage data, including the use of spreadsheets and application of mathematical principles.
d. Use computer data input and output devices that handle audio, video, static graphic, and alphanumeric-based information.
e. Create and deliver multimedia presentations.

5. Develop 21st Century Skills - 21st Century Skills Culture at High Tech High
(Show students this video and discuss their reaction prior to beginning instruction)

a. Use flexibility and adaptability as they evaluate their work throughout the project process.
b. Become self-directed learners as they produce quality products.
c. Work in diverse teams to complete projects on time.
d. Develop leadership, responsibility, social skills, collaboration skills, and cultural awareness.

Materials/Technology Integration:

· Word processing software
· Presentation software (e.g. 3DS Max, Premiere Elements, Movie maker, Photo Story)
· Computer with Internet access and a web browser that is Java –enabled
· Electronic Portfolio
· Storyboard template
· Multimedia Projector
· Mapping software e.g. Google Earth
· Graph paper
· Computer with appropriate graphical software
· Pencil and paper

Anticipatory Set: Virginia port operations are vital not only to Virginia's economic growth but also to the US economy. However, a problem of the Port of Virginia is the landside area where the containers are temporarily stored – often referred to as the container yard. A container yard is a port facility at which containers are accepted for loading onboard ships, and off -loaded containers are delivered for eventual delivery to their market destination. Therefore, the limiting factor for future container handling capacity will always be available container yard space. Craney Island is key to the future of the Norfolk Ports. The Craney Island Marine Terminal will provide over 500 acres of additional container handling space. It will provide necessary capacity that will allow The Port to grow in the future. The Virginia Port Authority (VPA) and the U.S. Army Corps of Engineers (USACE) are partnering to construct the Craney Island Eastward Expansion project. Construction of the eastward expansion is scheduled to begin in 2010 and the first phase of the marine terminal is planned to be operational by 2020. The undertaking will generate $6 billion in National Economic Development (NED) benefits over the 50-year life of the project.

Ask students: What are some goods they use that come from the ports of Virginia? Allow students the opportunity to discuss their understanding of impacts on port traffic in their community and their results.

Estimated Time: 15 Minutes

Correlation with Virginia Standards of Learning:

English: 10.4
Mathematics: A.1, A.2, A.4, G.2, G.3, G.10, G.12 and AII-T.2
Science: PH.1, PH.2
History and Social Science: WHII.1, WHII.6, WHII.8

The overall goal of these activities is to empower students to use 21st century tools in a learning process that requires critical and creative thinking, collaboration, and problem solving. The immediate goal is to engage students in hands-on, less abstract learning. The ultimate goal is preparing students for work and life in a changing economy that demands participants who are creative and innovative thinkers in addition to being skilled digital-age workers. *The following activities are designed to be used in order or randomly as the teacher sees fit based on student needs. The activities were developed with differentiation in mind for both product and process.*

Evaluation: Assigned Activities 1. Students successfully answer 75% of the post test questions. 2. Review storyboard for correctness. 3. Students complete an animated model of the operational movement of cargo within the port. 4. Students present and explain their portion of the project to their team and the other members of the class. 5. Present completed model to the class for peer critique. **Estimated Time:** As Noted	**Closure:**
Homework: None	**Reflections:**
Procedure: Guided Practice (Instructional Strategies)	**Procedure:** Independent Practice

Teacher's Note: View video: *21st Century Skills: How Do We Get There?*

PROJECT 1	
Project #1: Administer Pre Test to students. Explain that The results on this test will help identify their understanding and learning needs. **Estimated Time:** 20 Minutes	**Project #1:** Answer to the best of your ability the Pre Test questions. The results on this test will help identify your understanding and learning needs. **Estimated Time:** 20 Minutes
PROJECT 2	
Project #2: Show and discuss Virginia Port Authority ppt **Estimated Time:** 20 Minutes	**Project #2:** Watch and discuss Virginia Port Authority ppt **Estimated Time:** 20 Minutes
PROJECT 3	
Project #3: Assign students the activity of defining the terms on Terminology worksheet and use them in context. This can be a team assignment where one member defines and the other team member using the word in context.	**Project #3:** Define the terms on Terminology worksheet and use them in context as directed by your teacher.
PROJECT 4	
Project #4: Invite guest speaker to discuss port operations with students. Craney Island Expansion Academic Outreach Contact Form: **Estimated Time:** 25 Minutes	**Project #4:** Listen to a Port professional and ask questions about the day to day operations. Complete the guest speaker worksheet and discuss at the conclusion of the presentation. **Estimated Time:** 25 Minutes
PROJECT 5	
Project #5: Explain to students the benefits of the deep water access in the Hampton Roads. Demonstrate how to fly to Craney Island using Google Earth at lat-lon *N 36.89098 and W -76.3355*. Have students note the surroundings and make a list important land and water features. **Estimated Time:** 25 Minutes	**Project #5:** Explain the benefits of the deep water access in the Hampton Roads. Demonstrate how to fly to Craney Island using Google Earth at lat-lon *N 36.89098 and W -76.3355*. Note the surroundings and make a list of important land and water features which make this an ideal location for a port facility. **Estimated Time:** 25 Minutes

PROJECT 6	
Project #6: Show the Norfolk International Terminals "Ride the Tide" and Virtual Tour videos to develop background knowledge. **Estimated Time:** 20 Minutes	**Project #6:** View the Norfolk International Terminals "Ride the Tide" and Virtual Tour videos to develop background knowledge which will help you with your modeling assignment. **Estimated Time:** 20 Minutes
PROJECT 7	
Project #7: Show and discuss the Material handlers and Logistics video on careers. Have students make a list of the careers identified also have them team up to determine ways that modeling and simulation can help these jobs be more efficient. Have them also answer questions on Video worksheet. http://media.internet4associations.com/mheda/Introducing-Material-Handling.wmv http://media.internet4associations.com/mheda/Introducing-Material-Handling.wmv **Estimated Time:** 20 Minutes	**Project #7:** View the Material handlers and Logistics video on careers. Make a list of the various careers identified and think of ways that modeling and simulation can make these jobs more efficient. (6 minutes) http://media.internet4associations.com/mheda/Introducing-Material-Handling.wmv Answer questions on Video worksheet. http://media.internet4associations.com/mheda/Introducing-Material-Handling.wmv **Estimated Time:** 20 Minutes
PROJECT 8	
Project #8: Show and discuss this port transfer loading operation have students brainstorm ways that it could be more efficient. Direct students to model and animate this process or a more efficient one. http://www.youtube.com/watch?v=0eAgTsajLTU **Estimated Time:** 10 Minutes	**Project #8:** View this port transfer loading operation and consider ways that it could be more efficient. Model and animate a more efficient process. http://www.youtube.com/watch?v=0eAgTsajLTU **Estimated Time:** 120 Minutes
PROJECT 9	
Project #9: Demonstrate the purpose and process of using a storyboard. Be sure student work is copyright friendly and permission is obtained to distribute their work following the Acceptable Use Policies (AUP) within your school district.	**Project #9:** Develop a storyboard for a port operation e.g. Transload, Intermodal Terminals, Warehouses or Distriparks. See various port pictures. [More on next page]

Show video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/ Direct student teams to organize, plan, and design a modeled scene of a port operations of their choosing. **Estimated Time:** 35 Minutes	Watch video of: Disney – The Art of Storyboarding http://filmmakeriq.com/2008/09/disney-the-art-of-storyboarding/ **Estimated Time:** 55 Minutes
PROJECT 10	
Project #10: Show the Northport commercial. Organize student teams to develop a similar commercial for Craney Island using your 3d modeling and animation tools. http://www.youtube.com/watch?v=mufmBDThC8&feature=related **Estimated Time:** 5 Minutes	**Project #10:** View the Northport commercial. You and your team will develop a similar commercial for Craney Island using your 3d modeling and animation tools. http://www.youtube.com/watch?v=mufmBDT8&feature=related **Estimated Time:** 360 Minutes
PROJECT 11	
Project #11: Provide students with a overview of using a spreadsheet to organize data and make it useful in problem solving and decision making. Have students use this web site: Waterborne Commerce of the United States (WCUS) Waterways and Harbors on ***Sheet 33***: http://www.iwr.usace.army.mil/ndc/wcsc/webpub/Part1_Ports_tonsbycomm.HTM a. Determine the number of short tons of peanuts shipped to domestic locations from our ports in 2007. b. What was the largest export commodity in 2007? From this web site Waterborne Commerce of the United States (WCUS) Waterways and Harbors on ***Sheet 38***: http://www.iwr.usace.army.mil/ndc/wcsc/webpub/Part1_Ports_tonsbyTT_Dr_Yr_comm.HTM	**Project #11:** From this web site: Waterborne Commerce of the United States (WCUS) Waterways and Harbors on ***Sheet 33***: http://www.iwr.usace.army.mil/ndc/wcsc/webpub/Part1_Ports_tonsbycomm.HTM a. Determine the number of short tons of peanuts shipped to domestic locations from our ports in 2007. b. What was the largest export commodity in 2007? From this web site Waterborne Commerce of the United States (WCUS) Waterways and Harbors on ***Sheet 38***: http://www.iwr.usace.army.mil/ndc/wcsc/webpub/Part1_Ports_tonsbyTT_Dr_Yr_comm.HTM c. Plot on an excel spreadsheet the total amount of commodities shipped and received in the Hampton Roads port from 2003 through 2007. From the data entered, develop a chart in the spreadsheet graphing the following.

c. Have students to plot on an excel spreadsheet the total amount of commodities shipped and received in the Hampton Roads port from 2003 through 2007. Ask students to determine the trend for both shipped and received commodities over this period. d. How many short tons of total coal were shipped from Hampton Roads in CY2007? **Estimated Time:** 10 Minutes	What is the trend for both shipped and received commodities over this period? d. How many short tons of total coal were shipped from Hampton Roads in CY2007? **Estimated Time:** 40 Minutes

Additional Resources

Transportation education and training solutions
http://onlinepubs.trb.org/Onlinepubs/trnews/trnews257.pdf

McHenry Community College Transportation, Warehousing and Logistics studies
http://www.mchenry.edu/twl/index.asp

SEVAPORT News on M&S High school programs collaboration with Junior Achievement
http://seva-port.org/news/news.html#news3

The Port of Virginia
http://www.portofvirginia.com/

Teaching Port operations Outreach programs
http://www.aapa-ports.org/files/PDFs/sec5.pdf

HPTI Hamburg Port Training Institute GmbH
http://www.hpti.de/port_operations_courses.html