1. Unit 1- The Nature of Life (Life Science, Engineering Design)

Content Area: **Science**
Course(s): **Biology**
Time Period:
Length: **15 Days**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Biology, High School

The Nature of Life

Belleville Board of Education

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Board Approved: September 23, 2019

Unit Overview

Science is not a list of facts, but a way of knowing. Science is an organized method of evaluating evidence about the natural world. Scientific research reveals, rules and patterns that can explain, and predict some events in nature. To ensure that scientific knowledge is used for the benefit of society, we must all understand the nature of science. The study of Biology requires a thorough understanding of the nature of science, and the use of science practice to evaluate complex problems.

Enduring Understanding

- Science is not a list of facts, but a way of knowing.

- Observations, questions, and experiments are used to explain the natural world.
- Scientific research reveals, rules and patterns that can explain, and predict some events in nature.
- The study of Biology requires an understanding of the nature of science and science and engineering practices.
- There are millions of organisms on Earth, which share common characteristics, demonstrating both the unity and diversity of life.

Essential Questions

- Why is it essential that scientists share knowledge, collaborate, and build on each other's discoveries?
- What is the role of skepticism in scientific research?
- How does the hierarchy of biological organization illustrate emergent properties?
- What are the major themes of biology?
- What characteristics are shared by all living things?
- Why is the scientific method of investigation universally accepted?

Exit Skills

By the end of Unit 1 Biology Students should be able to

- Implement Scientific Methodology
- Explain how scientific attitudes help generate new ideas
- Learn the Engineering Design process and how it relates to the Scientific Method
- Recall characteristics of all living things

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
9-12.HS-LS1	From Molecules to Organisms: Structures and Processes
9-12.HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

9-12.HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
9-12.HS-LS1-2.2	Developing and Using Models
9-12.HS-LS1-2.2.1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-LS1-3.3	Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
9-12.HS-LS1-3.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-LS1-1.6	Constructing Explanations and Designing Solutions
9-12.HS-LS1-1.6.1	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Interdisciplinary Connections

LA.RH.9-10.2	Determine the theme, central ideas, key information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.
MA.S-IC.A	Understand and evaluate random processes underlying statistical experiments
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.11-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
LA.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
LA.WHST.11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.

Learning Objectives

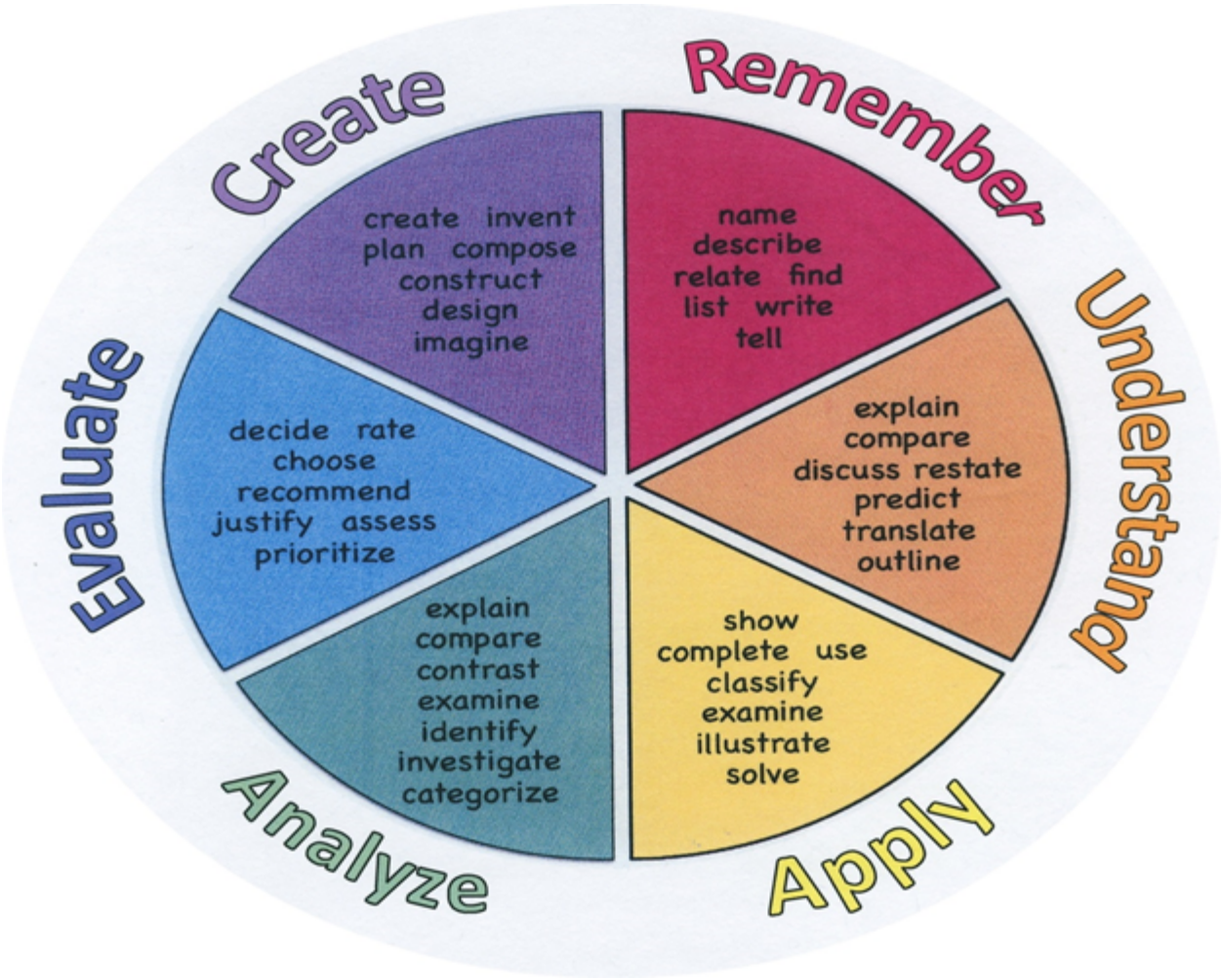
Students who understand the concepts are able to:

- State the goals of science.
- Describe the steps used in scientific methodology.
- Explain how scientific attitudes generate new ideas.
- Describe the importance of peer review.

- Explain what a scientific theory is.
- Explain the relationship between science and society.
- List the characteristics of living things.
- Identify the central themes of biology.
- Explain how life can be studeied at different levels.
- Discuss the importance of a universal system of measurement.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct
Reproduce	Tell	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			
	Generalize				
	Predict				



Suggested Activities & Best Practices

- Surface Tension and Scientific Method Penny Lab
- Characteristics of Life Wheel Activity
- Is Yeast Alive Lab
- Conclusion Writing Practice
- Metric Measurement Lab
- Safety Contract
- Safety Quiz
- Lab Safety Scavenger Hunt

Assessment Evidence - Checking for Understanding (CFU)

Assessments Generated using ExamView Test Generator and Test Bank from Miller/Levine Biology 2017 (Summative)

Common, Department Quarterly Benchmarks (Benchmark)

Oncourse Assessment Tools (Formative)

"Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests

- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Prentice Hall: Biology

Kenneth R Miller, Ph.D. - Joseph Levine, Ph.D. - New Jersey - Pearson Prentice Hall, Upper Saddle River - 2014, 2017

Ancillary Resources

- PearsonEasyBridge.com
- Chrome Book Projects/ Research/ Analysis
- Google Classroom
- On-line Databases via Media Center

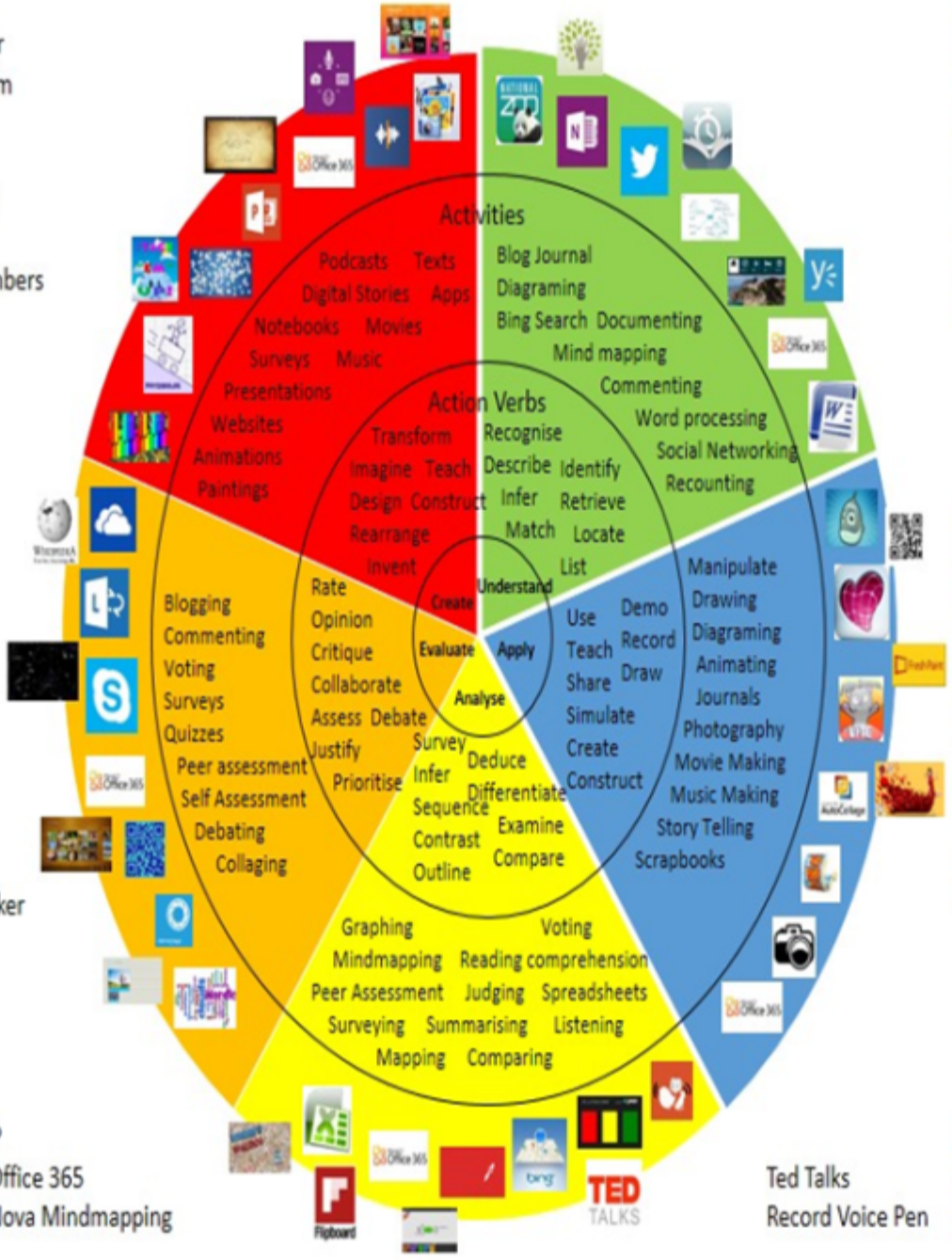
Technology Infusion

- Creation of Characteristics of Life Powerpoint/ Prezi presentation
- Collaboravie Document Editing using Google Docs

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

- Civic Literacy
- Environmental Literacy
- Global Awareness
- Health Literacy

Differentiation

Differentiations:

Students particpate in jigsaw style activity to review characteristics of living things.

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

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- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Students are provided with written notes and digital copies of presentations, as well as hard copy and digital textbook access.

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan

- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Students are provided with glossary in their native language.

Spanish speaking students may utilize Spanish Edition of Textbook for in class assignments.

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

Student provided access to digital learning tools via EasyBridge platform.

This should include virtual labs, presentations, videos, and practice questions.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing

- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Students may design, run, and present experimental procedures to test hypothesis related to the characteristics of life.

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Unit Name: The Nature of Science

NJSLS: See Linked Standards

Interdisciplinary Connection: See Linked Standards

Statement of Objective: Accurately communicate the procedure used for building a structure out of blocks (in writing), modeling the way scientists write procedures that can be replicated.

Anticipatory Set/Do Now:

Read the following excerpt and write a short five sentence response:

"Although Rosalind Franklin prompted the discovery of the double helix shape of D.N.A., with X-ray crystallography image, the credit and Nobel Prize was awarded to Watson and Crick. They used her work to eventually come up with the model with have today. Was this fair?"

Learning Activity:

1. Working with a partner behind a screen, assemble ten Lego blocks into an unusual structure. Write directions that others can use to replicate that structure, without ever seeing it.

2. Exchange directions with another team. Replicate their structure by following their directions.

3. Compare the replicated structures with the originals. Identify which parts of the directions were clear and accurate and which were unclear and misleading.

Student Assessment/CFU's:

Teacher Observation Checklist

Materials:

10 lego blocks per group, lined paper, table screens

21st Century Themes and Skills: See Linked Standards

Differentiation/Modifications:

(Process) Pair Kinesthetic learners with Auditory/ Visual Learners. Have the Kinesthetic learner build the original structure, and the partner, write the procedure. When exchanging the procedure sheets, have the students switch roles and have the Auditory/ Visual learner build the replicate, while the Kinesthetic learner reads the directions aloud.

Integration of Technology:

Ted Talks/ Ted Ed- lessons worth sharing

http://www.ed.ted.com

"Following Directions with Goofy"

Summary: Accurate communication is important in science as is collaboration. That includes not only writing directions well, so that results of experiments can be replicated and validated, but also "following directions", in a precise way. This puts just as much responsibility on the person on the receiving end.

HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.