CURRICULUM STANDARDS ALIGNMENT

HOW DO THE *RESEARCH QUEST* INVESTIGATIONS FIT INTO MY CURRICULUM?

The three *Research Quest*: *Mysteries of Cleveland-Lloyd* investigations provide an applied context for students to practice and transfer their knowledge of the science and engineering practices, disciplinary core ideas, and crosscutting concepts that serve as the backbone of the new Next Generation Science Standards (NGSS) and many other state science curriculum standards. In Utah, these investigations are most closely aligned to the new 7th grade SEEd Standards, though components of each work in support of standards across multiple grades. In short, completing any of the three investigations provides the opportunity for students to apply their knowledge of the natural world and its systems, while also practicing crucial critical thinking skills. We have found the emphasis on the development and practice of critical thinking skills brings these investigations into alignment with standards in other disciplines, such as English and Language Arts, as well.

HOW CAN THIS ALIGNMENT DOCUMENT HELP ME?

The *Research Quest* investigations are intended to be a resource that can be easily adapted for a variety of needs. Use this document as a starting place to identify the learning outcomes most beneficial to your students. Please note, we have developed these pilot investigations to align with multiple standards developed for Utah's 7th grade and we have only included the standards and concepts explicitly supported through delivery of the investigations as outlined in the instructional guides. There are many other standards and skills in Utah's 7th grade and in other grades that could be addressed with minor adjustments to lesson plans or through extension activities. We encourage you to consider your specific learning objectives when planning to use *Research Quest* with your students.

Below is a list of the specific alignments (with page numbers) included in this document. For more information on any of these standards and/or frameworks, visit the links provided at the bottom of each section.

STANDARDS

NEXT GENERATION SCIENCE STANDARDS (NGSS)

DISCIPLINARY CORE IDEAS

MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

For more information, visit **http://www.nextgenscience.org/overview-dci**

SCIENCE and ENGINEERING PRACTICES

Asking Questions and Defining Problems

Asking questions and defining problems in 6-8 builds on K-5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

Ask questions:

- That arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- That require sufficient and appropriate empirical evidence to answer.
- That can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate hypothesis based on observations and scientific principles.

Developing and Using Models

Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Evaluate limitations of a model for a proposed object or tool.
- Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed.
- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop and/or use a model to predict and/or describe phenomena.

Planning and Carrying Out Investigations

Planning and Carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meets the goals of the investigation.
- Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Analyzing and Interpreting Data

Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Distinguish between casual and correlational relationships in data.
- Analyze and interpret data to determine similarities and differences in findings.
- Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Construct an Explanation Using Models or Representations

Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) 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.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
- Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.

Engage in Argument from Evidence

Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.
- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
- Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.

- Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

For more information, visit **https://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf**

CROSSCUTTING CONCEPTS

Patterns- Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- Graphs, charts, and images can be used to identify patterns in data.

Structure and Function—The way an object is shaped or structured determines many of its properties and functions.

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Systems and System Models—A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.
- Models are limited in that they only represent certain aspects of the system under study.

Cause and Effect: Mechanism and Prediction—Events have causes, sometimes simple, sometimes multifaceted. Deciphering casual relationships, and the mechanism by which they are mediated, is a major activity of science and engineering.

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Stability and Change—For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- Small changes in one part of a system might cause large changes in another part.

For more information, visit **https://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf**

THE NATURE OF SCIENCE

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods and tools to make measurements and observations.
- Science investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Scientific Knowledge is Open to Revision in Light of New Evidence

- Scientific explanations are subject to revision and improvement in light of new evidence.
- The certainty and durability of science findings varies.
- Science findings are frequently revised and/or reinterpreted based on new evidence.

For more information, visit **https://www.nextgenscience.org/sites/default/files/Appendix%20H%20-%20The%20Nature%20of%20Science%20in%20the%20Next%20Generation%20Science%20Standards%204.15.13.pdf**

FRAMEWORK FOR 21st CENTURY LEARNERS

LEARNING AND INNOVATION SKILLS: CREATIVITY AND INNOVATION

Think Creatively

- Use a wide range of idea creation techniques (such as brainstorming)
- Create new and worthwhile ideas (both incremental and radical concepts)
- Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others

- Develop, implement and communicate new ideas to others effectively
- Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work
- View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes

LEARNING AND INNOVATION SKILLS: CRITICAL THINKING AND PROBLEM SOLVING

Reason Effectively

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

Use Systems Thinking

- Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.

Make Judgments and Decisions

- Effectively analyze and evaluate evidence, arguments, claims and beliefs.
- Analyze and evaluate major alternative points of view.
- Synthesize and make connections between information and arguments.
- Interpret information and draw conclusions based on the best analysis.
- Reflect critically on learning experiences and processes.

Solve Problems

- Solve different kinds of non-familiar problems in both conventional and innovative ways.
- Identify and ask significant questions that clarify various points of view and lead to better solutions.

LEARNING AND INNOVATION SKILLS: COMMUNICATION AND COLLABORATION

Communicate Clearly

- Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts.
- Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions.
- Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade).

Collaborate with Others

- Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal.
- Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.

INFORMATION, MEDIA, AND TECHNOLOGY SKILLS: INFORMATION LITERACY

Access and Evaluate Information

- Evaluate information critically and competently

Use and Manage Information

- Use information accurately and creatively for the issue or problem at hand

LIFE AND CAREER SKILLS: INITIATIVE AND SELF DIRECTION

Work Independently

- Monitor, define, prioritize and complete tasks without direct oversight

Be Self-directed Learners

- Reflect critically on past experiences in order to inform future progress

LIFE AND CAREER SKILLS: SOCIAL AND CROSS-CULTURAL SKILLS

Interact Effectively with Others

- Know when it is appropriate to listen and when to speak.

Work Effectively in Diverse Teams

- Respond open-mindedly to different ideas and values

For more information, visit **http://www.p21.org/our-work/p21-framework**

WEBB'S DEPTH OF KNOWLEDGE (DOK) LEVELS

DOK-1- Recall & Reproduction

- Recall of a fact, term, principle, concept, or perform a routine procedure.

DOK-2- Basic Application of Skills/Concepts

- Use of information, conceptual knowledge, select appropriate procedures for a task, two or more steps with decision points along the way, routine problems, organize/display data, interpret/use simple graphs.

DOK-3- Strategic Thinking

- Requires reasoning, developing a plan or sequence of steps to approach problem; requires some decision making and justification; abstract, complex, or non-routine; often more than one possible answer.

For more information, visit **http://www.aps.edu/re/documents/resources/Webbs_DOK_Guide.pdf**

UTAH: SCIENCE WITH ENGINEERING STANDARDS (SEEd)

This investigation strongly supports the three dimensions of science (science and engineering practices, disciplinary core ideas, and crosscutting concepts) which come from the K-12 Framework for Science Education and the Next Generation Science Standards (NGSS), and are the foundation of Utah's SEEd standards. However, due to the way that the three dimensions of science have been articulated in the SEEd standards, there is not a single standard that is completely supported by the activities in this investigation. For information about how this investigation supports the three dimensions of science, please see our documentation of the Next Generation Science Standards (NGSS) listed on pages 2-4 of this document, or visit **http://www.nextgenscience.org/** to learn more.

UTAH: ENGLISH AND LANGUAGE ARTS STANDARDS

READING: INFORMATION TEXT

Standard 4

Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.

WRITING

Standard 1

Write arguments to support claims with clear reasons and relevant evidence.

a. Introduce claim(s) and organize the reasons and evidence clearly.
b. Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.

SPEAKING AND LISTENING

Standard 1

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
d. Acknowledge new information expressed by others and, when warranted, modify their own views.

Standard 3

Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.

Standard 4

Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

LANGUAGE

Standard 6

Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

For more information, visit **https://www.uen.org/core/core.do?courseNum=4270**

UTAH: SECONDARY LIBRARY MEDIA (6TH-8TH GRADE)

STRAND II LITERACY: INFORMATION AND RESEARCH

Standard 1.1

Define an information problem.

a. Analyze the task to identify the information problem.
b. Seek clarification from teachers and others.

Standard 4.1

Engage with information by reading, listening, and viewing sources in a variety of formats.

b. Build connections between prior knowledge and new information through engaging with information, and collaborate with others to broaden and deepen understanding.

Standard 4.2

Extract relevant information that answers the information problem and meets task requirements.

e. Abstract, summarize, and paraphrase.

Standard 5.1

Organize information from multiple sources.

c. Analyze and organize information to support conclusions

d. Evaluate critically whether or not the selected information supports the proposed conclusions.

For more information, visit **https://www.uen.org/core/core.do?courseNum=6512**