Scientific Method – Escape Room Activity

Subject / Discipline: Science/Biology
Grade Level: 9-12

Unit/Lesson New Jersey Student Learning Standards Bases on Next Generation Science:

Scientific Practices:
4. Analyzing and interpreting data
8. Obtaining, evaluating, and communicating information

Cross Cutting Concepts:
1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Core Idea LS1: From Molecules to Organisms: Structures and Processes
HS-LS1.D: Information Processing

Scientific Investigations Use a Variety of Methods
HS-LS1.3 Scientific inquiry is characterized by logical thinking, precision, open-mindedness, objectivity.

Brief Summary of Cultural Competencies Related to the Unit/Lesson
Does this lesson relate to and/or is inclusive of accurate histories, representation, contributions of: *LGBTQ community*

What makes this lesson culturally relevant?
LGBTQ+ rights and concepts are currently at the forefront of both social and political discussions, and yet less than 1 in 5 students seem to be taught with any positive LGBTQ+ representation in any form in pedagogy (Kosciw, Greytak, Palmer, & Boesen, 2013). In fact, in 28 states it's still legal for employers to discriminate against someone for their sexual or gender identity (Human Rights Campaign, 2018). Therefore, there is a real need to integrate positive representation into our curricula. The goal of this lesson is to incorporating positive LGBTQ+ representation, without the idea of sexuality in the do-now, and by using scientific method created by Francis Bacon who was part of the LGBTQ+ community. The lesson will then spin off the scientific method and create an engaging environment where students participate in an escape room activity to learn about the steps of Bacon's fundamental contribution.

Reference:
Human Rights Campaign (2018). Retrieved from https://www.hrc.org/state-maps/employment

Kosciw, J., Greytak, E., Palmer, N., Boesen, M. (2013). GLSEN's 2013 National School Climate Survey. Retrieved from https://www.glsen.org/sites/default/files/2013%20National%20School%20Climate%20Survey%20Full%20Report_0.pdf

Lesson Overview:

Essential Question(s)	What is the value of a hypothesis? How can we draw on data to draw conclusions? What do effective problem solvers do when they get stuck? What is the value of a controlled experiment? How can scientist best represent visual data? What are the values of observations and inferences in data collection?
Enduring Understanding(s)	Scientist use the scientific method to ask relevant questions, collect data, analyze and interpret evidence, and solve problems.
Potential Misconceptions:	Although sexuality is what seems to be focused on in lessons that involve LQBTG+ representation, this lesson is about the contribution of an LGBTQ+ individual in the formation of the scientific method. This lesson will use his positive contributions as a discussion point, but the activity centers around the scientific method.

Learning Plan, Experiences, Instruction and Learning Activities:

	The Teacher will… set up stations in preparation of the activity. Details of stations and set up are provided in the power point. Also, answer keys, and extension activities, and potential modifications are given as well.
W What is expected? • List the intentional learning objectives on the board	**Students will be able to:** • work in collaborative groups, and use problem solving skills and technology to solve puzzle sets that revolve around the idea of the scientific method, set up in the style of an escape room. • solve problems in a variety of ways (i.e. spatial, kinesthetic, verbal, logical, & social) to see how investigations use a variety of methods like logical thinking, precision, open-mindedness, and objectivity to draw accurate conclusions. • use choice to model their understanding by designing their own group puzzle. *Today we will be working on...* the scientific method

H How will we hook (Introduce this to) the students? • Activate thinking • Consider the language you will use to introduce the lesson (See example in the table)	**Link to Engagement** **Hook/Do Now:** What does a scientist look like? Sketch your idea on a piece of paper (2 min.) **Think-pair-share:** Discuss your drawing with a person sitting next to you. Are there any patterns that came up in these drawings? (2 min.) Load the website: https://www.500queerscientists.com/ • Scroll down: Look at what real scientists look like: backgrounds, cultural, size, age, gender, color self-identify is all different. • The fact that these humans are willing to share their stories is important. This is especially true when a survey found more than 40% of LGBTQ+ identified people working in STEM fields are not out to their colleagues (Yoder & Mattheis, 2016). • *You are really beginning to understand the* contribution that the LGBTQ+ community has in the field of STEM. *Today, we're going to dig deeper with a new focus. This focus* will be about the scientific method. In fact, the man given credit for discovering the scientific method, Francis Bacon, was part of this community as well. • **Goal of the lesson:** The created activity is structured so that student are activating and using different part of their brains to make genuine connections between the various concepts being discusses (LQBTQ+ positive representation and links to the step of the scientific method) to increase retention of the material, and provide a deeper understanding of each complex concept. • LINK to the google form: https://forms.gle/q4b5fd6UytNRoCqa9 Reference: Yoder, J. & Mattheis, A. (2016). Queer in STEM: Workplace experiences reported in a national survey of LGBTQA individuals in science, technology, engineering, and mathematics careers. Journal of Homosexuality, 63:1, 1–27, DOI: 10.1080/00918369.2015.1078632
E What equipment, resources, or materials are needed?	• Computers - you will need one per group you make – up to 6: however, if teachers do not have access to computers they can use the option paper sheet provided in the lesson) If computers are used: Access to google form LINK: https://forms.gle/q4b5fd6UytNRoCqa9 (or create your own) • Test tube rack • test tubes • 0.1M HCL

	• 0.1M NaOH • Universal indicator • 36 dropper bottles to label or beakers/flask with pipetman • Paper • UV pens and lights or lemon juice • Lesson plans (with answer keys provided).
R How will we rethink or revise our thinking throughout the lesson? • What learning is confirmed? • What misconceptions are uncovered? • What is your new thinking?	Students are solving for problems in a variety of ways (i.e spatial, kinesthetic, verbal, logical, & social)– students reflect on how the scientific method revolves around logical problem solving skills which can be applicable to any other concept. Learning is confirmed when the puzzles are solved as a group. The google form will only unlock the next station when students have entered the previous code from the past activity in correctly. In this way students are getting instant feedback to their answers. Plus, student groups can self-pace through to the puzzles. There is a misconception that scientists are cis-white men. The hope is that the idea is broadened considerably with this activity. The scientific method is the foundation of science. To know and understand that this was developed by a member of the LGBTQ+ community hundreds of years ago is a positive representation of this community.
E How will students self-evaluate and reflect on their learning?	• Instant feedback is given directly from the google form. • Collaborative group discussion and peer feedback is given in group work. • Various problem solving takes place while strengthening social interactions.
T How will we tailor learning to varied needs, interests, and learning styles?	• The learning is taking place in groups. Each group member could have a role if needed, and groups can be hand-picked by the teacher to have groups with students with different skill sets. • Students work together to solve puzzles at each station before they can move on to the next stations – in this way it is self-paced. • The end of the activity groups get to design their own puzzle, therefore choice is an aspect of this activity as well.

	• Spatial, kinesthetic, verbal, logical, & social learning styles are incorporated into the lesson. Provided Rubric.
O How will we organize the sequence of learning during the lesson?	**Scaffold the Instruction** 1. Model: A Cipher will be modeled. For example: *Numbers can be used as a numerical/visual/symbol representation. For example A = 1* Students will set this cipher up. 1. Guided Practice Students will be told: Francis Bacon has been attributed with the discovery of the scientific method. What is a quote is also attributed to him: Students will use the cipher to discover the Francis Bacon's quote is "With Knowledge comes power." This is an example of how each puzzle will be completed. 1. Independent Practice This will be the activity (attached documents). 2. Extension Students will work in their groups to design their own puzzle.

Check for Understanding

(Formative evidence such as conferencing, group Q/A, teacher observation, exit-slip, etc.)	A suggestion here would be the **CAT** (classroom assessment techniques): • Ask students at the end of the activity: 2 things you learned and 1 thing you still need help with – this could be a Ticket-Out-The-Door • This will give the teacher time and feedback on need for re-teaching topics.
Performance Task/Project: (attach rubric)	• **Goal:** Your Group Task is to pick one of the scientific method steps and design one escape room puzzle for this topic. Be as creative as possible. • Rubric is provided with attached documents.