

## Bad Science vs. Better Science

Total Number of Lessons: [3]

Total Estimated Time for Module: [3-4 90 min blocks]

### Section 1: Module Overview and Curricular Connections – Required

- **Module goal:** [At the end of this module, SWBAT...; try to make it one big goal]
  - SWBAT... apply their criteria for bad science vs. better science to formulate and implement their own experiment on a big question they are curious about in the application of science in their life.
- **Connection to standards:** [List standards that will be addressed by the module. Should include Indiana standards; NGSS and CCSS are strongly recommended; CSTA could also be useful for the Computing RET.]
  - **HS-LS1-1** (Science and Engineering Practices) Constructing Explanations and Designing Solutions
  - Any of the Standards that talk about students developing models or experiments to demonstrate an understanding. My final Project will allow students to create their own experiment so the standards that connect vary on student choice for this project.
- **RET materials/ideas to be leveraged:** [Describe what elements of your summer experience you will use as part of the module for students.]
  - In the beginning of the summer Dr. Bowyer presented about Artificial Intelligence (AI) and its role in facial recognition technology. In his presentation, he showed a paper that claimed to be able to use facial recognition to predict whether a face was criminal or non-criminal with a 97% accuracy. Dr. Bowyer then proved how false this statement truly was. This big question inspired me to ask my students this question and use it as an applicable avenue to help them learn about what makes bad science and better science.

### Section 2: Overview of Module Framework – Required

- **Real-world context:** [Describe in 1-2 paragraphs]
  - Students will encounter a lot of news presented to them from various platforms. Such as, social media, news, word of mouth, papers, articles, YouTube, etc. Students need to be empowered and equipped with the skills to be able to discern between reliable and unreliable news. The Module I have developed does just that. It brings up this topic in a safe space that allows for discussion and learning so that students will leave with the skills to dictate what is worth believing and what is fake news.
  - Students also will experience more and more technology as they live their lives. When introduced in an environment outside of the classroom, technology can be used to cut corners and hinder that academic growth of students. By introducing AI technology in the classroom, the teacher is able to control the conversation surrounding it. It allows students to see the benefit

technology can have and how they can use it as a tool to challenge and provoke academic growth.

- **Possible Lesson Ideas:** [What are some ideas for a lesson or two focused on the real-world context and framing the project for students?]

- **Lesson 1:**

- **Main Learning Objective:** SWBAT... list key criteria for good science vs bad science with examples they may find in class/social media

- 1) **Pre-Assessment Voting Activity:** showing statements from reliable and unreliable sources and have students vote reliable or unreliable and discuss WHY - stand on either side of room
- 2) Students will play **Harmony Square** - intro fake news
- 3) Students then come up with the **criteria for bad science vs better science** AND include examples for each point (at least 5 each)

- **Lesson 2:**

- **Main Learning Objective:** SWBAT... Identify key criteria for good science vs bad science when reading science text and SWBAT... discuss what they found with other groups and teacher

- 1) **Voting Activity Round 2:** Show students the same reliable and unreliable statements but this time they support their stance with evidence from their criteria they formed last class (it may be diff.)
- 2) **Scientific Writing Activity:** I have pre-identified key info in scientific papers/articles/journals, students will annotate this info in the text (highlighting, circling, drawing connections) and ultimately state whether they agree on reliable or unreliable and why. - Studies B and C (bad) and Studies A and D (better)

Report/Study A	Report/Study B
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Report/Study C	Report/Study D

<p><b>Title:</b> Criminal tendency detection from facial images and the gender bias effect. <a href="#">Link</a>.</p> <p><b>Question being investigated:</b> Can you use facial photos to determine if someone is a criminal?</p> <p><b>Sample Size:</b> 10,000 facial images</p> <p><b>Duration:</b> Training and testing a computer system</p> <p><b>Primary Conclusion:</b> The danger of this technology lies in its imperfection, since misclassifying individuals can have grave repercussions. It would be too optimistic to claim that the 97% test accuracy, achieved by the CNN in this work, is easily generalizable to face shots from any other source.</p> <p><b>Cited References:</b> 34</p> <p><b>Retracted?:</b> Yes</p>	<p><b>Title:</b> The “Criminality from Face” Illusion. <a href="#">Link</a></p> <p><b>Question being investigated:</b> Can you use facial photos to determine if someone is a criminal?</p> <p><b>Sample Size:</b> 10,000 facial images (same data set as Study C)</p> <p><b>Duration:</b> Analysis of study C’s training and testing a computer system</p> <p><b>Primary Conclusion:</b> The concept that a criminality-from-face algorithm can exist is an illusion, and belief in the illusion is dangerous.</p> <p><b>Cited References:</b> 41</p> <p><b>Retracted?:</b> No</p>
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3. **Group Discussion:** Share with other groups and discuss different and similar thoughts.

o Lesson 3:

- **Main Learning Objective:** SWBAT... apply their criteria for good science vs bad science to formulate their own requirements if facial recognition can identify criminal and non-criminal and present their idea through a mock up article with supporting evidence.

- 1) **AI with Facial Recognition Presentation:** ask students, “Do you think it is possible to use facial recognition to identify a person as criminal or non-criminal?” Discuss as a class and in small groups.
- 2) **Mock Article Activity:** Using their “Better Science” requirement list, students will draft up an article abstract that would claim this is possible or not (what a reliable article abstract would look like and what an unreliable article would look like). Gallery walk with class votes on reliable and unreliable with 3 indicators of their claim. Group will reveal and the group with the most accurate votes gets a prize.

- **Background STEM content:** [Describe in 1-2 paragraphs]
  - o Ability to read science writing and decipher main points from text.
  - o Effective discussion techniques (healthy ways to communicate thoughts and disagree/challenge others to enhance learning for both themselves and others)
  - o How to annotate science writing
- **Possible Lesson Ideas:** [What are some ideas for a lesson or two focused on the background STEM content?]
  - o Somehow giving students a paragraph or a few sentences they must identify the main goal of the science text. Doing this in a form of background info for the “why” behind an experiment or activity?
- **Description of Main Activity/Project:** [Describe in 1-3 paragraphs]
  - o **Scientific Writing Activity:** I will give students 4 scientific writing pieces. I will pre-label them as “reliable” or “unreliable” and will pull out key information for them (such as, title, main question be studies, resources, claims, etc). Students will be instructed to go into the text and highlight where the key information is found in the text. As they read each scientific text, they will decide whether they agree or disagree with my pre-labeling with at least three specific reasons supporting their stance. This will initially be done individually then they will turn to a partner and

- discuss, then end with the partners going to a different pair and discussing. They must find one thing they don't fully agree on and one thing they do fully agree on.
- **Mock Article Abstract Activity:** Students will be presented with the question “Do you think it is possible to use facial recognition to identify a person as criminal or non-criminal?”. After discussion with not firm “answer” from teacher students will pick a stance on whether they think it is possible or not and they will write an abstract for a hypothetical article that would take their claim (they do NOT need to agree with the stance they're writing about but the class must be equally distributed with their stance). Students will pair with a partner with the same chosen claim. Their abstract must meet all the requirements for “bad science and better science” they have been drafting and revising. Once the abstracts are created they will do a gallery walk. Partners will read all their classmates' abstracts and state whether they think each abstract would be for a reliable or unreliable article with 3 supporting examples/reasons from student text. Once done, students will reveal what their abstract was written towards and partners with the most correct wins a prize.
  - **Experiment Creation and Implementation Project:** Students will pick something they are curious about that is biology/science related. Phase 1: They will first write a question they will investigate, formulate a hypothesis, come up with how they're going to test their hypothesis (procedure), and list of supplies they'll need (this gets approved by the teacher for being possible to do). Phase 2: Next they will have at least 3 other students read what they have a point out 2 things they think are really good/creative about experiments and 2 areas they can make better. Phase 3: Students make suggested edits and they will get at least 2 more students to repeat phase 2. Phase 4: Student performed experiment and writes up a conclusion answering the given questions: (1) What was the result of your experiment? Is it what you expected? Why or Why not? Give supporting evidence from performing your experiment. (2) What scientific concept does your experiment support? Explain with supporting evidence from performing your experiment. (3) If you were to do this experiment again, what would you change to improve your results and why?
  - **Possible Activity/Project Ideas:** [What is the goal? What will students do? What is the timeline? At what point would students work in groups or individually?]
    - **Goals:** For students to be able to identify key features of reliable and unreliable news/statements/claims, formulate their own scientific claims with reliable supporting evidence, and execute their own scientific experiment building off their own “bad science and better science” criteria.
    - **Timeline:** 4-5 class periods (is this reasonable?)
    - **Students work individually:** initial thoughts and stances on reliable and unreliable statements, John's fake city game, the physical writing of their mock article on facial recognition, cold/initial read of article packet
    - **Students work in groups:** discussing and processing the goals of the module (reliable vs unreliable claims) and the process of formulating any ideas, discussion of article packet.

- **Brief description of sequenced learning objectives:** [How do learning objectives build from lesson to lesson to meet the module goal?]
  - Lesson 1: SWBAT list key criteria for good science vs bad science with examples they may find in sources in class/social media
    - Students will use their key criteria to help them identify key criteria in science text and give them meaningful discussion next time.
  - Lesson 2: SWBAT Identify key criteria for good science vs bad science when reading science text and SWBAT discuss what they found with other groups and teacher
    - Their learning through discussion and practicing identifying key criteria in science text will help guide them into their own creativity in addressing the question next time.
  - Lesson 3: SWBAT apply their criteria for good science vs bad science to formulate their own requirements if facial recognition can identify criminal and non-criminal and present their idea through a mock up article with supporting evidence.
    - Through moving around the room and problem solving each abstract article, finding info, and labeling them, as well as creating their own abstract with a partner, they will deepen their understanding of “bad science va better science” that will empower them to get more creative for what’s next.
  - Ending Project: SWBAT formulate their own scientific question, hypothesis, procedure, and conclusion for their own experiment by building off their “better science” criteria.
- **Brief description of formative and summative assessment approaches:** [When/what techniques will you use to assess student progress towards objectives during and at the end of the module?]
  - Formative assessment: class discussion, handouts to organize their initial thought processing, initial list of criteria, seeing their understanding of good vs bad science develop through their class participation, group discussion, and individual thoughts/writings.
  - Summative assessment: mock article activity and experiment creation and implementation activity.
- **Recommendations for implementation:** [Describe any “safety tips” or advice you have for other educators who might implement this module, including logistical considerations.]
  - Not sure yet. I will know more after I implement this in my classroom

**Section 4: Draft Module Lesson Plans – Required; Other Docs/Handouts - Optional**

- **REQUIRED:** Please include draft lesson plans for your module below. They can be in your typical planning format.
  - **Scientific Writing Activity:** I will give students 4 scientific writing pieces. I will pre-label them as “reliable” or “unreliable” and will pull out key information for them (such as, title, main question be studies, resources, claims, etc). Students will be instructed to go into the text and highlight where the key information is found in the text. As they read each scientific text, they will decide whether they agree or disagree with my pre-labeling with at least three specific reasons supporting their stance. This will initially be done individually then they will turn to a partner and discuss, then end with the partners going to a different pair and discussing. They must find one thing they don’t fully agree on and one thing they do fully agree on.
    - - Studies B and C (bad) and Studies A and D (better)

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- Optional: If you have any additional handouts or supplemental materials for your module that you’d like to include at this draft stage, please feel free to add them here as well.