WHAT IS A TRANSFORMATION?

Scientists observe the world around them and generate guiding questions about observed phenomenon. From these guiding questions, the scientists can develop a hypothesis, conduct an experiment to test the hypothesis, and analyze the results. These steps are often done as a scientific study. The process of creating a scientific study is important for students to understand because it helps explain how science works. Scientific studies are often published as articles in peer reviewed journals.

To be published in a peer reviewed journal, the scientific article must first go through a peer review process. The article is critiqued by other researchers and scholars in. The study methods and results are analyzed in the peer review process. If an article passes the peer review process, it is published in peer reviewed journals and made available to the general public.

When studies are published in scientific journals they can be difficult to comprehend outside of the scientific community. To better understand the content and significance of a scientific article, it can be transformed. Transformation is a process used to summarize a scientific article to support learning objectives and state science standards or the Next Generation Science Standards, NGSS. Transformations will help students better understand the details of a study and the nature of investigations in science. Additionally, transforming scientific articles into grade appropriate material increases student understanding of the direct impact scientific research can have on their lives and health.

TACKLING TRANSFORMATIONS

Article transformations can be completed by teachers or students. Transforming articles into plain language and age-appropriate text enables students to engage with the work of scientists who are making new discoveries that impact our lives on multiple levels. In other words, transformations make science approachable and relevant. Transformations aid in the development of science literacy skills. When combined with supporting activities, transformations can engage students in critical thinking as they evaluate the information presented.
**Guide to Selecting and Transforming Science Articles**

1. **Identify the Targeted Standard(s):**

   Whether using state standards or the Next Generation Science Standards, NGSS, it is important to identify and understand the targeted standard or standards. Is the standard focused on content or process skills? Is the standard designed to introduce students to a concept or is it intended to build upon prior student knowledge, thereby creating depth?

2. **Identify the Primary Learning Objectives:**

   “Begin with the end in mind”: a phrase often stated in education, but so important. What is the primary objective for the transformation? In other words, after completing the transformation and supporting activities, what should students accomplish? Is it mastery of a concept, demonstration of a skill, creation of a model or something else? The primary learning objective should be measurable, actionable, and clearly support the targeted standard.

3. **Article Search:**

   Selecting a good article for the transformation is probably the most important part of the process. Keep in mind the targeted standard and the primary learning objective. If the targeted standard is content focused, search databases using key words found in the standard. If the targeted standard focuses on process skills, then look for articles rich in data with a focus on content with which students are already familiar or are about to study.
The school librarian is an excellent resource when looking up articles for transformations. Most schools have access to multiple databases and journals from which to select articles. The librarian can help you with conducting searches and accessing databases. Select several articles as transformation candidates. Selected articles should provide sufficient information to support the targeted standards and primary learning objective.

Helpful Hints
- Articles should be interesting and relevant for the students, yet keep in mind the appropriateness of the article. For example, depending on the age of students, articles dealing with the mechanics of human reproduction could cause unwanted controversy.
- When reading a peer-reviewed article, read it section by section (abstract, background, methods, analysis, discussion, conclusion), highlighting sentences that align with the targeted standard and/or primary objective.
- Depending on the standard and primary objective, some sections may be more useful to the transformation than others. It is NOT recommended to transform the entire journal article! Be selective about what parts of the article will be most supportive of the standard and learning objective.
- Look up unfamiliar terms and reach out to “experts” regarding content and statistics.

4. Stop and Check: Do the articles support the Standard & the Primary Learning Objective?
Once you have selected several articles and reviewed them, stop and check for alignment with the targeted standard and the primary learning objective. Remember that transformations are written in age-appropriate, plain language format. Selecting too long or too complex an article may result in a challenging transformation. Consider focusing on articles that are rich in data (tables and graphs) as these generally lend themselves well to developing engaging activities.

5. Select Sections of the Article for Transformation:
Keep focused on the targeted standard and primary learning objectives to help determine which sections and/or paragraphs are best suited for inclusion in the transformation. Remember: a transformation does not include every bit of information from the original article. The goal is to create a plain language transformation of the scientific article. This does not mean technical terms are left out! On the contrary, transformations can help students expand their science vocabulary in meaningful and relevant ways.

Helpful Hints: Vocabulary Terms
- Italicize new terms:
  - **Invertebrates**
- Include phonetic spelling for new terms:
  - **Invertebrates (in-VER-tah-brayts)**
- If the context does not provide a clear definition, include an age appropriate definition in the transformation:
  - **Invertebrates (in-VER-tah-brayts), organisms that do not have a backbone or spinal column.**

Keep in mind the reading stamina of your students. This will serve as your guide for determining the final length of the transformation. Consider using a different font to create visual interest for students. The use of two columns for text in the transformation can also make it more visually appealing for students.
**Helpful Hints: Transformation Length**

- **Elementary**
  - No more than one side of a page.
  - Consider including colorful tables and figures.
  - Transformations for elementary are excellent for practicing process skills and introducing science literacy.
  - Reading the transformations at this level should be broken into parts, perhaps reading and discussing only one section of the transformation each day.

- **Middle School**
  - Up to two pages, printed front and back.
  - Use tables and figures to break up blocks of text.
  - Include a “Disclosure” section. This information is generally found at the end of the original article, providing information about study funding and conflict of interest disclosures, and will lend itself well to activities about potential study biases.
  - Consider using groups when reading the transformation applying the Jig Saw approach (groups can become “experts” on one section of the transformation and present section information to the class).

- **High School**
  - Up to three pages, printed front and back.
  - Keep selected data (tables and graphs) embedded in appropriate section.
  - As with middle school, include a “Disclosure” section.
  - Consider using groups when reading the transformations. Group members can read the transformation together and discuss each section to generate a group understanding/consensus of the content. Each group can be assigned to present a specific section and remaining groups can add their own group insights to the presenting group’s information.

Don’t forget about the data. Use a few selected tables and or graphs to support the targeted standard and primary learning objective. Although the data itself may not be changed, it is an option to limit the data. For example, a table may contain data about age, gender, height, weight, eye color, and shoe size. However, to support the targeted standard, it may only be necessary to include age, gender, and eye color.

Use the article headings as a guide for the transformation. Suggested headings for a transformation include, but are not limited to:

- Background
- Method
- Data
- Results
- Discussion/Conclusion

As part of the transformation, it is important to cite the authors and publication information (recommend APA formatting) and to indicate this is a transformation of a peer-reviewed article. The transformation title should reflect the research of the original article title and indicate it is a transformation. For example:

“Dopamine May Affect Thrill-Seeing Behavior in Humans”

* A Peer-Reviewed Article Transformation
Original Article Citation:

When actually writing the transformation, restate the selected text in your own words. However, keep in mind that a transformation does not change the integrity or focus of the original scientific research. It is inevitable some passages from the original article may appear in the transformation. This is why the original work must be properly cited and credited.

6. Creating the Transformation

It is time to start writing. Keep in mind the 3 R’s (Reduce, Restate, Revise). Ask colleagues to review the transformation and provide feedback. If possible, invite colleagues to join in the transformation process.

7. Stop and Check: Does the transformation support the Standard & the Primary Learning Objectives?

8. Identify Learning Objectives to Develop Activities:

As with every step of the transformation, the Learning Objectives and Activities must directly support the targeted standard and primary learning objective. The depth of the activities will determine if the transformation is a novice level or intermediate level.

- Novice Level: contain four lessons with one or two activities per lesson:
  - **Lesson 1:** Thinking About the Study: intended to identify study design (observational or experimental).
  - **Lesson 2:** The Results: define variables, identify sources of bias, examine the nature of data collection.
  - **Lesson 3:** Analyzing the Results: analyze data (mean, median, mode), and interpret graphs.
  - **Lesson 4:** Compare and Contrast: a media article related to the content of the transformed peer-reviewed article can be transformed into a plain language, grade appropriate length. Students can then compare and contrast the two transformations for consistency with the science transformation and depth of content.

- Intermediate Level: expanded lessons to accommodate additional activities with greater complexity, such as:
  - **Lesson 1:** Thinking About the Study: Possible activities include expanded study designs, identifying biases and conflicts of interests, investigating funding sources, and increasing science vocabulary.
  - **Lesson 2:** The Results: Activities may include variable associations, changing variables, and cross disciplinary connections (math, language arts, social studies)
  - **Lesson 3:** Analyzing the Results: Students can create graphic representations of data, apply study results to real world connections, making presentations/public service announcements (PSAs), games, labs, and Socratic discussions.
  - **Lesson 4:** Compare and Contrast: students locate and/or transform media articles to compare for consistency with the science transformation and depth of content. Additionally, advanced students may work on their own science article transformation and create a presentation to be presented to the class, to parents, and/or administrators.
For examples of transformation units, go to the Critical Thinking – Science Literacy curriculum located on the Teacher Enrichment Initiatives website: [http://teachhealthk-12.uthscsa.edu/curriculum/critical-thinking/critical-thinking.asp](http://teachhealthk-12.uthscsa.edu/curriculum/critical-thinking/critical-thinking.asp). Each posted transformation unit was created by actively practicing middle school teachers through a Science Education Drug Abuse Partnership Award, SEDAPA, supported by the National Institute on Drug Abuse, NIDA, and the National Institutes of Health, NIH.