Table of Contents:

I. GENERAL USE OF *Science* in the Classroom
   a. Student Learning Goals (general)
   b. Using this Resource
      i. Learning Lens
      ii. Learning Notes
      iii. References
      iv. Thought Questions
   c. Suggestions for Classroom Use

II. ARTICLE-SPECIFIC MATERIALS
   a. Student Learning Goals (specific)
   b. Connect to Learning Standards
   c. Summary of the Article for the Teacher
   d. Resources for Interactive Engagement
      i. Discussion Questions
GENERAL USE OF Science in the Classroom

Student Learning Goals:

“One fundamental goal for K-12 science education is a scientifically literate person who can understand the nature of scientific knowledge.”

The U.S. National Academy of Sciences defines science as: “Any new finding requires independent testing before it is accepted as scientific knowledge; a scientist is therefore required to honestly and openly report results so that they can readily be repeated, challenged, and built upon by other scientists. Proceeding in this way over centuries, the community effort that we call science has developed an increasingly accurate understanding of how the world works. To do so, it has had to reject all dogmatic claims based on authority, insisting instead that there be reproducible evidence for any scientific claim.”

An important student learning goal, central to any understanding of “the nature of scientific knowledge,” is to give each student an appreciation of how science is done.

This includes knowing why:

- Scientists must be independent thinkers, who are free to dissent from what the majority believes.

- Science can deal only with issues for which testable evidence can be obtained.

- All scientific understandings are built on previous work

- It is to be expected that one scientist’s conclusions will sometimes contradict the conclusions of other scientists.

- Science is a never-ending venture, as the results from one study always lead to more questions to investigate.

1 A Framework for K-12 Science Education, National Research Council, 2012
Using This Resource

Learning Lens:

The Learning Lens tool can be found on the right sidebar of each resource and is the source of annotations. Click on the headings to highlight portions of the text of the corresponding research article. A subsequent click on the highlighted text will produce a text box containing more information about that particular piece of text. Below is an example of the Glossary function of the Learning Lens.

An example of the resource with the Glossary, Previous Work, Author’s Experiments, News and Policy Links, and References and Notes tools turned on. The Glossary tool is in use.
Learning Notes:

Learning Notes accompany each figure and are designed to help students deconstruct the methods and data analysis contained within each figure.

Fig. 1. Spatial distribution of head scales. (A) Head scales in most snakes (here, a corn snake) are polygons (two upper panels) with stereotyped spatial distribution (two lower panels); left (yellow) and right (red) scale edges overlap when reflected across the sagittal plane (blue). (B) Polygonal head scales in crocodiles have a largely random spatial distribution without symmetrical correspondence between left and right. (C) Head scales from different individuals have different distributions of scales’ sizes and localizations (blue and red edges from top and bottom crocodiles, respectively).

Method: 3D geometry and color-texture reconstruction

The authors took 120 color pictures of each animal to create detailed, three-dimensional models of reptile heads. Watch this video in which the authors further explain their modeling methods:

http://www.sciencemag.org/content/suppl/2012/11/29/science.1226265.DC1/1...
References:

The Reference section of each resource is annotated with a short statement about how or why each reference relates to the current research study.

16. Lewejohann et al., Environmental bias: Effects of housing conditions, laboratory environment and experimenter on behavioral tests. Genes Brain Behav. 5, 64 (2006).
Thought Questions

Thought Questions are located above the Learning Lens in the right sidebar of each resource. These questions were written to be universal and applicable to any primary research paper. Thought questions do not have a single answer, or a correct answer for that matter, and can be used to stimulate discussion among students.
Suggestions for Classroom Use:

In addition to the thought questions discussed above, other resources are provided for use in the classroom. These can be found toward the end of the teacher guides associated with each specific article and include:

1. Discussion questions specific to the article, related to the standards, and/or associated with the figures.

2. Activities tied to the articles.

Some ways to use the Science in the Classroom articles:

1. Assign to student groups to read and discuss during class.

2. Assign small sections of the article to student groups to read and discuss during class, with the expectation that they will present or use jigsaw to teach the entire class what is in their part of the article.

3. Assign to individual students to complete during class or as homework.

4. Assign reading as an extra credit project.

Some ideas for interactive student engagement after reading the article:

1. Students write answers to discussion questions (for example, those linked to the standards or those linked to the diagrams).

2. Go over the abstract, as well as information about the purpose and structure of an abstract, and have students write their own abstracts for the articles in language that could be understood by their peers.

3. Have students edit the article, or parts of the article, to a simpler reading level.

4. Have students, alone or in small groups, use the annotated list of references to explain how the scientists who wrote this article built on the published work of at least one independent group of scientists in making their discoveries. In the process, did they produce data that supports the findings of the earlier publication that they have cited in the text? In what way does this article support the statement that scientific knowledge is built up as a “community effort”?
5. Use the article and discussion questions linked to the standards and the diagrams for a teacher-led classroom discussion. The discussion can focus on the nature of science and scientific research, as well as on the science in the article itself.

6. Have students give a classroom presentation about the article, parts of the article, or their answers to discussion questions.
ARTICLE-SPECIFIC MATERIALS

Connections to the nature of science from the article

- Identifies independent variables (different types of fiction)
- Tests a hypothesis (that literary fiction would improve Theory of Mind)
- Manipulates participants psychologically and collects data using validated, objective measures (RMET, DANVA2-AF, Yoni Test)
- Statistically analyzes and reports dependent variables (Theory of Mind, Tables 1 & 2)

The importance of this scientific research

- First causal claim about the effects of reading literature on Theory of Mind in scientific literature
- Provides empirical evidence for debates about the social value of different types of fiction/policy implications regarding the Common Core Standards and recent de-emphasis on fiction education in American K to 12 curriculums
- Offers a deeper understanding of a common pastime and major industry (writing, literature, publishing, journalism)
- Stimuli are ecologically valid/relevant to daily living
- Connects science, the arts, and the humanities

The actual science involved

- Multiple experiments consisting of:
- Random assignment of human participants into groups
- Manipulation: Priming
- Data collection: Online tests
- Data analysis: Statistical analysis and theoretical interpretation of results
- Replication of results
Connect to Learning Standards:

- Connects to Next Generation Science Standard Practice 1:

  Asking questions (for science) and defining problems (for engineering)

  The researchers formulated an empirically answerable question (Do different types of fiction affect Theory of Mind differently?) about a phenomena (the relationship between familiarity with fiction and Theory of Mind).

- Connects to Next Generation Science Standard Practice 3:

  Planning and Carrying Out Investigations

  To carry out a systematic investigation of their hypothesis, the researchers had to operationalize their variable, literary fiction.

  They identified books with prestigious awards as a category generally representative of literary fiction.

  In doing so, they manipulated their independent variable to create distinct experimental conditions.

- Connects to Next Generation Science Standard Practice 6:

  Constructing Explanations and Designing Solutions

  The researchers are constructing a theory that attempts to provide an explanatory account of the effects found in their data.

http://www.nap.edu/openbook.php?record_id=13165&page=42
Summary of the Article for the Teacher:

*It is recommended that this not be used by students in place of reading the article.*

General Overview:

The books we read change our minds, but in what ways? This study shows that certain types of books (nonfiction, popular, literary, and everyone’s favorite: no books) affect the minds of readers differently. Although reading fiction has long been a requirement in education and a pastime for many, little empirical research has investigated the ways in which interacting with characters who are not really real can affect our ideas about real people in real life. This study shows causal effects of reading on a social cognitive process called Theory of Mind, “mind-reading,” or our ability to imagine the thoughts and emotions of others. The researchers found that literary fiction improved Theory of Mind.

Topics Covered:

- Social cognition
- Social relationships
- Theory of Mind
- Nonfiction and fiction reading
- Literary theory

Methods used in the Research:

- Experimental, between groups, with pre-/post-test design
- Random sample and random assignment
- Priming
- Two (Experiments 1, 3, and 4) or three (Experiments 2 and 5) experimental conditions in each experiment: Nonfiction (Experiment 1), popular fiction (Experiments 2 through 5), and no-reading (Experiments 2 and 5).
- Statistical analysis
- Tested for influence of subject variables (i.e., education, age, gender) and confounds
- Multiple experiments

Conclusions:

- Reading literary fiction, and not popular fiction, may hone adults’ Theory of Mind
- Engaging with fiction affects social cognitive processes
Areas of Further Study:

- Literary arts, film, theater, music, and other arts
- Social cognitive and other mental processes
Resources for Interactive Engagement:

Discussion Questions

1. Can you imagine designing an experiment like this? What other empirical questions can be asked about fiction (films, theater, music)?

2. Do you agree with the theoretical contentions made by the researchers? How else might you explain the results?

3. What category would the books you are currently reading in English class or in your personal life be a part of?

4. Why is “literariness” a complicated variable to quantify, and how did the researchers account for this complexity?