3-D Molecular Designs™
. . .where molecules become real

Teacher Notes

The Data Dilemma© — Modeling Scientific Practice

Introduction

Modeling is an important and integral part of scientific practice. The Data Dilemma© Activity is designed to model the process of incorporating evidence into a working external representation of the data. This activity may be used to facilitate a discussion on how scientific models evolve.

Materials

Five piece tangram set (all of the same color)
One extra data piece (a different color)

Procedure

1. Hand out the first piece of the tangram (the large triangle labeled “A”). Create a scenerio for the students explaining that while investigating a topic in the lab you have developed a “triangle model”.

2. Hand out the second piece of the tangram (the second large triangle labeled “B”). Have the students build upon the first triangle model with this second piece. You will notice that some groups will continue to form a triangle while others may form a square or a parallelogram. Stacking pieces is not allowed.

Class Discussion Questions

A. How many different shapes were created with this second piece of information collected from the lab?

B. How do you suppose scientists decide which model to continue building on as their investigation progresses?

3. Tell the students that because the initial evidence acquired suggested the simple triangle model, you decide to continue developing the triangle model and not the parallelogram or square models. Hand out the next three pieces (C, D and E) and have the students continue to build a more robust triangle model using these pieces. There are at least three solutions to this puzzle. If a group quickly discovers a solution, encourage them to find other solutions.

1050 North Market Street • Suite CC130A • Milwaukee, WI 53202
Phone: (414) 774-6562 Fax: (414) 774-3435
3dmoleculardesigns.com

Modeling Scientific Practice (continued)

Class Discussion Questions

C. Why do you think your teacher directed you to continue with the triangle model?

D. Why do you think researchers would choose to pursue the simplest model that would explain the data?

4. Introduce the "rogue" data piece (F). This part of the tangram is in a different color. Instruct the students that they now have to incorporate this latest piece of data into a geometric shape with the fewest sides possible. There are at least four solutions. If a group discovers a solution quickly, encourage them to find other solutions.

Class Discussion Questions

E. What shape did your model take once the extra piece was incorporated?

F. How did your model evolve when the new piece of data was uncovered?

G. How does this tangram activity model scientific practice?

H. Why might a scientist find it difficult to let an old model go?

I. Considering that there were multiple solutions to the data dilemma, how might a scientist determine if their explanation is the right one?

Teacher Tips

A. We recommend the students work in groups of two or three for this activity. Collaboration is an important skill to develop in the field of science.

B. Many teachers may opt to use this as an opening day activity to introduce the process of science to their students.

1050 North Market Street • Suite CC130A • Milwaukee, WI 53202
Phone: (414) 774-6562 Fax: (414) 774-3435
3dmoleculardesigns.com

Extension

The Missing Piece

Teachers may want to pose the question
Can you build another model that would require an additional piece of data while still maintaining the rectangle shape?

It is possible to construct a four sided rectangle model with a missing piece of data in the middle of the model. Other models may be built with a piece of data missing from an outside edge. Teachers may want to discuss the significance of the missing piece. Once a model has been developed, the researcher may find holes in the model that may direct the path of continued research on a given project in an effort to lend credibility to the work that has already been established. This is the crux of scientific practice. As basic researching progresses and engineering provides more sophisticated tools to collect and analyze data, the basic research that follows may provide models which evolve into more robust explanations of observed phenomena.

National Framework

Connections to A Framework for K-12 Science Education
Practices, Crosscutting Concepts, and Core Ideas

Dimension 1: Scientific and Engineering Practices
1. Asking questions and defining problems
2. Developing and using models
4. Analyzing and interpreting data
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence

Dimension 2: Crosscutting Concepts
1. Patterns
4. Systems and system models

Dimension 3: Disciplinary Core Ideas

Life Sciences

LS 1: From molecules to organisms: Structure and processes

Engineering,Technology and the Application of Science

ETS 1: Engineering design

ETS 2: Links among engineering, technology, science, and society

1050 North Market Street • Suite CC130A • Milwaukee, WI 53202
Phone: (414) 774-6562 Fax: (414) 774-3435
3dmoleculardesigns.com