OOEY GOOEY: MAKING SENSE OF SCIENTIFIC INQUIRY

Module 1

Guide to Module 1:

Ooey Gooey! Making Sense of Scientific Inquiry

Introduction

"Scientific inquiry" is a broad term that refers to the varied ways that all scientists—from biologists to physicists to chemists—study the natural world and develop theories based on their ideas. According to the *National Science Education Standards* (NSES), inquiry involves the following:

- Making observations;
- Posing questions;
- Planning investigations;
- Examining books and other sources of information to see what is already known;
- Using tools to gather, analyze, and interpret data; and
- Proposing answers, explanations, and predictions and communicating the results.

The purpose of the mission in the program's first module is to introduce students to these key processes of science. The students' challenge is to identify the contents of the mystery goo. To solve the problem, students must make observations, record their observations, ask questions, develop experiments to answer their questions, and draw conclusions from their results. Students will use these processes as a starting point for completing the missions in subsequent modules.

Learning Objectives

- Students experience the processes of science.
- Students learn how to ask appropriate scientific questions.
- Students learn how to develop investigations to answer their questions.
- Students discover how information is transmitted through their senses.

Relationship to the *National Science Education Standards*

This mission aligns with several standards identified in the NSES: overall physical science standards, the history and nature of science, and standards for science as inquiry. The charts below show how the mission aligns with the standards.

PHYSICAL SCIENCE STANDARDS	
Levels K–4	**How Mission is Aligned**
Properties of objects and materials	Students observe the mystery goo, identify its properties, predict what it is made of, and develop an investigation to check their predictions.
HISTORY AND NATURE OF SCIENCE	
Levels K–4	**How Mission is Aligned**
Science as a human endeavor	After viewing the DVD showing different kinds of scientists, students begin to understand that science encompasses many disciplines. Because they, too, will be working as scientists, they also start to realize that anyone who asks questions and tries to find the answers to their questions is a scientist.
SCIENCE AS INQUIRY	
Levels K–4	**How Mission is Aligned**
Abilities necessary to do scientific inquiry	Students go through the steps of scientific inquiry: observing, making predictions, experimenting to test their predictions, and drawing conclusions.
Understandings about scientific inquiry	Students learn about different kinds of scientists who ask different questions and develop original experiments to answer their questions.

Background

This mission has two purposes: to introduce students to the process of science and to illustrate how information is transmitted through the senses. During this mission, students will use their senses—seeing, hearing, smelling, and touching—to describe the *properties* of an object. Properties are those characteristics that describe an object, such as color, shape, and texture. For safety, the sense of taste will not be used in this module. After completing the mission, students will brainstorm about the brain, where the information gathered by the senses is processed. The brainstorming session prepares students for module 2, which focuses on the parts of the brain and what each part does.

Scientific inquiry has a distinct benefit for young students: It does not rely solely on traditional vehicles of learning, such as reading and listening. Children who learn best through hands-on activities and the visual arts also have an opportunity to excel.

Materials

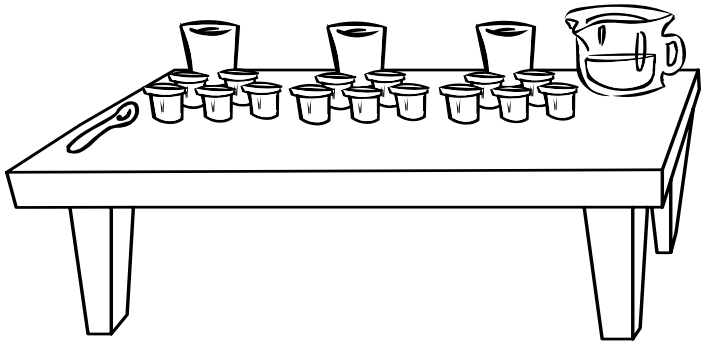
Five or six bags of goo
Cornstarch
Sugar
Talc
Water
Five or six medium-sized bowls
Five or six measuring cups and spoons
Plastic bags with a seal
NIDA Junior Scientists DVD
Instruction sheets
Stirrers
Log sheets

Preparation

1. Prepare five or six bags of goo by following the instructions below:
   a. Measure ¼ cup of cornstarch and put it in a bowl.
   b. Add about 3½ teaspoons of water to the cornstarch. The mixture should be thick enough to shape into a ball. You may have to adjust the amount of water so that it is not too dry and not too wet.
   c. Duplicate the recipe so that you have five or six bags of goo, one for each group.
   d. Make sure you put each batch of goo in a plastic bag with a seal. If not, the water may evaporate, and the goo will dry out.

You may want to have parent volunteers or instructional assistants available to help in the preparation of the bags of goo.

2. For the second half of the activity, measure the following materials and lay them out for each group of students:
   ¼ cup of cornstarch
   ¼ cup of sugar
   ¼ cup of talc
   3½ teaspoons of water
   Spoons and stirrers



3. This activity will take 2 days to complete. On the first day, show the students the DVD, hand out the log sheets, and have them work on the experiment. On the second day, students can record their results and discuss what they learned.

If possible, have at least one other adult in the room while the children are working on the experiment.

Tell students never to taste anything in science class.

Procedure

1. Show the class the introductory segment of the DVD or read the story on page 1-16 of this guide. Make sure the students understand their mission.

2. Divide the class into five groups of about five or six students. Give each group a bag of goo. Remind the groups of their mission—to figure out what the goo is made of.

3. Tell the groups to observe the contents of the bags. Ask them to consider the following questions:
   What does the goo look like?
   What does it smell like?
   What does it feel like?
   Can you roll it into a ball? Does it break apart?

4. After the groups have thoroughly observed the goo, have them record their observations on the log sheet.

5. Have each group make a prediction of what they think the goo is made of. Have students write their predictions on the log sheet.

6. Point out the ingredients on the table. Using their observations as a guide, have the groups select ingredients that they think they need to make a fresh batch of goo. If the two goos match, the students will have succeeded in uncovering the identity of the mystery material.

   The biggest decision students have to make is which solid to use. There are equal measurements of three different solids—cornstarch, sugar, and talc—laid out on the table, as well as containers of water. If they pick the wrong solid, they will have to throw the mixture away and prepare another one using water and a second solid.

7. Let students work independently as much as possible. After they have completed the investigation, have them record what ingredients they think are in the goo. Make sure they include reasons why they think the goo is made of those ingredients.

8. Have each group present its findings to the class. Each presentation should include the evidence students have that supports their conclusions.

   These presentations do not have to include any written materials, and they can be very short. The idea is for the children to try to articulate what they learned and begin to give reasons for their thinking.

9. **THE MISSION IS NOW ACCOMPLISHED!**

Discussion Questions

1. Discuss with the students what information about the mystery goo they got from their senses.
2. Ask students what they think happens to the information their senses gather. Where does it go? Help students understand that the information is processed in the brain, the control center for our bodies.
3. Ask students what they know about the brain. Record their responses on a piece of newsprint. You may want to revisit their ideas later in the program.
4. Start a class list about the functions of the brain. Plan to add to this list in subsequent modules.

Extensions

The activities listed below provide a link to other areas in the curriculum. These activities also make use of the trading cards included in the module.


1. Divide the group into pairs. Make copies of the trading cards and give each pair a set. Have them look at the scientists shown and imagine what a typical day would be like for each one. Students also can think about the differences and similarities among the scientists.



2. Divide the class into groups of five or six. Have the groups draw a large picture of what they have learned about scientific inquiry. Or students could pretend that they are reporters for the local newspaper assigned to describe scientific inquiry. Individually or in pairs, students can either write or draw their findings.

3. Have students draw a picture of what they think the brain looks like.

4. Read *Bartholomew and the Oobleck,* by Dr. Seuss, to the class.

Assessment

1. This activity can be viewed as an embedded assessment of how well students are grasping the concepts of scientific inquiry. As they work, look for the following:
   a. Are students able to make observations that are clear and specific? For example, can they note the color and shape of the material instead of saying, “It’s weird”?
   b. Are students able to make a prediction based on their observations?
   c. Are students able to figure out which materials to test to try to recreate the goo? Do they approach the problem logically and methodically?
   d. Are students able to record their results in either words or pictures?
   e. Can students support their conclusions with evidence gained from their investigations?

2. Keep track of what students know about the senses and the brain. Are they beginning with any prior knowledge, or is this subject completely new to them? If it is completely new, you may want to review what you discussed about the brain before proceeding to module 2.

3. After students complete their log sheets, you may want to make copies of them as part of a portfolio of their work. After completing each module in the NIDA Junior Scientists Program, students will be completing a log sheet. You can use the sheets to track their development as scientific investigators.

Additional Activities

Below are some additional activities that can be used after completion of the first mission. These activities are extensions to many other areas of the curriculum.

1. Have the students make a comic strip describing the steps involved in scientific inquiry. Make sure that each step is explained clearly.

2. Have the students write a letter to a friend comparing the NIDA Junior Scientists Mission Control Center with the brain, the body's "mission control." How are they similar? How are they different? Have students include in their letters additional information they would like to learn about their brain.

3. As a class, look at the recipe used to make the goo. Then discuss the following questions:
   a. What would you have to do to make twice as much goo as you did?
   b. What would you have to do to make half as much goo?
   c. What would happen if you added vinegar to the goo? Make a prediction, then perform the experiment to find out.

4. Ask students how they know that it's cold outside on a winter's day. What part or parts of their bodies let them know? How is the brain involved?

5. Ask students to draw a concept map showing what they have learned about the brain and their senses. Have students think about how the senses are connected to the brain. Make sure they indicate these connections on their concept maps.

6. Have students put on a play demonstrating what they have learned about scientific inquiry. Encourage them to explain the different elements of inquiry in creative ways. They also may want to include information about what they have learned about the brain.

Resources

The lists below include resources for teachers and students.

Resources for Teachers

National Institute on Drug Abuse (NIDA)
www.drugabuse.gov, 301-443-1124
This Web site contains information about drug abuse and a section designed specifically for parents, teachers, and students.

NIDA Drug Pubs
drugpubs.drugabuse.gov, 1-877-NIDA-NIH (1-877-643-2644)
Drug Pubs is NIDA's research dissemination center. Visitors can order hard copies of NIDA publications or download electronic versions in multiple formats.

National Clearinghouse for Alcohol and Drug Information (NCADI)
http://store.samhsa.gov, 1-800-729-6686
NCADI provides information and materials on substance abuse. Many free publications are available here.

Eisenhower National Clearinghouse (ENC)
www.goenc.com, 1-800-471-1045
This Web site provides useful information and products to improve mathematics and science teaching and learning.

National Academy of Sciences. *National Science Education Standards.* Washington, DC: National Academy Press, 1995. Book and a brochure summarize the key ideas in the Standards; provides good places to learn more about science education.

National Science Teachers Association and Miami University. *Dragonfly*. Science magazine for children that may include some relevant stories and activities; published as a pullout section in *Scientific American Explorations*.

National Science Teachers Association (NSTA)
www.nsta.org, 703-243-7100
Provides resources and information for science teachers.

Resources for Students

Churchill, E.R., Loeschnig, L.V., & Mandell, M. *365 Simple Science Experiments With Everyday Materials*. New York, NY: Black Dog & Leventhal Publishers, Inc., 1997. Includes easy projects with step-by-step instructions for using materials around the house to explore science.

Dr. Seuss. *Bartholomew and the Oobleck*. New York: Random House, 1970. This book tells the tale of a king that is bored with rain and snow so he orders his royal magicians create oobleck. This ooey-gooey substance is not exactly what the king had in mind.

Science Series: *Kitchen Chemistry*. Monterey, CA: Evan Moor Educational Publishers, 1996. Includes activities and experiments that help students learn about the basic principles of chemistry with materials found in the kitchen.

VanCleave, J.P. *Chemistry for Every Kid: 101 Easy Experiments That Really Work*. New York: John Wiley & Sons, Inc., 1991. A collection of more than 100 chemistry experiments showing how chemistry is part of our lives.

Wiese, J. *Head to Toe Science*. New York: John Wiley & Sons, Inc., 2000. Includes over 40 activities and experiments that teach kids about the human body.

Houghton Mifflin Science Center
www.eduplace.com/science
Links to science-based activities and lessons.

The Why? Files
http://whyfiles.org
Explanations for scientific phenomena discussed in the news.

Student Instruction Sheet

Module 1: Ooey Gooey! Making Sense of Scientific Inquiry

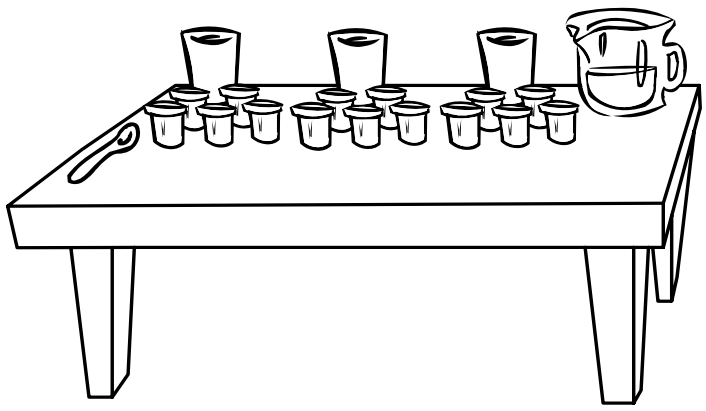
1. Did your teacher give your group a bag of goo? Work with your partners to answer these questions:
   a. What does the goo look like?
   b. What does it smell like?
   c. What does it feel like?
   d. Can you roll it into a ball? Does it break apart?

REMEMBER, NEVER TASTE ANYTHING IN SCIENCE CLASS!

2. Record your thoughts on the log sheet.

3. What do you think the goo is made of? Make a prediction. Record your prediction on the log sheet.

4. Look at the ingredients on the table. Can you pick out which ones to use to make more goo? You must make the same kind of goo that is in your bag.



5. Work until your goo matches the goo in the bag. If you make a mistake, clean up and try again.

6. What ingredients are in the goo? Record them on your log sheet. Why do you think the goo is made of those ingredients?

7. Tell the class what ingredients are in the goo. How do you know those are the right ingredients?

8. **CONGRATULATIONS! THE MISSION IS NOW COMPLETED.**

If you do not have a DVD player, read this story to your class to introduce the mission.

Introductory Story for Module 1

"Hi, everyone. I'm Kevin, better known as 'Brain Teaser.' They call me that because I love a good joke. Meet my friend, Ami. We call her 'Brain Trust' because she's what we call smart, and I mean REAL smart. We're both in a really cool club called *'Brain Power!'* NIDA Mission Control sends us missions to solve."

"Wait a minute, Teaser," said Ami. "Let me talk, too. We go on missions with Corty to solve problems. Our trusty friend Corty usually lets us know what to do."

"That's right. Hi to all. I'm the famous Corty. And I see on my trusty computer monitor that *Brain Power!* has a riddle to solve."

"Great," said Teaser. "Riddles are right up my alley."

"Okay, you ready? Here comes the riddle:

'We map the stars in outer space.
And chart the bottom of the deep blue sea.
We even teach animals to talk to us, and study how drugs can affect your brain.
Everybody on this list truly is . . .'"

"A scientist," shouted Kevin and Ami.

"You got it," said Corty. "Now ask me what science is."

"Okay," said Ami. "What's science?"

"Gee, I'm so glad you asked," replied Corty. "Science involves observing, asking questions and making predictions, doing experiments, and collecting information through the use of scientific inquiry."

"Cool," said Kevin. "I'm off to do science right now. I'm really interested in that experiment part."

"Kevin may be ready, but I'm not sure I understand what scientific inquiry is. Could you run it by me again?" asked Ami.

Before Corty had a chance to reply, Kevin came running back into the room. He was covered in sticky, icky white goo.

"What happened to you?" asked Ami.

"I'm not sure," said Kevin. "I was looking in the closet for something to experiment with, but instead, all I found was this white goo."

"This is a big problem," said Corty. "We've got to figure out what this stuff is before we're all stuck together. Ami, come on. Think of something."

"Okay, but the kids in the class are going to have to help," said Ami. "Let's try out this scientific inquiry thing. I think we're supposed to 'observe' first. That should be easy enough. The stuff is all over Kevin."

"Then you need to guess what this goo is made of," said Kevin.

"Right. Next, test your guess by trying to make more goo. Then you can decide if your guess was right. Observe, predict, experiment, and conclude—the four big steps," finished Ami.

Now it's up to you, kids. Use the materials on hand to make the goo. Kevin is counting on you to work fast.

Good luck. And remember, *Brain Power!* rules.

Log Sheet

Name:_____

What I observed

My group's prediction

What I discovered

BRAIN POWER NEWS

Parent Newsletter

Volume 1, Number 1

Welcome to the NIDA Junior Scientists Program

Your child has been working on the first module of the National Institute on Drug Abuse (NIDA) Junior Scientists Program. Geared to students in second and third grades, the program is made up of six modules introducing the following key concepts:

- The steps of scientific inquiry—observing, making predictions, performing experiments to test predictions, and making conclusions;
- The parts of the brain and how information is transmitted throughout the body;
- The differences between drugs used as medicines and drugs used for other purposes;
- The effect that nicotine and other drugs have on the body and the brain.

By teaching young children about how drugs affect the body, we can lay a foundation for students to make better decisions about their own health in the future.

This newsletter is designed to provide you with information so that you can reinforce at home what your child has been learning in school. Each module has a parents' newsletter that includes the following:

- The content of the module;
- Activities you can do at home;
- Additional resources;
- A suggestion for your child to share some thoughts through words or pictures.

We hope that you and your child enjoy working on the program together and that the knowledge gained now will serve your family well in the future.

continued

What is Scientific Inquiry?

The term "scientific inquiry" sounds pretty sophisticated, but actually, it simply refers to a systematic way of approaching a problem. The four steps of scientific inquiry are:

- Observing the features of an object or phenomenon;
- Predicting what the object or phenomenon is;
- Experimenting to check the prediction; and
- Figuring out what the results mean.

Students used these four steps to figure out what a mystery goo was made of. This activity aligns with the *National Science Education Standards* (NSES), guidelines developed in 1996 by the National Academy of Sciences to help schools know what science information should be covered in kindergarten through high school. The standards stress the importance of using scientific inquiry as a tool for approaching and solving problems. Throughout the NIDA Junior Scientists Program, we will let you know how each activity fits in with the NSES recommendations.

Science at Home

Ask your child what he or she learned about scientific inquiry. Then try a science experiment with your child. Mix 1/3 cup of cornstarch and 1/3 cup of baking soda. What happens when you add water? Try it again, but add vinegar instead. What do your results tell you about the differences between water and vinegar? What do they tell you about the properties of the liquids? Try to use the steps of scientific inquiry to answer these questions.

What Does Your Child Think?

Have your child write or draw a picture about something related to scientific inquiry.

Additional Resources

You and your child may want to try some of the science experiments included in some of these resources.

National Institute on Drug Abuse (NIDA)
www.drugabuse.gov, 301-443-1124
This Web site contains information about drug abuse and a section designed specifically for parents, teachers, and students.

NIDA Drug Pubs
drugpubs.drugabuse.gov, 1-877-NIDA-NIH (1-877-643-2644)
Drug Pubs is NIDA's research dissemination center. Visitors can order hard copies of NIDA publications or download electronic versions in multiple formats.

National Clearinghouse for Alcohol and Drug Information (NCADI)
http://store.samhsa.gov, 1-800-729-6686
NCADI provides information and materials on substance abuse. Many free publications are available here.

Science Series: Kitchen Chemistry. Monterey, CA: Evan Moor Educational Publishers, 1996. Includes activities and experiments that help students learn about the basic principles of chemistry with materials found in the kitchen.

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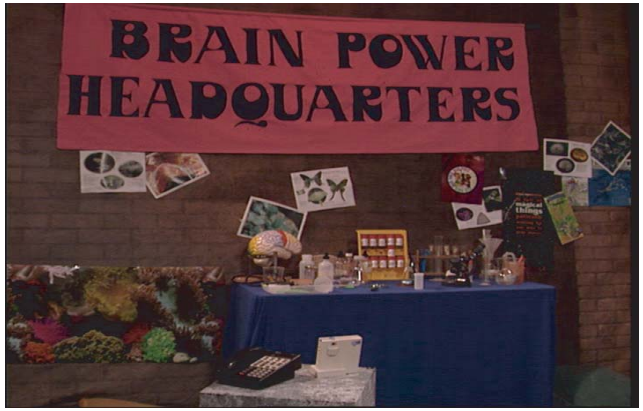
Explanations for scientific phenomena discussed in the news.

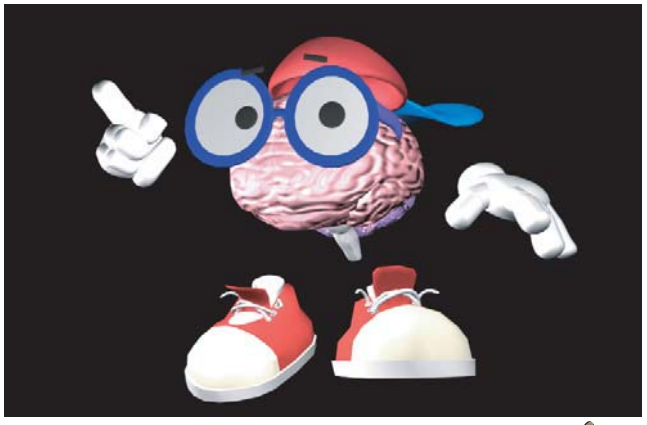
Edible/Inedible Experiments Archive
www.madsci.org/experiments
Lists of both simple and more complex experiments.

BRAIN POWER CLUB



Brain Power is a science club where kids come together and complete missions. The missions come from the NIDA Junior Scientists Mission Control Center. These missions are all about the brain and how drugs affect the brain. Brain Power meets in this clubhouse.

CORTY



Corty is the Brain Power Club's trusty partner in completing missions. He receives the missions from the NIDA Junior Scientists Mission Control Center and helps send the kids on their way.

SCIENTIFIC INQUIRY

The Brain Power Club uses these four steps to complete missions:

- Observe: Check out the problem.
- Hypothesize: Time to make a good guess.
- Experiment: Is your guess right? Find out by doing an experiment.
- Conclude: Put the pieces together to figure out what's really going on.

These steps are scientific inquiry.

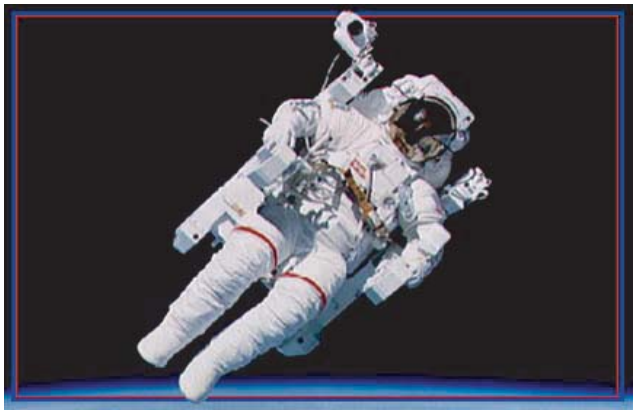
KEVIN, BRAIN TEASER

Meet Kevin, Brain Power's very own funny guy. Kevin's club name is Brain Teaser! He loves completing missions with the help of his friends in the Brain Power Club. When Kevin grows up, he wants to be a scientist! The Brain Power missions are helping him learn about science.

AMI, BRAIN TRUST

Here's Ami, a member of the Brain Power Club. Ami's club name is Brain Trust. She's quick, she's smart, and she can help you complete any mission. Ami spends extra time in the clubhouse learning about science by reading books and Web sites!

ASTRONAUTS

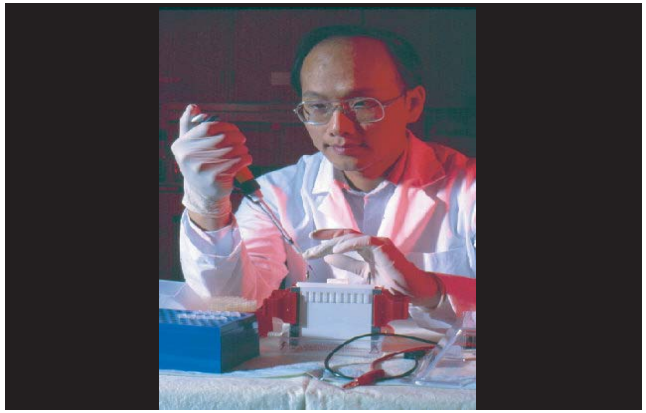


Astronauts are scientists, too! These scientists study outer space, stars, and planets. Their work helps us learn about our own history here on earth. They wonder if there is life on other planets!

OCEANOGRAPHERS

Scientists do all sorts of interesting things! Some scientists study oceans and the animals and plants that live there. Their work will help save the planet so that you and your children can grow up with clean water and interesting fish, animals, and plants to learn about!

NIDA SCIENTISTS



NIDA sends missions for the Brain Power Club to complete. Scientists at NIDA are studying the brain and how drugs affect the brain. Their work will help children like you stay safe and healthy!

BRAIN POWER! CLUB

Brain Power! is a science club where kids come together and complete missions. The missions come from the NIDA Junior Scientists Mission Control Center. These missions are all about the brain and how drugs affect the brain. *Brain Power!* meets in this clubhouse.

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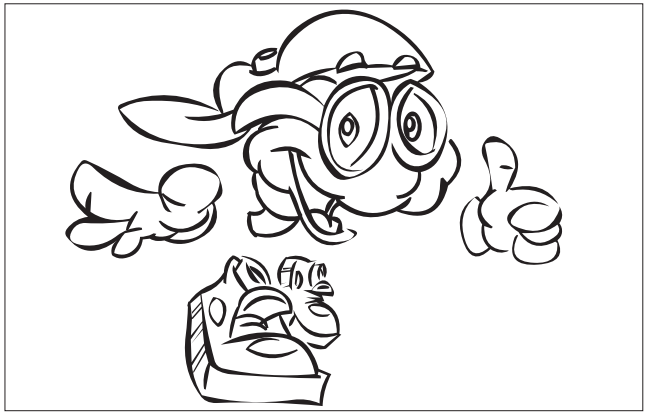

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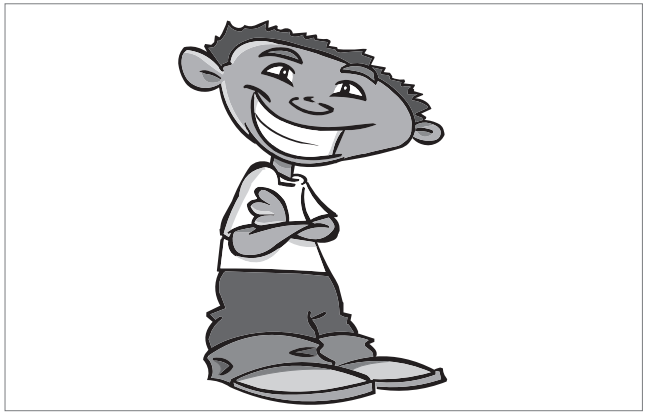

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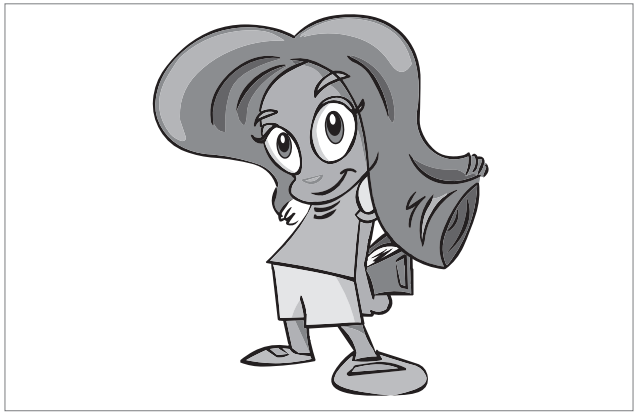

Here's Ami, a member of the *Brain Power!* Club. Ami's club name is Brain Trust. She's quick, she's smart, and she can help you complete any mission. Ami spends extra time in the clubhouse learning about science by reading books and Web sites!

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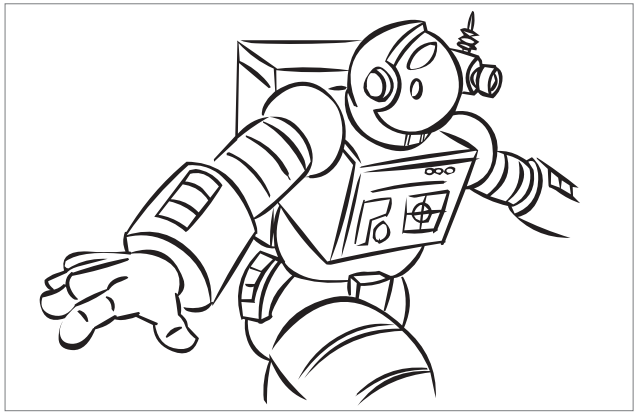

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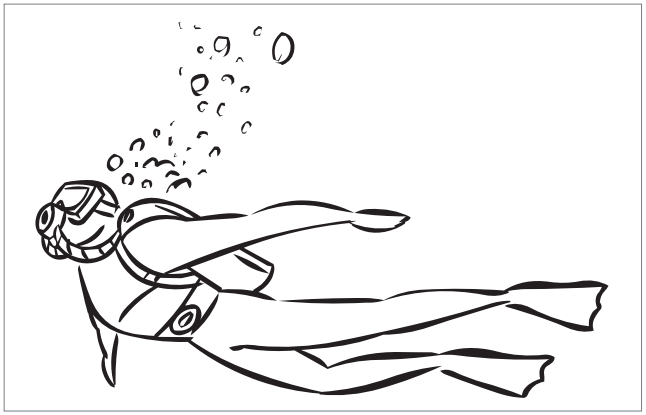
OCEANOGRAPHERS



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NIDA SCIENTISTS

NIDA sends missions for the *Brain Power!* Club to complete. Scientists at NIDA are studying the brain and how drugs affect the brain. Their work will help children like you stay safe and healthy!

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OOEY GOOEY: MAKING SENSE OF SCIENTIFIC INQUIRY

Observe: Check out the problem.

Hypothesize: Time to make a good prediction.

Experiment: Is your prediction right? Find out by doing an experiment.

Conclude: Put the pieces together to figure out what's really going on.