



Reasoning, Hypothesis, Experimentation

Some kids know that one of the best ways to irritate their parents is to ask a bunch of questions: What is air? How does electricity work? Why do balls bounce? Why can't I fly? Why can't dogs talk? How does gravity work? Why is snow white when water isn't? What is lightning? What is thunder?

Scientists are a lot like those little kids. They are curious, and they ask hard questions that have been perplexing people for years. But then they do something else: They find answers. They develop hypotheses (possible answers) and then set out to prove those hypotheses through observation and experimentation. Their answers might just add to humanity's knowledge base, but on occasion, their answers lead to breakthroughs in medicine, technology, space travel, and many other fields.

This month, Scouts will get a taste of what it's like to be a scientist. The unit's weekly meetings will be full of engaging experiments, while the main event will take the unit out into the world of science. Who knows? Some Scouts may even decide that asking—and answering—questions is something they want to do for the rest of their life.

Objectives

This month's activities should:

- Define what science is
- Help Scouts understand careers that use science
- Help Scouts understand and demonstrate the scientific method
- Help Scouts understand the different sciences, or "-ologies"
- Relate science to science fiction
- Encourage Scouts to earn the Nova and Supernova awards

RELATED ADVANCEMENT AND AWARDS

- Merit badges: Animal Science, Chemistry, Energy, Environmental Science, Geology, Insect Study, Mammal Study, Medicine, Nature, Nuclear Science, Oceanography, Plant Science, Reptile and Amphibian Study, Soil and Water Conservation, Space Exploration, Veterinary Medicine, Weather
- Nova and Supernova awards



LEADERSHIP PLANNING

As a leadership team, you may want to discuss the following items when choosing science as your program feature during your planning meetings.

1. Choose a main event.
2. Is there a science museum nearby?
3. Is there a science fair in the near future?
4. What are the travel demands for the main event?
5. Will the main event be an overnighter?
6. What science fiction movie/show will we watch?
7. Who will present the instruction portions?
8. Where will we do our main event?
9. How can we involve parents?
10. What science-related merit badge should we focus on?
11. To meet our needs, what should we change in the sample meeting plans?

Parents can help with the Science program feature by:

1. Sharing their expertise
2. Providing transportation for the main event
3. Providing materials for the chemistry, biology, and physics experiments
4. Supplying catapult materials (such as Tinkertoys®)

THREE AREAS OF SCIENCE

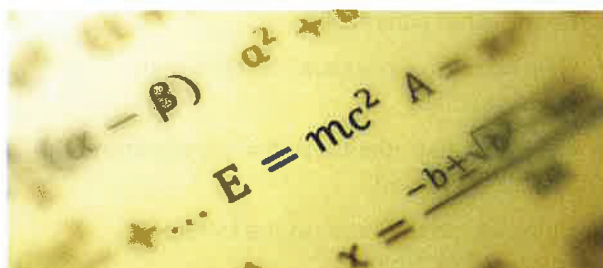
Science is the study of the structure and behavior of the physical and natural world through observation and experimentation. Because science studies literally everything, scientists specialize in many areas. Although some specialties overlap, all sciences tend to focus on one area of the chemical, living, or physical world.



Chemistry deals with the identification of the substances of which matter is composed, the investigation of their properties, and the ways in which they interact, combine, and change.



Biology is the study of living organisms, divided into many specialized fields that cover their morphology (form and structure), anatomy (the branch of morphology that deals with structure), physiology (function and activities), behavior, origin, and distribution.



Physics is the scientific study of matter and energy and how they interact with each other. Physics often explains the fundamental mechanisms of other sciences.



SCIENCE GAMES

Match the “-ology”

Equipment: 5-by-7 cards with one word on each to make science pairs: geology/rocks, biology/living things, cardiology/heart, zoology/animals, etc. (See “Scientific Specialties” below for ideas.)

How to play: Shuffle the cards; have each player take one without looking at it. When told to begin, each player tries to find the person with the corresponding card. Points can be awarded individually or by teams; 1 point per correct match.

Sci-fi Trivia

Equipment: A list of sci-fi trivia questions and answers. Find questions and answers through an Internet search or create your own.

How to play: Two options—teams take turns answering questions OR players write the answers on their own sheet of paper. The winner is the team or player with the most correct answers.

Variations: 1. Create a “Jeopardy!”-style game with multiple categories and escalating point values; 2. Let teams create and ask their own trivia questions, and award points when they stump the other teams.

Human Knot

Equipment: None

How to play: The group stands shoulder to shoulder in a circle. Players reach into the middle with both hands and grab two other hands at random, making sure they don’t belong to the same person. Without letting go, the group

untangles the “knot.” Afterward, discuss what hypothesis, theories, and facts players used to get untangled.

Blind Cannon

Equipment: Blindfolds and large, heavy sponges (dampen them to give them more weight)

How to play: Two teams face each other across “no man’s land,” about 15 feet apart. (Determine a distance based on how far a sponge can be thrown.) Each team has one general and one or two “cannons”—blindfolded players who throw sponges. The generals stand still on their respective sides of the playing field and give direction to their cannons. The cannons try to strike the opposing generals with their sponges. Other players collect sponges and return them to the cannons. The last general standing wins.

Marshmallow Catapult Contest

Equipment: Materials to make a catapult, a bucket for a target, and marshmallows as ammo. Tinkertoys work well for catapults, but with a little imagination other materials can be used.

How to play: Each player or team creates a catapult that can shoot marshmallows at a bucket placed across the room. The person or team to get the most marshmallows in the bucket wins.



SCIENTIFIC SPECIALTIES

The suffix “-ology” means “the study of.” Words formed with this suffix describe the study of a particular subject. The areas of scientific studies are almost endless. Here are a few of the “ologies” and other scientific specialties.

Anthropology—the study of humans

Archeology—study of prehistoric peoples and cultures

Astronomy—the study of celestial bodies

Biology—the study of life

Cardiology—the study of the heart

Dermatology—the study of skin

Entomology—the study of insects

Ethnology—the study of cultures

Geology—the study of rocks and minerals

Hematology—the study of blood

Hydrology—the study of water

Ichthyology—the study of fish

Microbiology—the study of microscopic organisms

Oncology—the study of cancer

Neurology—the study of the nervous system

Paleontology—the study of fossils

Psychology—the study of the human mind

Radiology—the study of X-rays and their medical application

Seismology—the study of earthquakes

Toxicology—the study of toxins

Volcanology—the study of volcanoes

Zoology—the study of animals



E.D.G.E. Ideas

Explain how it is done—Tell them.

Demonstrate the steps—Show them.

Guide learners as they practice—Watch them do it.

Enable them to succeed on their own—Have them practice/teach it.

EXPLAIN

- Define science.
- Discuss the three main areas of science.
- Define “-ology” and give examples.
- Discuss the scientific method and the difference between a hypothesis, a theory, and a law.
- Show a science video from the Internet that discusses a scientific principle.

DEMONSTRATE

- Conduct a live chemistry, biology, or physics experiment.
- Show a YouTube or other Internet video of a science experiment.
- Show why certain science fiction “facts” are impossible or implausible.
- Demonstrate a simple catapult.
- Show a sample science fair project.

GUIDE

- Have Scouts conduct a simple science experiment while you supervise.
- Lead a reflection on an experiment the Scouts have conducted.
- Watch as Scouts design and built catapults, offering guidance throughout the process.
- Have Scouts work through a step in developing a science fair project.
- Help Scouts identify scientists or groups the unit could work with for the main event.

ENABLE

- Challenge Scouts to develop science fair projects.
- Have Scouts watch a science fiction show and critique the false science principles it embraces.
- Encourage Scouts to pursue a Nova or Supernova award.
- Have older Scouts lead younger Scouts in science experiments.
- Have Scouts teach a Cub Scout belt loop like Astronomy or Science.

MAIN EVENT SUMMARIES

● ESSENTIAL

Day Activity

Science museum visit—Visit a science museum or aviation museum. Arrange ahead of time to talk with a docent or staff member about a science topic related to the museum’s exhibits.

■ CHALLENGING

Day Activity

Science fair—Create tabletop displays that highlight a scientific topic and present it at a local science fair. Decide what prizes you would give if you were in charge. If you can’t find a local science fair, hold your own within your unit.

◆ ADVANCED

Overnight Activity

Research project—Contact a local college or environmental agency and volunteer to assist in a research project. Possibilities include participating in a fish count or bird count, identifying trees, or assisting in a geological or archeological dig.



SCIENCE

Meeting Plan: What Is Science?



Week 1 Date _____

ACTIVITY	DESCRIPTION	RUN BY	TIME*
Preopening 15 minutes before meeting	Show short science videos as Scouts arrive.		6:45 p.m.
Opening Ceremony 10 minutes	Flag presentation Oath and Law Uniform inspection		7 p.m.
Group Instruction 5 minutes	Discuss the following: <ul style="list-style-type: none">• The definition of science• The suffix “-ology” and some specific “ologies”• The three main branches of science: chemistry, biology, physics		7:10 p.m.
Skills Instruction 45 minutes	Conduct these experiments and discuss the scientific principles involved.		7:15 p.m.
	Chemistry: Combine baking soda and vinegar. Biology: Grow bean sprouts. Physics: Use levers and pulleys to move weights.		
	Chemistry: Combine Mentos and diet soda. Biology: Chart each Scout's height and shoe size and look for correlations. Physics: Ricochet marbles off one another.		
	Chemistry: Make a battery. Biology: Breed fruit flies and discuss genetics. Physics: Create a dominoes chain reaction and measure how long it takes dominoes in different configurations to fall		
Breakout Groups 15 minutes	<ul style="list-style-type: none">• New members practice basic Scout skills.• Older members choose a science-related merit badge or Nova award to work on together.• Review the last main event and discuss what could have made it better.		8 p.m.
Game 10 minutes	Play Match the “-ology” (described earlier).		8:15 p.m.
Closing 5 minutes	Announcements Leader's minute Closing		8:25 p.m.
Total 90 minutes of meeting			
After the Meeting 15 minutes	Leadership team reviews plans for the next meeting and for the main event.		

*All times are suggested.



SCIENCE

Meeting Plan: Potential Energy



Week 2 Date _____

ACTIVITY	DESCRIPTION	RUN BY	TIME*
Preopening 15 minutes before meeting	Play Blind Cannon (described earlier).		6:45 p.m.
Opening Ceremony 10 minutes	Flag presentation Oath and Law Uniform inspection		7 p.m.
Group Instruction 20 minutes	<ul style="list-style-type: none"> • Teach the basics of projectile motion. • Explain how angle and force combine to launch projectiles. • Define projectile and projectile motion. • Discuss the difference between forward velocity and acceleration due to gravity. 		7:10 p.m.
Skills Instruction 20 minutes	<ul style="list-style-type: none"> • On paper, design a basic catapult. 		7:30 p.m.
	<ul style="list-style-type: none"> • Build the catapult you designed using material like Tinkertoys. • Practice loading and firing the catapult. • Keep a record of distance. 		
	<ul style="list-style-type: none"> • On paper, design a catapult with adjustable elevation and force. • Using household items, build the catapult you designed. • Practice loading and firing the catapult. • Keep a record of angle, force, and distance. 		
	<ul style="list-style-type: none"> • On paper, design a catapult with adjustable elevation and force. • Build the catapult you designed using dowels and lashings of string. • Practice loading and firing the catapult. • Keep a record of angle, force, and distance. 		
Breakout Groups 15 minutes	<ul style="list-style-type: none"> • New members practice basic Scout skills. • Older members choose a science-related merit badge or Nova award to work on together. • Make plans for participation in main event. 		7:50 p.m.
Game 20 minutes	Play Marshmallow Catapult Contest (described earlier).		8:05 p.m.
Closing 5 minutes	Announcements Leader's minute Closing		8:25 p.m.
Total 90 minutes of meeting			
After the Meeting 15 minutes	Leadership team reviews plans for the next meeting and for the main event.		

*All times are suggested.






SCIENCE

Meeting Plan: Scientific Method



Week 3 Date _____

ACTIVITY	DESCRIPTION	RUN BY	TIME*
Preopening 15 minutes before meeting	Play Three-Person Tug-of-War (see <i>Troop Program Resources</i>).		6:45 p.m.
Opening Ceremony 10 minutes	Flag presentation Oath and Law Uniform inspection		7 p.m.
Group Instruction 20 minutes	<ul style="list-style-type: none">• Define the scientific method.• Explain the difference between hypotheses, theories, and laws.• Compare and contrast experimentation and observation.		7:10 p.m.
Skills Instruction 30 minutes   	<ul style="list-style-type: none">• Design an inhabited base located on the moon or Mars.		7:30 p.m.
	<ul style="list-style-type: none">• Discuss what theories and laws you need to consider.• Discuss sources of energy, construction process, life support, and purpose.• Draw or make a model of your base.		
	<ul style="list-style-type: none">• Make a theory of how gravity works.• Discuss what scientific laws are involved in your theory.• Devise experiments that could test your theory.• Repeat this process for other topics.		
	<ul style="list-style-type: none">• Research a modern scientific subject.• Find two competing theories and defend one of them in a debate. (This could be done in an ethical controversy format.)		
Breakout Groups 15 minutes	<ul style="list-style-type: none">• New members practice basic Scout skills.• Older members choose a science-related merit badge or Nova award to work on together.• Make plans for participation in main event.		8 p.m.
Game 10 minutes	Play Human Knot (described earlier).		8:15 p.m.
Closing 5 minutes	Announcements Leader's minute Closing		8:25 p.m.
Total 90 minutes of meeting			
After the Meeting 15 minutes	Leadership team reviews plans for the next meeting and for the main event.		

*All times are suggested.



SCIENCE

Meeting Plan: Science vs. Science Fiction



Week 4 Date _____

ACTIVITY	DESCRIPTION	RUN BY	TIME*
Preopening 15 minutes before meeting	Play Science Fiction Charades: Take turns acting out scenes from sci-fi movies or portraying familiar sci-fi characters.		6:45 p.m.
Opening Ceremony 10 minutes	Flag presentation Oath and Law Uniform inspection		7 p.m.
Group Instruction 30 minutes	<ul style="list-style-type: none">Discuss how science fiction is often rooted in science fact.Watch an episode of a sci-fi series like "Star Trek," "Doctor Who," "Stargate," or "Battlestar Galactica" (or part of a sci-fi movie).		7:10 p.m.
Skills Instruction 30 minutes	<ul style="list-style-type: none">Give examples of science fact in the show you just watched.		7:40 p.m.
	<ul style="list-style-type: none">Give examples of science fiction in the show you just watched.What advances in science would be required to make the examples of science fiction into science fact?		
	<ul style="list-style-type: none">What scientific laws were used in the show you just watched?Name something that was impossible.Identify two examples of technological or scientific advances in the chosen show and discuss how they could come to pass.		
	<ul style="list-style-type: none">After watching the show, explain what was possible and impossible in the show. Share with the group what you learned. If you were a scientific consultant on this show, tell what changes you would suggest to make it more scientifically accurate.		
Breakout Groups 15 minutes	<ul style="list-style-type: none">New members practice basic Scout skills.Older members choose a science-related merit badge or Nova award to work on together.Confirm assignments for main event.		8 p.m.
Game 10 minutes	Play Sci-Fi Trivia (described earlier).		8:15 p.m.
Closing 5 minutes	Announcements Leader's minute Closing		8:25 p.m.
Total 90 minutes of meeting			
After the Meeting 15 minutes	Leadership team reviews plans for the next meeting and for the main event.		

*All times are suggested.



SCIENCE

Main Event: Science Museum Visit



Date _____

Logistics

Location: _____

Departure time: _____

Return time: _____

Duration of activity: 4 hours

Budget: Completed _____ Approved _____

Camping: Duty roster _____ Menu _____

Transportation: Group _____ Self _____

Tour and activity plan: Completed _____ Submitted _____

Essential (Tier I)

Visit a science museum or aviation museum. Arrange ahead of time to talk with a docent or staff member about a science topic related to the museum's exhibits.

Equipment List

- Decided-upon uniform
- Pad and paper for taking notes
- Camera
- Lunch (decide on individual or group)
- Cell phones as appropriate
- Water
- Scout Basic Essentials (Review the list and take what you need.)

Activity

- Choose a science or aviation museum near you.
- Research the hours of operation and cost.
- Contact the museum to arrange to talk to a docent.
- Explore the museum.
- Select one exhibit that interests you and learn all you can about it.
- After the group reassembles at a designated time, report to the others on what you learned.

Safety

Use the buddy system. Have a first-aid kit. Cell phones are a good idea.

Notes



SCIENCE

Main Event: Science Fair



Date _____

Logistics

Location: _____

Departure time: _____

Return time: _____

Duration of activity: 4 to 8 hours

Budget: Completed _____ Approved _____

Camping: Duty roster _____ Menu _____

Transportation: Group _____ Self _____

Tour and activity plan: Completed _____ Submitted _____

Challenging (Tier II)

Create tabletop displays that highlight a scientific topic and present it at a local science fair. Decide what prizes you would give if you were in charge. If you can't find a local science fair, hold your own within your unit.

Equipment List

- Your science fair entry
- Decided-upon uniform
- Pad and paper for taking notes
- Camera
- Lunch (decide on individual or group)
- Cell phones as appropriate
- Water
- Scout Basic Essentials (Review the list and take what you need.)

Activity

- Find a science fair or contest in your area.
- Determine the entry requirements.
- Enter your group/individual project.
- Set up and present your topic at the science fair.
- Explore the other exhibits.
- Decide who you would give awards to.
- Participate in the awards ceremony.
- After the group reassembles at the designated time, report to the others on what interested you the most.

Safety

Use the buddy system. Have a first-aid kit. Cell phones are a good idea.

Notes



SCIENCE

Main Event: Research Project



Date _____

Logistics

Location: _____

Departure time: _____

Return time: _____

Duration of activity: Weekend

Budget: Completed _____ Approved _____

Camping: Duty roster _____ Menu _____

Transportation: Group _____ Self _____

Tour and activity plan: Completed _____ Submitted _____



Advanced (Tier III)

Contact a local college or environmental agency and volunteer to assist in a research project. Possibilities include participating in a fish count or bird count, identifying trees, or assisting in a geological or archeological dig.

Equipment List

- Appropriate clothing
- Equipment needed for research
- Cell phones or two-way radios as appropriate
- Computers, if needed
- Power source, if needed
- Camping gear as needed
- First-aid kit
- Meal plan
- Water
- Scout Basic Essentials (Review the list and take what you need.)

Activity

- Decide on an area of interest for the research project.
- Contact colleges, universities, or environmental agencies for research opportunities.
- Invite a researcher to visit with group.
- Determine how your group will assist with the research.
- Make appropriate assignments.
- Consider safety needs.
- Make plans to camp near the research site.
- Work on research project as planned.
- Submit research results and/or observations.
- Follow up to find out when the research is published.

Safety

Identify possible risks of research activity. Have a first-aid kit and develop a plan in case a researcher needs medical assistance. Consider using two-way radios.

Notes



RESOURCES AND REFERENCES

Books

Animal Science, Chemistry, Nuclear Science, Plant Science, and Space Exploration merit badge pamphlets

Nova Awards pamphlets

Organizations and Websites

Chem4Kids.com

Website: <http://chem4kids.com>

Science journal

Website: <http://www.sciencemag.org>

ItsNotMagicItsScience.com

Website: <http://www.itsnotmagicitsscience.com>

Science Friday

Website: <http://www.sciencefriday.com>

Related Program Features

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