Webelos & Arrow of Light Elective Adventures

Current vs. Modified Adventure Requirements

Webelos /AOL Elective Adventure

Adventures in Science

Do all of these:

1. An experiment is a "fair test" to compare possible explanations. Draw a picture of a fair test that shows what you need to do to test a fertilizer's effects on plant growth.
2. Visit a museum, a college, a laboratory, an observatory, a zoo, an aquarium, or other facility that employs scientists. Prepare three questions ahead of time, and talk to a scientist about his or her work.
3. Complete any four of the following:
   a. Carry out the experiment you designed for requirement 1, above. Report what you learned about the effect of fertilizer on the plants that you grew.
   b. Carry out the experiment you designed for requirement 1, but change the independent variable. Report what you learned about the effect of changing the variable on the plants that you grew.
   c. Build a model solar system. Chart the distances between the planets so that the model is to scale. Use what you learn from this requirement to explain the value of making a model in science.
   d. With adult supervision, build and launch a model rocket. Use the rocket to design a fair test to answer a question about force or motion.
   e. Create two circuits of three light bulbs and a battery. Construct one as a series circuit and the other as a parallel circuit.
   f. Study the night sky. Sketch the appearance of the North Star (Polaris) and the Big Dipper (part of the Ursa Major constellation) over at least six hours. Describe what you observed, and explain the meaning of your observations.
   g. With adult assistance, explore safe chemical reactions with household materials. Using two substances, observe what happens when the amounts of the reactants are increased.
   h. Explore properties of motion on a playground. How does the weight of a person affect how fast they slide down a slide or how fast a swing moves? Design a fair test to answer one of those questions.
   i. Read a biography of a scientist. Tell your den leader or the other members of your den what the scientist is famous for and why his or her work is important.

Webelos /AOL Elective Adventure: Adventures in Science

Complete Requirements 1-3.

1. An experiment is a "fair test" to compare possible explanations. Draw a picture of a fair test that shows what you need to do to test a fertilizer's effects on plant growth.
2. Visit a museum, a college, a laboratory, an observatory, a zoo, an aquarium, or other facility that employs scientists. Prepare three questions ahead of time, and talk to a scientist about his or her work.
3. Complete any four of the following:
   a. Carry out the experiment you designed for Requirement 1.
   b. If you completed 3a, carry out the experiment again but change the independent variable. Report what you learned about how changing the variable affected plant growth.
   c. Build a model solar system. Chart the distances between the planets so that the model is to scale. Use what you learned from this requirement to explain the value of making a model in science.
   d. With adult supervision, build and launch a model rocket. Use the rocket to design a fair test to answer a question about force or motion.
   e. Create two circuits of three light bulbs and a battery. Construct one as a series circuit and the other as a parallel circuit.
   f. Study the night sky. Sketch the appearance of the North Star (Polaris) and the Big Dipper (part of the Ursa Major constellation) over at least six hours (which may be spread over several nights). Describe what you observed, and explain the meaning of your observations.
   g. With adult assistance, explore safe chemical reactions with household materials. Using two substances, observe what happens when the amounts of the reactants are increased.
   h. Explore properties of motion on a playground. How does the weight of a person affect how fast they slide down a slide or how fast a swing moves? Design a fair test to answer one of those questions.
   i. Read a biography of a scientist. Tell your den leader or the other members of your den what the scientist is famous for and why his or her work is important.

READ through the requirements **FIRST** on the following pages to have a better understanding of the plan and chart below.

- We would divide the Scouts into 5 groups for a round-robin stations.
- Each Station would last 15 minutes and there would be an extra 15 minutes for a group wrap up.

1	1. An experiment is a "fair test" to compare possible explanations. Draw a picture of a fair test that shows what you need to do to test a fertilizer's effects on plant growth. 2. Visit a museum, a college, a laboratory, an observatory, a zoo, an aquarium, or other facility that employs scientists. Prepare three questions ahead of time, and talk to a scientist about his or her work.	We would need paper and pens, (Scouts will be asked to bring a pen and notebook).	Pages 2 to 4
2	C. Build a model solar system. Chart the distances between the planets so that the model is to scale. Use what you learn from this requirement to explain the value of making a model in science.	Have Scouts make planets from paper and the using correct distance hang from a close line. (We could also have the planets precut and let them hang.)	Pages 7 to 9
3	E Create two circuits of three light bulbs and a battery. Construct one as a series circuit and the other as a parallel circuit.	We would need to make up in advance materials for a simple battery and light circuits.	Pages 10 to 12
4	G. With adult assistance, explore safe chemical reactions with household materials. Using two substances, observe what happens when the amounts of the reactants are increased.	Need baking soda, vinegar, and a zip loc bag.	Pages 14 to 15
5	H. Explore properties of motion on a playground. How does the weight of a person affect how fast they slide down a slide or how fast a swing moves? Design a fair test to answer one of those questions. I. Read a biography of a scientist. Tell your den leader or the other members of your den what the scientist was famous for and why his or her work is important.	If there is a playground with a slide outside the gym we could do "H". I. We could have bio's ready and have them pick one and write about them or review and make it a homework requirement to finish up at the next den meeting.	

Science is all about asking questions like "What is it?" "How does it work?" and "How did it come to be that way?" In Adventures in Science, you will discover how scientists answer those questions and what we can learn as we try to answer our own questions. Best of all, you'll get to do what real scientists do: design and perform experiments. Along the way, you'll learn about physics, chemistry, astronomy, plant science, and more. So grab your notebook, and let's get started!

REQUIREMENT 1 | An experiment is a "fair test" to compare possible explanations. Draw a picture of a fair test that shows what you need to do to test a fertilizer's effects on plant growth.

Imagine that you're a medical researcher who wants to test three new medicines to see which one helps people who have a cold feel better. If you gave a sick person all three medicines and he got well, how would you know which medicine worked? You wouldn't!

But what if you started with three sick people and gave each one a different medicine? Then you would know which medicine (or medicines) worked.

When a scientist asks a question, he or she comes up with a fair test to answer that question. This is called an experiment. An experiment is designed to rule out possible explanations and, as much as possible, test only a single explanation.

In an experiment, scientists look at three things:

- What they will change—called the **independent variable**
- What they will keep the same—called the **control variable**, or **control**
- What difference they are looking for—called the **dependent variable**

In the medicine experiment, the independent variable is which medicine each person takes. The control is the fact that each person has a cold. The dependent variable is whether or not each person gets well.

For this requirement, you will draw a picture of an experiment to test fertilizers. First, think about what independent variables, controls, and dependent variables your experiment would use.

A scientist might start by creating a chart like the one below to help figure out what the important parts of the experiment could be. One of the biggest challenges in creating a fair test is to figure out what to keep the same, what to change, and how to find out if a meaningful result occurs.

Measuring the Impact of Fertilizer

Independent Variable	Controls	Dependent Variable
Fertilizer added vs plain soil	Same type of plant Same amount of water Same type of soil Same amount of light Same temperature	How tall the plant grows

What would you add to the list of controls? What are some other ways to see whether the fertilizer made a difference? Measuring how tall the plant grows might not be the only dependent variable you could test for.

Draw a picture of your own fair test to compare fertilizers and label your drawing with all the variables that you would want to keep track of in your experiment. You might draw this as a comic strip to show the steps in your test and the changes over time.

REQUIREMENT 2 | Visit a museum, a college, a laboratory, an observatory, a zoo, an aquarium, or other facility that employs scientists. Prepare three questions ahead of time, and talk to a scientist about his or her work.

Scientists work in many different places. When you visit a scientist in one of those places, you can better understand what he or she does and the tools he or she uses every day.

Just like you plan your investigations, you should plan your visit to a scientist. What would you like to learn? Write down your questions in your field notebook ahead of time.

Before your visit, try to guess how the scientist might answer your questions. Afterward, see how his or her answers compare with your guesses.

REQUIREMENT 3 | Complete any four of the following:

REQUIREMENT 3A | Carry out the experiment you designed for requirement 1, above. Report what you learned about the effect of fertilizer on the plants that you grew.

An important part of designing a fair test is deciding ahead of time what you expect the result to be. For your fair test, that means making a prediction about how the fertilizer will influence the way the plant grows. Write your prediction in your field notebook, and then carry out the experiment.

After the experiment ends, compare your prediction with what you actually observed. Did the plant grow as tall as you predicted? Did the plants grow in ways that you were not able to predict? How can you explain this result?

Draw a picture of what happened, and make a note in your field notebook about what you would like to do to learn more.

REQUIREMENT 3B | Carry out the experiment you designed for requirement 1, but change the independent variable. Report what you learned about the effect of changing the variable on the plants that you grew.

There are lots of different ways to carry out an investigation using the same materials and variables. Here are some other independent variables you could test in the plant experiment:

- Potting soil vs. sand
- Six hours of light per day vs. 24 hours of light per day
- Colored light vs. white light
- Fresh water vs. salty water
- 100 ml of water per day vs. 1,000 ml of water per day

Design another fair test and write down what you predict will happen. Remember to use only one independent variable in your experiment.

Now, carry out the new experiment. What did you find out? Did the result match your prediction? If not, how was it different? Draw a picture of what happened, and make a note in your field notebook about what you would like to do to learn more.

The more you carry out experiments like this, the more you will learn about the subject you are studying. For example, over time you might learn that a combination of factors—say, fertilizer plus plenty of sunlight—helps plants grow better than fertilizer alone. Or you might learn that a certain fertilizer works better on flowers than on vegetables.

Scientists also like to repeat the same experiments over and over. They even publish the details of their experiments so other scientists can reproduce them. Getting the same results many times proves that the results are accurate and not caused by some random event, like worms in the soil affecting plant growth.

REQUIREMENT 3C | Build a model solar system. Chart the distances between the planets so that the model is to scale. Use what you learn from this requirement to explain the value of making a model in science.

Our solar system is really, really big. It takes Earth one year to travel around the sun, but it takes Neptune, which is way out at the edge of the solar system, 165 years. Light travels at a speed of 238,000 miles every second, but it takes light from the sun more than seven minutes to reach Earth, which is 93 million miles away. Yes, the solar system is huge!

For this requirement, your challenge is to build a model solar system that has the same scale as the actual solar system. In other words, the relative distances between the planets in your model will be the same as they are between the real planets.

This chart shows each planet's

approximate distance from the sun, along with scale distances in both inches and centimeters. It also shows Proxima Centauri, the nearest star to the sun.

Object	Approximate Distance to Sun (miles)	Scale Distance (1) 1 million miles = 1 inch	Scale Distance (2) 1 million miles = 1 cm
Sun	—	—	—
Mercury	36,000,000	36 in	36 cm
Venus	67,000,000	67 in	67 cm
Earth	93,000,000	93 in	93 cm
Mars	141,500,000	141.5 in	141.5 cm
Jupiter	483,300,000	483.3 in	483.3 cm
Saturn	886,200,000	886.2 in	886.2 cm
Uranus	1,782,900,000	1,782.9 in	1,782.9 cm
Neptune	2,792,600,000	2,792.6 in	2,792.6 cm
Proxima Centauri (nearest star to sun)	25,200,000,000,000	25,200,000 in	25,200,000 cm

To get started, make a series of signs, one for the sun and one for each planet. Label the signs and add pictures if you want to. Write on the planet signs how far away from the sun each one is.

Now, decide whether you will use inches or centimeters in your model. An inch is more than twice as long as a centimeter, so the scale model in inches would be larger than the scale model in centimeters. Will the sun and all of the planets fit in your home if you make the model in inches? What if you make it in centimeters? Get out a ruler and test your prediction.

Unless you live in an aircraft hangar, the model organized in inches won't fit in your home. The distance from the sun to Neptune is more than 230 feet—that's two-thirds of a football field! You will need to make your model solar system outside.

Use a measuring tape and an open space to lay out your model solar system. A school yard or a park would be a good spot if you have permission to build your model there. You will need a friend to help you lay out your solar system. In fact, this would be a fun project to do with your whole den.

Every Webelos Scout could pick a planet and make his own sign.

In your field notebook, write down answers to these questions:

- What is the value of making a model for things that are so big, such as the solar system?
- How can models be useful in science?

REQUIREMENT 3D | With adult supervision, build and launch a model rocket. Use the rocket to design a fair test to answer a question about force or motion.

Building a model rocket is a great project to do with your den or with an adult. Rockets are lots of fun, and they are also a great tool for investigating ideas related to force and movement. As you did earlier, use the chart below to help you design a fair test to answer some questions about force and motion. Add anything else to this list that you believe is important.

Testing the Effect of Weight on a Rocket's Flight

Independent Variable	Controls	Dependent Variable
Heavy rocket vs. light rocket	Same rocket motor Same rocket size Same wind speed	How high will the rocket fly?

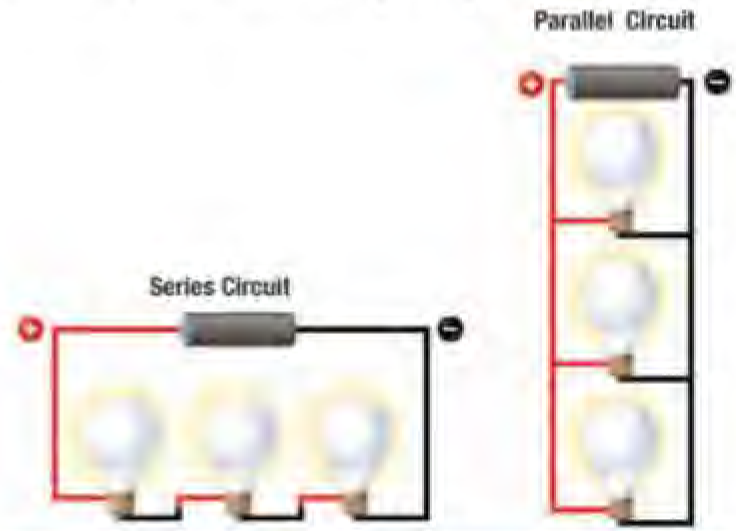
Part of being a scientist is being creative. Your rocket may fly hundreds of feet into the air. How can you measure how high it flies? Talk with friends in your den or your adult partner about how to measure the rocket's maximum height.

You might want to explore some other properties of a model rocket. Can you launch a raw egg and return it—uncracked—to the earth? Can you consistently predict where the rocket will land? What other experiments could you come up with to extend your knowledge of force and motion?

REQUIREMENT 3E | Create two circuits of three light bulbs and a battery. Construct one as a series circuit and the other as a parallel circuit.

How long does a battery last? If you've been on a campout and had a flashlight that didn't light up, you know that battery life can be a big problem. In this investigation, you will explore possible connections between the way an electrical circuit is put together and how long a battery will last.

An electrical circuit is like a big circle. The electricity comes out of the power source (the battery in this case), goes through the output device (the bulbs in this case), and cycles back to the power source. If you break the circuit, the electricity stops flowing.



When you have more than one output device, you can create two types of circuits: series and parallel. In a series circuit, the electricity goes through each of the output devices in turn. In a parallel circuit, the electricity follows separate paths through each output device. The pictures on this page show the difference.

Here is a chart of possible variables and controls. Add anything else to this list that you believe is important.

Measuring Battery Life in Different Circuit Types

Independent Variable	Controls	Dependent Variable
Series circuit vs. parallel circuit	Same kind of bulb Same kind of batteries Batteries in the same condition Same kind of wire	Working life of battery (time)

To carry out this investigation, you will need flashlight bulbs, wire, several batteries, and a watch to time the life of the battery. Set up one series circuit and one parallel circuit using a battery and three bulbs. You can find bases for bulbs and batteries at some hardware and technology stores; your science teacher may also have some materials that you can borrow. The bases are handy to use, but you can simply fasten the wires to the batteries and bulbs with electrical or duct tape.

One of the challenges of this test is to figure out when the light bulbs go out. That will be your evidence that there is no longer enough energy in the battery to light the bulb. You will need to think creatively about how to measure when the light goes out.

After your investigation, think about these questions:

- In which circuit did the battery last longer? Is there a connection between the type of circuit and how long the battery works?

- What other differences do you observe?
- Is there a connection between the brightness of the bulbs and the way the circuit is hooked up?
- What other questions can you ask about the circuits you built?

If you end up with more questions in your field notebook than when you started, you are on track to being a talented scientist. More questions lead to more future adventures in science!

REQUIREMENT 3F | Study the night sky. Sketch the appearance of the North Star (Polaris) and the Big Dipper (part of the Ursa Major constellation) over at least six hours. Describe what you observed and explain the meaning of your observations.

Making observations of the world around you is an important part of science. The things you observe help you form important questions and start to make predictions. Your predictions, whether or not they are correct, are important steps in helping you explain why things happen the way they do.

The stars and constellations of the northern hemisphere can help you understand changes in the night sky. For this investigation, sketch the appearance of the North Star and the Big Dipper, which is part of the Ursa Major constellation, over at least six hours. You will want to do this on a clear weekend night, when you can stay up late with your family's permission. (This would be a great activity to do on a Webelos den campout.)

As early in the evening as possible, make a sketch of the night sky. Draw it as precisely as you can, so that you can see which way the "pointer stars" on the side of the Big Dipper are oriented.

Return in three hours and make

another sketch. Try to be precise as before, so that you can accurately record any motion that you observe.

Return three hours later and record what you see. You might have to wake yourself up or get your parent to help. Again, make your sketch as accurate as possible.

Compare your three sketches and think about these questions:

- What are some ways to explain what you observed?
- Which is the best explanation: that the earth is moving or that the stars are moving?
- How long will it take for the Big Dipper to return to where it was when you first recorded it?
- How could you use what you observed to tell time? What are the advantages and disadvantages of a "star clock" that uses a constellation?

REQUIREMENT 3G | With adult assistance, explore safe chemical reactions with household materials. Using two substances, observe what happens when the amounts of the reactants are increased.

Chemical changes are an important area in the science of chemistry. When some substances are combined, they create a new substance that is different from the ones you started with. Sometimes, chemical reactions create changes in color or temperature or produce gases.

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Some chemical combinations, such as those involving household cleaners, can cause dangerous reactions. Check with a parent or guardian and consult a chemistry book before trying any experiments with household chemicals.

One choice for this investigation is to combine two simple chemicals from your family's kitchen in a zip-top bag: baking soda and vinegar. Both have chemical formulas that can be used to describe them. Baking soda is called sodium bicarbonate ($NaHCO_3$); vinegar is a weak acid called acetic acid ($C_2H_4O_2$).

When baking soda and vinegar are combined, a chemical reaction takes place and a gas is produced. Your challenge is to see if there are any patterns in how much gas is produced when baking soda and vinegar are combined in different proportions.

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For this and all other chemistry experiments, you should wear eye protection.

Measuring the Gas Produced in a Chemical Reaction

Here are the factors to consider in your investigation. Add anything else to this list that you believe is important.

Independent Variable	Controls	Dependent Variable
Amount of chemicals	Types of chemicals Tools to collect and measure products	How much bag expands

Think about these questions as you design your investigation:

- How can you combine the baking soda and vinegar in such a way that you capture all the gas that is produced?
- How can you accurately measure how much gas is produced?
- How can you make sure the bag you mix the chemicals in doesn't contain anything else that could affect the experiment?
- Can you use what you learned to make a prediction for how much a bag will expand with different combinations of baking soda and vinegar? If so, make a prediction and see how close your prediction comes to the actual expanded size of the bag.

REQUIREMENT 3H | Explore

properties of motion on a playground. How does the weight of a person affect how fast they slide down a slide or how fast a swing moves? Design a fair test to answer one of those questions.

Does a heavier person slide faster? Does a lighter person swing faster? These are questions that you can answer using playground equipment and some friends or family members who weigh different amounts.

Here are some factors to consider if you choose the slide investigation. Add anything else to this list that you believe is important.

Measuring the Effect of Weight on Slide Time

Independent Variable	Controls	Dependent Variable
Weight of person	Amount of friction: have everyone sit on a towel to keep it the same Consistent starting point: start the timer when the person begins to slide Consistent ending point: stop the timer when the same part of the body reaches the same point at the bottom of the slide	Time to reach the bottom of the slide

Set up an experiment where you time how fast different people go down a slide. Decide when and where to start your timer. What timer will you use? Smartphones and digital watches usually have a stopwatch function.

Consider these things as you plan your investigation:

- Before you do the investigation, create a chart to write down your data. This will help you think through the project in advance and ensure you record everything you need to make a good decision.
- Have everyone go down the slide several times and figure out an average for each person.

- Sitting on a towel can ensure that everyone touches the slide with the same kind of fabric. (If one person wore jeans and another wore slick pants, that would affect the results.) You could also use waxed paper from your kitchen.
- Be careful! Have a spotter at the bottom of the slide to keep people from hitting the ground.

After your investigation, think about these questions:

- What did you learn?
- Did the weight of the person on the slide have a big effect on how fast he or she moved down the slide?
- Was there a pattern?

Write down your conclusions in your field notebook. If you can think of better ways to do the experiment or if new questions come up, be sure to record them in your notebook as well.

Here are some factors to consider if you choose the swing investigation. Add anything else to this list that you believe is important.

Measuring the Effect of Weight on Swing Time

Independent Variable	Controls	Dependent Variable
Weight of person	Release everyone from the same height Keep legs from swinging Start timer at the same point in the swing Stop timer at same point in the swing	Time for one swing

Consider these things as you plan your investigation:

- Before you do the investigation, create a chart to write down your data. This will help you think through the project in advance and ensure you record everything you need to make a good decision.
- Have everyone repeat the swing several times and figure out an

average for each person.

- How do you make sure that everyone starts from the same point?
- How can you make sure everyone swings the same way? Because you are measuring the time for a swing, it will affect your findings if a person pumps his or her legs.
- Decide when and where to start your timer. What timer will you use? Smartphones and digital watches usually have a stopwatch function.

After your investigation, think about these questions:

- What did you learn?
- Did the weight of the person on the swing have a big effect on the time for a single swing?
- Was there a pattern?

Write down your conclusions in your field notebook. If you can think of better ways to do the experiment or if new questions come up, be sure to record them in your notebook as well.

A Scout is cheerful. When a science

investigation doesn't work out as planned, focus on what you did learn and what you can try next.

REQUIREMENT 3I | Read a biography of a scientist. Tell your den leader or the other members of your den what the scientist is famous for and why his or her work is important.

Reading stories about scientists and what they have accomplished can be inspiring. It may even start you on the road to your own great scientific adventures!

Here are some scientists you could learn about:

Albert Einstein, physicist

Galileo Galilei, astronomer

George Washington Carver, botanist

Benjamin Franklin, researcher in many fields

Marie Curie, physicist and chemist

Paul Siple, weather researcher (and Eagle Scout)

Peter Agre, biologist (and Eagle Scout)

E.O. Wilson, biologist (and Eagle Scout)

Guion S. Bluford Jr., astronaut (and Eagle Scout)

Luis W. Alvarez, physicist

Lee Berger, archaeologist (and Eagle Scout)

Michael Manyak, expedition medicine pioneer (and Eagle Scout)

Who Will Be the Scientists of Tomorrow?

One day, you could become a NESA World Explorer. The National Eagle Scout Association

started the program to reward Eagle Scouts who aspire to be explorers and field scientists. The Scouts who are chosen head off to the learning experience of a lifetime.

Here are some recent Eagle Scout Explorers:

Alex Overman
Eagle Scout Argonaut

C.B. Wren
Eagle Scout Argonaut

Tristan Bullard
Eagle Scout Astronomer

Alex Houston
Antarctic Sustainability Eagle Scout