



Junior *FIRST* LEGO® League  
2006 Nano Quest  
Challenge Instructions

Welcome teams! This year's Junior *FIRST* LEGO League (JFL) Challenge aligns with the research project portion of the 2006 *FIRST* LEGO League (FLL) Challenge: Nano Quest. Like the students in FLL, your team will explore the nano universe through building and research.

'Nano' is a prefix meaning one billionth and is Greek for *dwarf*. A nanometer is one billionth of a meter. One hair is about 100,000 nanometers wide and a red blood cell is about 10,000 nanometers.

Your team members may start the season thinking a grain of salt is one of the smallest things they can imagine. Have them smash a grain of salt with the back of a spoon and see how small the pieces are. Did the team's perception of tiny shift?

During this season, we want your team to learn about scale. For some, that might mean comparing a grain of sand to a rock and a rock to a boulder and a boulder to a mountain. Some teams may focus on the human body: the body is macroscopic and can be seen with the naked eye, cells are microscopic and require a microscope to be seen, and DNA is nano and requires a very powerful microscope.

***Your team's Nano Quest challenge is to build a model that shows one thing at three different levels of scale.***

### **Suggested introductory activities**

Nanotechnologists deal with tiny things in their work every day. Nano objects don't behave like objects in the visible world. For example, tables that look solid are full of atoms that are constantly in motion. A table isn't sticky when it's full-size, but an atom from a table might be impossible to unstick from another object. It's hard to work with objects that are sticky and in constant motion.

First activity: To teach your team more about how the properties of everyday things change with the size of the object, have them try cutting a piece of paper in half. Then cut it in half again. And again. Have them cut it in half over and over again until the properties of the paper change. Ask them: If you have a normal-sized sheet of paper, how easy is it to pick up? What about when you have a tiny dot of paper? Do the different sizes behave differently? Have them put a tiny dot of paper in a drip of water on the surface of a table. Now how does it behave? Have them try this activity with a variety of items to see how their properties change as their parts get smaller and smaller.

Second activity: Ask the team to choose a distant object and look at it through binoculars or a telescope. Your team could look at a building in your town or a planet in the night sky. Ask them: How does it look different when you see it through binoculars? Next, find something for the team

to examine with a magnifying glass and/or a microscope. A very thin slice of fruit or onion or paper would work well for this activity. Look at everyday items with the naked eye and then with the magnifying glass or microscope. Things that look one way to the naked eye may look very different magnified. Some things you might want to look at are: the edge of a ripped piece of paper, salt, a favorite food, sawdust, skin, hair, and metal.

### **Building Your Season**

1. Ask your team to decide on something they would like to explore and build. Maybe there is a favorite food they would like to explore, a favorite building, or a biological subject such as a plant, animal, fruit, or vegetable.
2. Visit or interview experts in nanotechnology about the object your team is studying. To find a nanotechnologist, your team might consider calling a local company specializing in nanotechnology, or contact a college or university doing research in nanotechnology. Nanotechnology is truly interdisciplinary—the team might find chemists, physicists, biologists, medical doctors, computer scientists, and others who can help. Also, have the team visit websites that discuss nanotechnology.
3. Have the team build a model of the object they chose, demonstrating three different levels of scale. They might start out large and then dive deeper or they might start out small and go larger.
4. In the model the team must create a piece that can move. This can be moved by hand or they can use the motor included in the JFLL base kit. If teams choose to use the motor, they are allowed only to use the motor included in the kit and no others. The kit also includes many other excellent pieces that can be used for moving parts, including wheels, pulleys, chains, and axles. Be sure that the team remembers that at the nano level, things are always moving. How does the team think the object might move on a nano scale? Are the atoms jumping around? Vibrating? Spinning?
5. Have the team prepare to talk to the Model Reviewers at the JFLL Expo about why they chose and built the model. The reviewers may also ask about what the object might look like one scale larger or smaller.
6. Create a Show Me poster on a tri-fold display board. The team will share this with the Model Reviewers at the JFLL Expo. This poster will demonstrate the team's research about the object they have chosen to represent in their building project. The team members should prepare to share information with the Reviewers about the properties of the object in a macro scale, a micro scale, and a nano scale. For example, if they are building models of an orange, in the macro scale the orange is smooth and round. As the orange is peeled, the properties change. After it is peeled, a section can be crushed so that juice pours out. The outer surface doesn't lead us to believe that the inside will be anything other than smooth.
7. Bring the leftover LEGO bricks from the team's JFLL kit to the Expo. There will be a team activity at the event, so be ready to build! For more flexibility, bring additional bricks if the team has them.

### **At the Expo**

If you choose to attend a JFLL Expo\*, be sure you and your team bring everything (all the models) they have built. Be sure to bring your team's Show Me poster. The kids should be ready to talk about their models and research. The Expo includes time to enhance the team's current model, meet with friendly Reviewers to share team members' experiences, and complete a fun activity taking the model to the next level. For example, what would the team's objects look like if they were able to examine them at one degree of scale smaller than they have demonstrated in their models? If the team built a grain of salt, they should be ready to talk about what the parts of the crystal look like.

At the end of the Expo, teams will receive recognition for their efforts at the Hi Fives ceremony.

\*To register for a JFLL Expo please read the Welcome Letter provided in each JFLL LEGO Base Kit product shipment.

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