Nano Quest Missions

The following missions are taken from the 2006 FLL Challenge, and have been adapted for use in Comp 2910. Note that while many of the challenges are the same, others are different or modified.

Note that there is lots of additional useful information on the FLL site. We encourage you to look there, but be careful that you are solving the 2910 missions as stated in this document, some of which require that the robot return to base!

Missions

Details of each mission start on the next page.

Individual Atom Manipulation

Mission: Move individual atoms accurately. The robot must remove at least 1 white atom from the blue surface without removing any red atoms, and return to the base. Counting atoms left on the surface, a count of fewer than 8 red atoms is worth no points. A count of 8 red atoms and 7 or 6 white atoms is worth 40 points. A count of 8 red atoms and 5 or fewer white atoms is worth 50 points.

Bonus points: Each removed white atom that is transported back to the base earns a bonus of 10 points.

Background: Lots of structures and processes involve materials loosely combined, like a pile of bricks, or material moving unpredictably, like thundershowers. But when we apply science, engineering, and work on the "macro" scale, we can turn bricks into cities and pipe water into our homes. Materials can be made or moved atom by atom, allowing special new properties and uses. Nanotechnology is about applying science, engineering, and work on the "nano" scale, where measurements range up to about 100 nanometers—the size of a few molecules—and where everything is moving and shaking.

Smell

Mission: Transfer molecules from the pizza toward the nose. The robot must get pizza molecules completely off the paper plate for 5 points each, and transferred to the yellow or black areas of the person's head or neck for an additional 10 points each.

Background: Do you realize that when you smell something yummy or disgusting, it means that molecules from that substance have reached your nose? You can't even see them, but they're there. Imagine trying to work with these nano scale objects to invent things and solve problems…that's nanotechnology!

Nanotube Strength

Mission: Lift the truck by a thin cable of carbon nanotubes. The robot must move the truck onto the lift frame and activate the lift. The truck completely on the frame is worth 20 points. The truck and frame supported completely and only by the cable is worth an additional 20 points.

Background: The carbon atom is of special interest in nanotechnology. One of the reasons for this is that carbon atoms can be arranged to form carbon nanotubes, which can form the basis of some unbelievably strong materials. Imagine a cable as thin as a toothpick, weighing one-sixth as much as a steel cable of the same size, yet it could support the weight of a car!

Stain-Resistant Fabric

Mission: Test some stain-resistant fabric. The robot must deliver the dirt trap to its location mark and completely dump out the tester's dirt dumper. The dirt trap at its mark is worth 15 points, and the dirt dumper when empty is worth 15 points. The dirt pieces are Bonus Objects, worth 5 points each in the dirt trap, and 3 points each everywhere else on the table.

Background: Nanotechnology can be thought of as the understanding and use of traditional sciences on the nano scale to achieve results we've never seen before, and those results are already finding their way into our daily lives. For example, a special treatment for fabric is already becoming available that can make it impossible to get your clothes wet or dirty!

Atomic Force Microscopy

Mission: Free the probe's nanotip. The robot must separate the nanotip from the material surface. The nanotip separated from the surface is worth 40 points.

Background: In the same way you can describe a surface as bumpy, sticky, or hot through the use of your finger on the large "macro" scale, the atomic force microscope can describe a surface atom by atom through the use of its probe on the nano scale. Unfortunately, the probe's nanotip often gets stuck on the surface, frustrating scientists.

Smart Medicine

Mission: Target medicine to reach only a specific problem spot. The robot must transport and release the Buckyball containing medicine into the person's arm. The Buckyball is placed anywhere in the red/yellow channel of the arm bone is worth 50 points (even if it hasn't reached the problem spot).

Background: When we are given medicine, it usually circulates throughout the body, and often causes harmful side effects in unintended areas. But through nanotechnology, some medicines can be strategically placed inside special molecules like the C60 Buckyball molecules, that only allow delivery to the exact area where the medicine is needed.

Self-Assembly

Mission: Start the self-alignment of atoms. The robot must cause the angled blue nanotube segments to align horizontally end to end. This alignment is worth 30 points.

Background: Atoms are super-super small, so it's very difficult and time consuming to work with them 1 by 1. For example, moving 3 atoms at a time (each water molecule has 2 hydrogen atoms and 1 oxygen atom), it would take about one hundred and seventy thousand million trillion loads to fill 1 teaspoon with water! With this in mind, an important part of nanotechnology is to find ways to get atoms and molecules to arrange themselves, sort of like magnets do.

Space Elevator

Mission: Operate the space elevator. There are two space elevators, one for each side of the table. A robot may earn points for one or both elevators. To earn points a robot the robot must cause the car with the yellow cargo to come down. Completing this mission earns 40 points.

Note: a robot is allowed to interfere with the other team on this mission by locking the other teams elevator so that it won't come down. This does not earn extra points.

Background: Do you know why the moon and other satellites don't fall to earth or escape into space? It's for the same reason that you can swing an open bucket of water in a vertical circle and the water stays in the bucket. The water is swinging fast enough to be thrown up into the air, but that force is balanced by the strength of your arm holding the bucket. In the same way, satellites are moving just fast enough and at just the right height to balance gravity's force on them, so they stay at the same place in space, sometimes above a particular spot on earth. Now imagine running a cable from the ground all the way to a satellite in space. If there were a cable material light enough and strong enough, like carbon nanotubes, could this be done? Could we send cargo or even people into space on an elevator, instead of on rockets?

Molecular Motor

Mission: Deliver an adenosine triphosphate (ATP) molecule to power a molecular motor, causing it to spin and release energy. The robot must deliver 1 of the 2 ATP molecules through the molecular motor's black frame for 40 points (even if nothing else happens). If the robot delivers the molecule such that the motor spins, an additional 20 points is added. Spinning action will be recorded by the ref and considered when points are tallied.

The second ATP molecule represents a second chance to complete this mission, but points are only given for 1 delivered molecule.

Background: Atoms and molecules are always moving or shaking, like loose balloons in a room full of fans. This can make it hard to work with them, but the right molecule spinning a certain way can actually be used to do work. Molecular motors are molecules that can convert chemical energy from other molecules into rotational energy, like a power tool, to do work on a scale where no other mechanical tool could fit—work such as transporting other molecules or contracting muscles.

no picture ... you know what a ball is - right?

Balls

Mission: Knock balls onto other teams field, return to base. This challenge has nothing to do with nano technology! It just seemed fun! The idea is to get as many balls as possible into the opponents side of the table. Balls may interfere with the other robots operation. This is intended.

At the end of the match points are earned based on the number of balls in your opponents field.

1 ball: 5 points	2 balls: 10 points	3 balls: 15 points	4 balls: 25 points
5 balls: 35 points	6 balls: 50 points	7 balls: 70 points	8 balls: 100 points

If the robot fails to return to base after knocking balls (ie: it must be rescued), the points attributed to these balls will be forfeited.

Background: Balls are fun and round.