

**FIRST  
LEGO  
LEAGUE**

# ANIMAL ALLIES<sup>SM</sup> CHALLENGE

**ANIMAL  
ALLIES<sup>SM</sup>**



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# Innovation Project

## THE PROCESS

### THINK ABOUT IT

When you meet an animal at the zoo, on a farm, or in your home, have you ever thought about whether that interaction helps you, the animal, or both? Share these situations with your team. Who is helping or being helped in each one? Not sure where to start?

Rosa lives on a farm in Syddanmark, Denmark. Rosa leads a pretty good life, for a cow. She eats grass, takes a nap, and – when she feels it's time – she visits the robotic milking machine. The machine uses lasers to find Rosa's udders, clean them, and then pump the milk. Rosa munches on special grain while the machine works. When it's done, Rosa feels better and leaves the milking machine to find some more tasty grass.

Randy loves to hike in the mountains of New Hampshire, USA. However, Randy lost his sight many years ago, so hiking mountains might be difficult and dangerous. Luckily, Randy has a friend who also likes to hike: Autumn. As a trained guide dog, Autumn knows how to identify obstacles that might harm Randy or her. Even through the winter, Autumn helps Randy find a safe path over snow-covered tree roots and boulders.

Elena carefully threads fruit onto a wire at the Omaha Zoo & Aquarium in Nebraska, USA. In the wild, fruit bats would generally eat fruit hanging from trees. Since fruit doesn't grow on the imitation trees in the jungle exhibit, Elena must think of creative ways to feed the bats. Instead of placing all of the fruit in a big pile, Elena hangs fruit from hooks or hides it somewhere unexpected in the exhibit. This way, breakfast is also an enrichment activity for the bats.

In the past, lions often attacked the livestock hunted the lions to protect their homes and farms. After trying a few ideas, Richard discovered that moving lights could scare the lions away without harming them. He invented a system of flickering lights and installed them around the village. The lights kept the lions away from the livestock, so the people had no reason to hunt the lions.

***For ANIMAL ALLIES<sup>SM</sup> think of people and animals as allies in the quest to make life better for everyone. Sometimes people help animals and sometimes animals help people. Your team's Innovation Project mission is to make our interactions with animals better – hopefully better for all of us.***

### IDENTIFY A PROBLEM

Ask your team to think about all the different ways that people interact with animals. Sometimes people purposely seek out animals (like Autumn helping Randy hike the mountain) and sometimes it happens by accident (like the lions attacking Richard's livestock). Have your team pick a situation in which people and animals interact, then identify a specific problem they want to solve.

### NOT SURE WHERE TO START?

Try this process to help your team choose and explore an animal problem:

**As a Team** – Choose an animal. It might be an animal that lives in your home or neighborhood. It might be an animal that you have seen at a zoo, aquarium, or farm. It might be an animal that lives in the forest, ocean, desert or another habitat.



In the ANIMAL ALLIES Challenge, an animal is any member of the scientific animal kingdom (besides humans) that is currently alive today.

Learn about the ways people interact with this type of animal. (People must interact with this animal in some way to be valid for ANIMAL ALLIES.) Ask questions like:

- When people interact with your animal, is it on purpose or by accident?
- Does the interaction help or hurt people, the animal, or both?
- What type of professionals work with or study your animal?
- Do you notice any ways that the interaction could be better – more productive, healthier, or happier for either the person or the animal? Look for these problems as you research.

This might be a great time for the team to interview a professional. The professional could be someone who works directly with animals or researches animal problems for his or her job. Can a professional help your team learn about animal health, safety, enrichment, or living environments?

**As a Team** – Identify a specific problem with the way people interact with your animal. You might select a problem in one of these areas (or add your own):

- Animals accidentally harmed by an activity that helps people
- Recreating a natural living environment inside human-made buildings
- Feeding
- Finding the right enrichment activities for a specific animal
- Healing injured or sick animals
- Managing feces
- Natural animal instincts accidentally harming people
- Conserving endangered species

**Transportation** After your team selects a problem, the next step is to find out about the current solutions. Encourage them to research their problem using resources like:

- News articles
- Documentaries or movies
- Interviews with professionals working in the field
- Ask your local librarian
- Books
- Online videos
- Websites

After your team selects a problem, find out about the current solutions. Why does this problem still exist? Why aren't the current solutions good enough? What could be improved?

**As a Team** – Decide when you feel that you know your team's animal and problem pretty well. Then, move on to the "Design a Solution" section.

## DESIGN A SOLUTION

Next, your team will design a solution to the problem. Any solution is a good start. The ultimate goal is to design an **innovative** solution that adds value to society by improving something that already exists, using something that exists in a new way, or inventing something totally new.

**As a Team** – Think about:

- What could be done better? What could be done in a new way?
- Could your solution make people and animals more productive, healthier, or happier?
- How can you reimagine the way we work with or study animals?
- Could you use an adaptation from an existing animal (biomimicry) to help solve the problem you identified?

Ask your team to think of your problem like a puzzle. Brainstorm! Then turn the problem upside down and think about it in a completely different way. Imagine! Get silly! Even a "silly idea" might inspire the perfect solution. Encourage team members to try one idea (or more), but be prepared that the first idea may need some improvements.



Field trips are a great way to learn about a new topic. Consider requesting a tour or interview from a local business, educational institution, or other animal-related site. However, some locations may have rules restricting visitors, or they may not have someone available to give an interview. If they say "no," ask about virtual tours online or other institutions you could contact.



A great solution might be a device or technology, but maybe not. Look for the solution that the team thinks will solve the problem best. Team members should be prepared to tell the judges what makes their idea better than the existing solutions.

Make sure your team thinks about how they could make their solution a reality. Try asking them questions like:

- Why would your solution succeed when others have failed?
- What information would you need to estimate the cost?
- Do you need any special technology to make your solution?
- Who would be able to use it?

Remember, your team's solution does not need to be completely new. Inventors often improve an idea that already exists or use something that exists in a new way.

## SHARE WITH OTHERS

Once the team has designed a solution, the next step is to share it!

**As a Team** – Think about who your solution might help. How can you let them know that you have solved their problem?

- Can you present your research and solution to people who own, sell, or care for animals?
- Can you share with a professional or someone who helped you learn about your problem?
- Can you think of any other groups of people who might be interested in your idea?

When your team plans their presentation, encourage them to use the talents of team members. Teams often explore creative presentation styles, but it is also important to keep the focus on your team's problem and solution. Sharing can be simple or elaborate, serious or designed to make people laugh while they learn.

*No matter what presentation style your team chooses, remember to keep the process fun!*



It might be helpful for your team to share with someone who could provide real-world feedback about the solution. Getting input and improving are part of the design process for any engineer. It is OK to revise an idea if the team receives some helpful feedback.

## THE INNOVATION PROJECT PRESENTATION

Any inventor must present their idea to people who can help them make it a reality, such as engineers, investors, or manufacturers. Like adult inventors, the Innovation Project presentation is your team's chance to share their great Innovation Project work with the Judges. Your team's presentation may include posters, slideshows, models, multimedia clips, props, costumes, and more. Creativity in the presentation is rewarded, but covering all of the essential information is even more important.

As long as your team covers the basic Innovation Project information, they may choose any presentation style they like. Check with your event organizer to see if there are any size or noise restrictions in the judging rooms.



Teams will only be eligible for Innovation Project awards if they:

- Identify a **problem** that meets this year's criteria.
- Explain their **innovative solution**.
- Describe how they **shared with others** prior to the tournament.

Presentation requirements:

- All teams must present **live**. The team may use media equipment (if available) only to enhance the live presentation.
- **Include all team members**. Each team member must participate in the Innovation Project judging session.
- Set up and complete the presentation in **five minutes or less** with no adult help.

The teams who excel at tournaments also use the Innovation Project presentation to tell the Judges about their sources of information, problem analysis, review of existing solutions, elements that make their idea innovative, and any plans or analysis related to implementation.

# INNOVATION PROJECT RESOURCES

FIRST does not control or endorse the content of these external websites. They are provided as optional references only. Please preview all resources based on the maturity level of your team.



## VIDEO

**Making peace with lions** - Richard Tuere describes his invention to help people and lions live more peacefully together in Kenya.  
[http://www.ted.com/talks/richard\\_tuere\\_a\\_peace\\_treaty\\_with\\_the\\_lions](http://www.ted.com/talks/richard_tuere_a_peace_treaty_with_the_lions)

## WEBSITES AND ARTICLES

**Animal swap** – Have you ever thought about what a puffin costs? Find out why many zoos and aquariums trade animals rather than buying them.  
<http://n.pr/1pSVVa0>

**Biomimicry** – What is biomimicry and how can it help you solve problems?  
<http://www.asknature.org>

**Crittercam** – Learn about how National Geographic's Crittercam makes studying animals both more productive and less disruptive for the animals.  
<http://animals.nationalgeographic.com/animals/crittercam/>

**Delving into Dung** – You can learn a lot about animals by studying their poop.  
<https://student.societyforscience.org/article/cool-jobs-delving-dung>

**Go local** – Zoos, aquariums, and animal sanctuaries often provide great resources and programs to learn about animals. Use a search engine to find these animal resources in your area or around the world.

**Meet a zoo animal** – The Association of Zoos and Aquariums would like to show you how zoos and aquariums work with all sorts of animals.  
<http://azaanimals.org>

## BOOKS

*Scientists in the Field* – This series from the publisher Houghton Mifflin contains many books about scientists and other professionals who work with animals. Some examples include:

- The Frog Scientist (2011)
- The Hive Detectives (2010)
- The Octopus Scientists (2015)
- Swimming with Hammerhead Sharks (2011)
- Wild Horse Scientists (2012)

*Wild Animal Neighbors: Sharing Our Urban World* – Learn about the conflicts between seven different animals and the people they encounter in cities around the world. By Ann Downer, Twenty-First Century Books (2014)

*Working Like a Dog: The Story of Working dogs through history* – Provides many examples of the ways that humans have interacted with dogs throughout history. By Gena K. Gorrell, Tundra Books (2003)

## ASK A PROFESSIONAL

Talking with professionals (people who work in the field of this year's Challenge theme) is a great way for your team to:

- Learn more about this season's theme.
- Find ideas for your ANIMAL ALLIES problem.
- Discover resources that might help with your research.
- Get feedback on your innovative solution.

## EXAMPLES OF PROFESSIONALS

Consider contacting people who work in the following professions. See if your team can brainstorm any other jobs to add to the list. Many company, professional association, government, and university websites include contact information for professionals.

Job	What they do	Where they may work
<b>animal curator</b>	Manages a collection of animals. May involve planning for animal care, display, enrichment, and acquiring or trading.	Aquariums, zoos, animal refuges
<b>aquarist</b>	Cares for aquatic (water) animals through feeding, training, and generally caring for their wellbeing.	Aquariums, marine research labs, government natural resources departments, theme parks, pet stores
<b>farm manager</b>	Runs a farm that produces crops, livestock, or dairy products.	Farms, universities
<b>game warden</b>	Enforces laws related to fishing, hunting, and owning of wild animals.	Local or national government agencies
<b>herder</b>	Cares for livestock in places where these animals wander through pasture lands.	Farms, ranches, traditional communities, wilderness areas
<b>nutritionist</b>	Uses knowledge about food science to suggest diet options and adjustments for animals.	Zoos, aquariums, pet food companies
<b>rancher</b>	Owns or works on a ranch where livestock are raised.	Ranches
<b>trainer</b>	Trains animals for obedience, performance, riding, or assisting people.	Obedience schools, stables, theme parks, service animal organizations
<b>veterinarian</b>	Provides medical treatment to animals.	Veterinarian's office, farms, aquariums, zoos, stables, pet stores, animal product companies, universities
<b>veterinary technician or veterinary nurse</b>	Works with veterinarians to treat or study animals.	Veterinarian's office, laboratory, university, farm
<b>wildlife rehabilitator</b>	Cares for ill, injured, or orphaned animals until they can be released into the wild. Wildlife rehabilitators require an official license.	Wildlife centers, aquariums, zoos, animal shelters
<b>wildlife biologist</b>	Studies animals and how they interact with their ecosystems.	Universities, government agencies, medical research laboratories, museums, zoos
<b>zookeeper</b>	Cares for captive animals through feeding, training and generally caring for their wellbeing.	Zoos, aquariums, animal refuges, theme parks
<b>zoologist</b>	Studies animals and how they interact with their ecosystems.	Universities, government agencies, medical research laboratories, museums, zoos

## WHO DO YOU KNOW?

One of the best recruiting tools for your Innovation Project is your own team. Think about it. Who do you know? Chances are good that someone knows a professional who works with animals in some way. Ask your team members to think about family, friends, or mentors who work in a job that involves animals.

Refer to the list of professionals on the previous page to help you brainstorm ideas. Think about the people who study, treat, or manage animals. Think about the technology that people use to care for animals. Who makes that technology?

Make a list of people your team might want to interview.

## HOW SHOULD YOU ASK?

As a team - talk about your list of professionals and choose one or more who you think could help your team learn about how people interact with animals. Do a little research about each professional. Find out how the person works with this year's theme and think about what questions you might want to ask in an interview.

Next, work with team members to contact the professional you chose. Explain a little about *FIRST* LEGO League and what you are researching this season. Tell the professional about the team's goals and ask if they can interview him or her.

## WHAT SHOULD YOU ASK?

Have the team prepare a list of questions for the interview. When you think about questions to ask:

- Use the research the team has already done to brainstorm questions about the professional's area of expertise. It's important to ask questions the person can answer.
- Keep the team's Innovation Project goal in mind. Ask questions that will help you learn more about your topic and design an innovative solution.
- Keep questions short and specific. The more direct team members can be, the more likely they are to receive a useful answer.
- Do NOT ask the professional to design an innovative solution for your team. The team's solution must be the work of team members. If you already have an innovative solution though, it is ok for the professional to provide feedback on the idea.

At the end of the interview, ask the professional if your team may contact him or her again. They might think of more questions later. Maybe the person would be willing to meet with your team again or give you a tour. Don't be afraid to ask.

And finally, show your team's *Gracious Professionalism*® during the interview, and remember to thank the professional for his or her time!



# Robot Game: Rules

## GUIDING PRINCIPLES

**GP1 - GRACIOUS PROFESSIONALISM®** You are “Gracious Professionals.” You compete hard against **problems**, while treating **all people** with respect and kindness.

### GP2 - INTERPRETATION

- If a detail isn’t mentioned, then it doesn’t matter.
- Robot Game text means exactly and only what it plainly says.
- If a word isn’t given a game definition, use its common conversational meaning.

**GP3 - BENEFIT OF THE DOUBT** If the referee feels something is a “very tough call,” and no one can point to strong text in any particular direction, you get the **Benefit Of The Doubt**. This good-faith courtesy is not to be used as a strategy.

## DEFINITIONS

**D01 - MATCH** A “Match” is when two teams play opposite each other on two Fields placed north to north.

- Your Robot **LAUNCHES** one or more times from Base and tries as many Missions as possible.
- Matches last 2-1/2 minutes, and the timer never pauses.

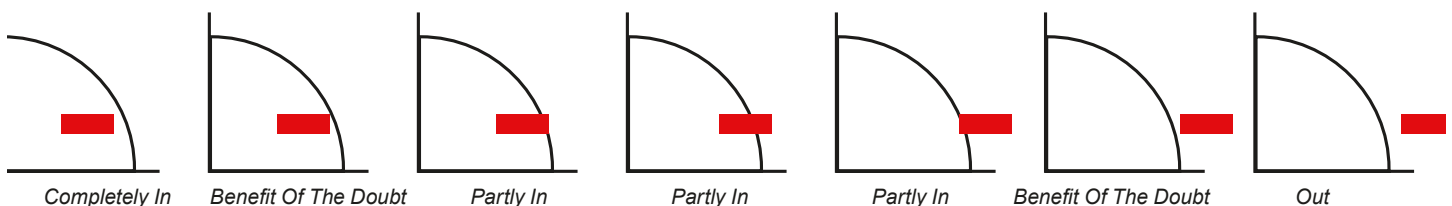
**D02 - MISSION** A “Mission” is an opportunity for the Robot to earn points. Requirements are written in the form of

- **RESULTS** that must be visible to the referee at the **END OF THE MATCH**.
- **METHODS** that must be observed by the referee **AS THEY HAPPEN**.

**D03 - EQUIPMENT** “Equipment” is everything **YOU BRING** to a Match for Mission-related activity.

**D04 - ROBOT** Your “Robot” is your **LEGO® MINDSTORMS®** or **SPIKE Prime** controller and all the Equipment you’ve combined with it by hand which is not intended to separate from it, except by hand.

### D07 - BASE



**GP4 - VARIABILITY** Our suppliers and volunteers try hard to make all Fields correct and identical, but you should always expect little defects and differences. Top teams design with these in mind. Examples include Border Wall splinters, lighting changes, and Field Mat wrinkles.

**GP5 - INFORMATION SUPERIORITY** If two official facts disagree, or confuse you when read together, here’s the order of their authority (with #1 being the strongest):

#1 = **MISSIONS** and **FIELD SETUP**

#2 = **RULES**

#3 = **REFEREE** In unclear situations, local referees may make good-faith decisions after discussion, with Rule GP3 in mind.

**D05 - MISSION MODEL** A “Mission Model” is any LEGO® element or structure **ALREADY AT THE FIELD** when you get there.

**D06 - FIELD** The “Field” is the Robot’s game environment, consisting of Mission Models on a Mat, surrounded by Border Walls, all on a Table. “Base” is part of the Field. For full details, see [FIELD SETUP](#).

**D07 - BASE** “Base” is the space directly above the Field’s quarter-circle region, in the southwest. It extends southwest from the outside of the thin curved line TO the corner walls (no farther). The thin line around any scoring area counts as part of that area. When a precise location related to a line is unclear, the outcome most favorable for the team is assumed. (See diagram below.)



**D08 - LAUNCH** Whenever you're done handling the Robot and then you make it GO, that's a "Launch."

**D09 - INTERRUPTION** The next time you interact with the Robot after Launching it, that's an "Interruption."

## EQUIPMENT, SOFTWARE, AND PEOPLE

**R01 - ALL EQUIPMENT** All Equipment must be made of LEGO-made building parts in original factory condition.

**Except:** *LEGO string and tubing may be cut shorter.*

**Except:** *Program reminders on paper are OK (off the Field).*

**Except:** *Marker may be used in hidden areas for identification.*

**R02 - CONTROLLERS** You are allowed only ONE individual controller in any particular Match.

- It must be from a LEGO Education Robot Set (RCX, NXT, EV3 or SPIKE Prime).
- ALL other controllers must be left in the **PIT AREA** for that Match.
- All remote control or data exchange with Robots (including Bluetooth) in the competition area is illegal.
- This rule limits you to only **ONE** individual **ROBOT** in any particular Match.

**R03 - MOTORS** You are allowed up to **FOUR** individual motors in any particular Match.

- Each one must come from a LEGO Education Robot Set.
- You may include more than one of a type, but again, your grand total may not be greater than **FOUR**.
- ALL other motors must be left in the **PIT AREA** for that Match, **NO EXCEPTIONS**.

**R04 - EXTERNAL SENSORS** Use as many external sensors from a LEGO Education Robot Set as you like.

- You may include more than one of each type.

**D10 - TRANSPORTED** When a thing (**anything**) is purposefully/strategically being

- taken from its place, and/or
- moved to a new place, and/or
- being released in a new place,

it is being "Transported." The process of being Transported ends when the thing being transported is no longer in contact with whatever was transporting it.

**R05 - OTHER ELECTRIC/ELECTRONIC THINGS** No other electric/electronic things are allowed in the competition area for Mission-related activity.

**Except:** *LEGO wires and converter cables are allowed as needed.*

**Except:** *Allowable power sources are ONE controller's power pack or SIX AA batteries.*

**R06 - NON-ELECTRIC ELEMENTS** Use as many non-electric LEGO-made elements as you like, from any set.

**Except:** *Factory-made wind-up/pull-back "motors" are not allowed.*

**Except:** *Additional/duplicate Mission Models are not allowed.*

**R07 - SOFTWARE** Use any software that allows the Robot to move autonomously – meaning it moves on its own. No form of remote control is allowed..

### R08 - TECHNICIANS

- Only two team members, called "Technicians," are allowed at the competition Field at once.  
**Except:** *Others may step in for true emergency repairs during the Match, then step away.*
- The rest of the team must stand back as directed by tournament officials, with the expectation of fresh Technicians being able to switch places with current Technicians at any time if desired.

## PLAY

**R09 - BEFORE THE MATCH TIMER STARTS** After getting to the Field on time, you have at least one minute to prepare. During this special time only, you may also

- ask the referee to be sure a Mission Model or setup is correct, and/or
- calibrate light/color sensors anywhere you like.

### R10 - HANDLING DURING THE MATCH

- You are not allowed to interact with any part of the Field that's not **COMPLETELY** in Base.

**Except:** You may Interrupt the Robot any time.

**Except:** You may pick up Equipment that **BROKE** off the Robot **UNINTENTIONALLY**, anywhere, any time.

- You are not allowed to cause anything to move or extend over the Base line, even partly.

**Except:** Of course, you may **LAUNCH** the Robot.

**Except:** You may move/handle/**STORE** things off the Field, any time.

**Except:** If something accidentally crosses the Base line, just calmly take it back – no problem.

- Anything the Robot affects (good or bad!) or puts completely outside Base **stays as is** unless the Robot changes it. Nothing is ever repositioned so you can “try again.”

### R11 - MISSION MODEL HANDLING

- You are not allowed to take Mission Models apart, even temporarily.
- If you combine a Mission Model with something (including the Robot), the combination must be loose enough that if asked to do so, you could pick the Mission Model up and nothing else would come with it.

### R12 - STORAGE

- Anything completely in Base may be moved/stored off the Field, but must stay in view of the referee.
- Everything in off-Field Storage “counts” as being completely in Base and may be placed on an approved holder.

**R13 - LAUNCHING** A proper Launch (or re-Launch) goes like this:

- **READY SITUATION**
  - Your Robot and everything in Base it's about to move or use is arranged by hand as you like, all fitting “**COMPLETELY IN BASE**” and measuring no taller than 12 inches” (30.5 cm).
  - The referee can see that nothing on the Field is moving or being handled.
- **GO!**
  - Reach down and touch a button or signal a sensor to activate a program.

**IF FIRST LAUNCH OF THE MATCH** – *In this case, accurate fair timing is needed, so the exact time to Launch is the beginning of the last word/sound in the countdown, such as “Ready, set, GO!” or BEEEEP!*

**R14 - INTERRUPTING** If you **INTERRUPT** the Robot, you must stop it immediately, \*then calmly pick it up for a re-Launch. Here's what happens to the Robot and anything it was Transporting, depending on where each was at the time:

#### • ROBOT

- Completely in Base: ..... Re-Launch
- NOT completely in Base: ..... Re-Launch + Penalty

#### • TRANSPORTED THING WHICH CAME FROM BASE DURING THE MOST RECENT LAUNCH

- Always: ..... Keep it

#### • TRANSPORTED THING WHICH DID NOT COME FROM BASE DURING THE MOST RECENT LAUNCH

- Completely in Base: ..... Keep it
- NOT completely in Base: ..... Give it to the referee

The “**PENALTY**” is described with the Missions.

**IF YOU DON'T INTEND TO RE-LAUNCH** – *In this case, you may shut the Robot down and leave it in place.*

**R15 - STRANDING** If the **UNINTERRUPTED** Robot loses something it was Transporting, that thing must be allowed to come to rest. Once it does, here's what happens to that thing, depending on its rest location:

#### • TRANSPORTED THING

- Completely in Base: ..... Keep it
- Partly in Base: ..... Give it to the referee
- Completely outside Base: ..... Leave as is

### R16 - INTERFERENCE

- You are not allowed to negatively affect the other team except as described in a Mission.
- Missions the other team tries but fails because of illegal action by you or your Robot will count for them.

### R17 - FIELD DAMAGE

- If the Robot separates Dual Lock or breaks a Mission Model, Missions obviously made possible or easier by this damage or the action that caused it do not score.

**R18 - END OF THE MATCH** As the Match ends, everything must be preserved exactly as-is.

- If your Robot is moving, stop it ASAP and leave it in place. (Changes after the end don't count.)
- After that, hands off everything until after the referee has given the OK to reset the table.

### R19 - SCORING

- **SCORESHEET** The referee discusses what happened and inspects the Field with you, Mission by Mission.
  - If you agree with everything, you sign the sheet, and the scoresheet is final.
  - If you don't agree with something, the head referee makes the final decision.
- **IMPACT** Only your **BEST** score from regular Match play counts toward awards. Playoffs, if held, are just for extra fun.
- **TIES** Ties are broken using 2nd, then 3rd best scores. If still not settled, tournament officials decide what to do.

# Robot Game: Field Setup

The field is where the Robot Game takes place.

- It consists of a field mat, on a table, with mission models arranged on top.
- The field mat and the LEGO® pieces for building the mission models are part of your Challenge Set.
- The instructions for building the mission models are [here](#).
- The instructions for how to build the table are [here](#).

**NOTE: BEGINNING IN 2019-20, THE FIELD MAT SIZE IS DIFFERENT AND WILL HAVE DIFFERENT RULES SURROUNDING ITS PLACEMENT ON THE TABLE.**

## MISSION MODEL CONSTRUCTION

**Build the mission models** - Use the LEGO elements from your Challenge Set. It will take a single person four to five hours to do this, so it's best done in a team construction party. For any team members with little or no experience building with LEGO elements, Mission Model construction is a great way to learn. This step is also a nice time for new team members to get to know each other.

## MISSION MODEL ARRANGEMENT AND SETUP

**Dual Lock** - Some models are secured to the mat, others are not. Where a model needs to be secured, the connection is made using the re-usable fastening material from 3M called Dual Lock, which comes in the flat clear bag with the LEGO elements in your Challenge Set. Dual Lock is designed to stick or “lock” to itself when two faces of it are pressed together, but you can unlock it too, for ease of transport and storage. The application process for the Dual Lock is only needed once. Later, the models can simply be locked onto the mat or unlocked. To apply Dual Lock:

**Step 1** - Stick one square, adhesive side down, on each box you see on the mat with an “X” in it.

**Step 2** - Press a second square on top of each of those, “Locking” them on, adhesive side up.

**TIP:** Instead of using your finger, use a bit of the wax paper the squares came on.

**Step 3** - Align the Model exactly over its mark, and lower/press it onto the squares.

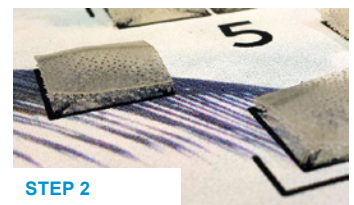
### CAUTION

1. Pay attention... Some Models which seem symmetrical in fact have a directional feature somewhere.
2. Be sure to place each square precisely on its box, and each Model precisely over its marks.
3. When pressing a Model down, press down on its lowest solid structure instead of crushing the whole Model. Pull on that same structure if later you need to separate the Model from the Mat.

**TIP:** For large and/or flexible models, apply only one or two sets at a time. There's no need to do it all at once.



STEP 1



STEP 2



STEP 3



## MISSION MODELS

(Any details not shown or mentioned are left to chance and officially don't matter.)

These Mission Models are secured on their marks with Dual Lock as shown...



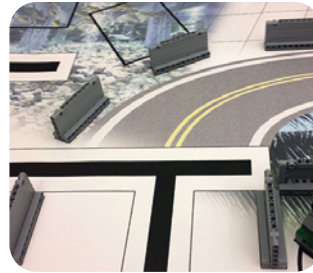
Service Dog and Man



Service Dog Cane



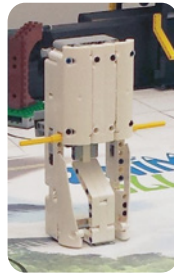
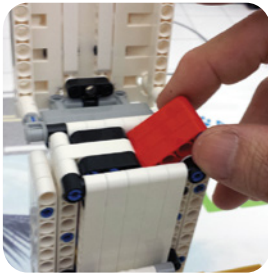
Warning Fence



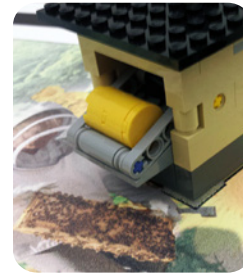
Barriers

Note: End of cane is on black dot. Man's arm is down. Dog's head is down. Warning Fence is up.

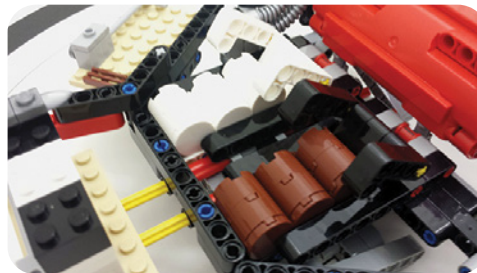
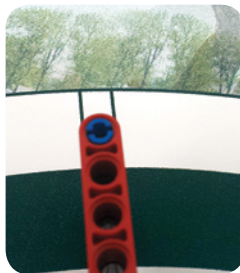
**REFRIGERATOR AND FOOD:** Refrigerator is loaded with all 8 Food inside, in random order. Door is closed.



**BEEHIVE:** Honey is loaded.



**MILKING AUTOMATION:** Red lever is aligned over its mark. Release-cow is pulled all the way out. Dispenser ramps are loaded with Milk and Manure (a type of feces) as shown.



**RAMP:** Tilt is all the way down at west side.

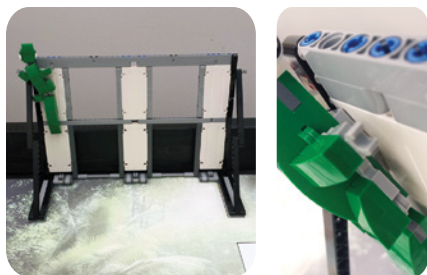


**ANIMAL CONSERVATION:** This Model is secured with Dual Lock, but not on "X" marks. Instead, you find the correct north-south location. Place the model between its red marks on the mat. Then center it over your Table's north border wall and a selection of "Dummy" wall. Next, make small pencil marks to show exactly where the model's feet are. After these location steps, apply Dual Lock – two pair under each foot. When loading an animal in your tray, push the animal north, and center it east/west. Finally, rest the red axle on its stopper.

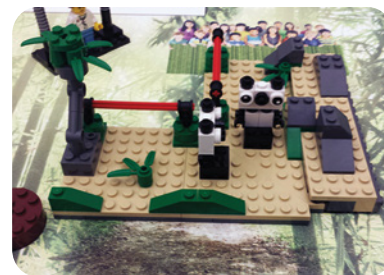


\*(Reindeer shown. You might load a different animal. See MISSIONS for full details.)

**BIOMIMICRY WALL AND GREEN GECKO:** The Biomimicry Wall's feet are spaced slightly wide. Center them as close to their marks as possible, and keep them parallel. Press the Green Gecko onto its holder at the center of its belly as shown.



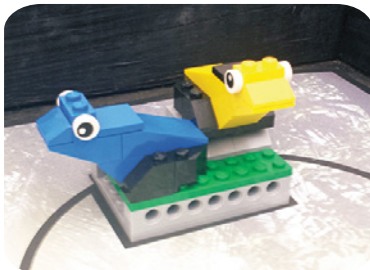
**PANDA OBSERVATION AND RETURN:** Starts with sliding section closed (counter-clockwise).



These models are placed **LOOSE** on their marks as shown...



*Pet (Our Little Friend)*



*Frogs*



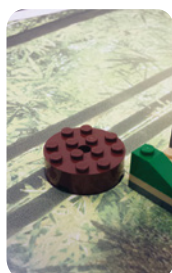
*Zoologist*



*Bee*



*West Manure Sample*



*East Manure Sample*



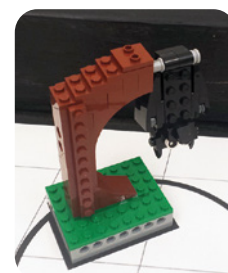
*Seal & Camera*



*Gorilla*



*Flamingo*



*Bat*

These models are placed loose completely in **BASE** as you please (the pictures are just for show)



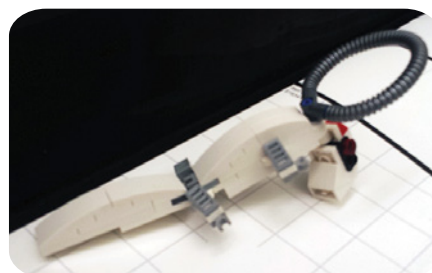
*Shark & Tank*



*Prosthesis*



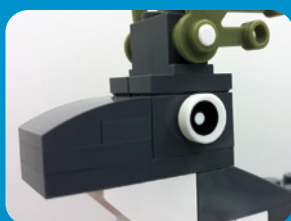
*Ten More  
Manure Samples*



*White Gecko*



*Dog & Trainer*



**REINDEER:** The Reindeer may be placed completely in **BASE**, OR it may be placed by hand into the south tray of the Animal Conservation Mission Model, OR it may take the place of another animal...See the MISSIONS for full details!



## FIELD MAINTENANCE

- **Border Walls:** Remove any obvious splinters, and cover obvious holes.
- **Field Mat:** Make sure the Mat touches the south Border Wall, and is centered east to west. Avoid cleaning the Mat with anything that will leave a residue. Any residue, sticky or slippery, will affect the Robot's performance compared to a new Mat (many tournaments use new Mats). Use a vacuum and/or damp cloth for dust and debris above and below the Mat. To get marks off, try a white-plastic pencil eraser. When moving the Mat for transport and storage, be sure not to let it bend into a sharp kink point, which could affect the Robot's movement. Tournaments using new Mats should unroll the Mats as far in advance of the tournament day as possible. For control of extreme curl at the east or west edges of the Mat, black tape is allowed, with a maximum of  $\frac{1}{4}$ " (6 mm) overlap. Foam tape is not allowed. Do not put Dual Lock under the Mat, or use it for anything other than securing Mission Models as described.
- **Mission Models:** Keep the Mission Models in original condition by straightening and tightening solid connections often. Ensure that spinning axles spin freely by checking for end-to-end play and replacing any that are bent.

GAME BOARD – WEST



GAME BOARD – CENTER





GAME BOARD – EAST



FULL VIEW OF BOARD





# Robot Game: Missions

**Do we need animals, or do they need us?** Answer: YES! This Robot Game showcases just a fraction of our wonderful story with animals. As you work on the Missions, pay attention to the many ways innovation and technology have enabled humans and animals to exchange learning, friendship, help, daily needs, protection, amusement, and love... As you'll see, there are many fun problems left to solve!

**M01 - SHARK SHIPMENT** - Move the Shark to her new home not touching her tank's walls.

#### EXACT SCORING REQUIREMENT OPTIONS:

- **Visible at the end of the match:**
  - Tank and Shark are completely in Target 1: **7 Points**, **OR** Target 2: **10 Points**
- **Bonus** (Added only if a Target score is earned): Shark is touching only the tank floor and no wall: **20 Points**
- **More:** After Launch for this Mission, nothing is ever allowed to touch the Shark except the Tank.



Target 1

Target 2

**M02 - SERVICE DOG ACTION** - Drive past the visually impaired man, and the dog will do her job.

#### EXACT SCORING REQUIREMENTS:

- **Visible at the end of the match:**
  - The Warning Fence is down: **15 Points**
- **More:** The Fence must be down because the Robot completely crossed it from the west, after traveling between the Barriers: Y/N



Fence Down

**M03 - ANIMAL CONSERVATION** - Work with the other team to unite identical animals. Every pair united will score for BOTH teams, no matter who worked on that union.

- Before the Match starts, hand-place your choice of **one** animal in your tray of the Animal Conservation Mission Model. The placement must match one of these \*options:
  - Reindeer facing west
  - Gorilla facing south
  - Bat facing south
  - Flamingo facing east
  - Frogs facing south & west
  - If placing another animal other than Reindeer, put Reindeer on that animal's mark facing west
- During the Match, participating Robots make the trays switch places. A switch is officially successful when the red axle causes the system to stop. Robots then have the option of removing the received animal and replacing it with a different animal for switching. The Referee resets the red axle.

#### EXACT SCORING REQUIREMENTS:

- **Visible at the end of the match:**
  - Two identical animals are completely on the same \*\*Side: **20 Points per pair**
  - Both teams get points for all pairs.
- **More:** Each pair must be created through rotation of the Animal Conservation Mission Model: Y/N

\*The five optional animals listed in this mission are the only ones allowed for exchange.

\*\*For M03, a "Side" is anywhere completely south of the symmetric line between Fields, including that Field's Storage areas.



*If placing an animal other than the Reindeer, put the Reindeer on that animal's mark, facing west.*

**M04 - FEEDING** - Deliver food from the Refrigerator to Target Animal Areas.

**EXACT SCORING REQUIREMENTS:**

- **Visible at the end of the match:**
  - A piece of Food is completely in a Target Area: **10 Points (Each Piece)**
- **More:** If multiple pieces of Food are in one area, all must match each other: Y/N



*ANIMAL AREAS FOR REFRIGERATOR FOOD  
(Areas do not include the rectangles)*

**M05 - BIOMIMICRY** - Test our ability to mimic the Gecko's "stickiness" by placing the White (mechanical) Gecko on the Biomimicry Wall, and/or by seeing if the Robot itself can get onto the wall.

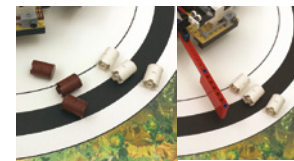
**EXACT SCORING REQUIREMENTS:**

- **Visible at the end of the match:** The Biomimicry Wall completely supports:
  - All the weight of the White Gecko: **15 Points**
  - All the weight of the Robot: **32 Points**
- **More:** For an object to score, no part of it may be in contact with anything but the Biomimicry Wall and/or Green Gecko, except two scoring objects may be in contact with each other: Y/N

**M06 - MILKING AUTOMATION** - Guide the cow into the machine, then spin the machine until Milk comes out. If you spin too far, \*Manure also comes out!

**EXACT SCORING REQUIREMENTS:**

- **Visible at the end of the match:**
  - Milk and Manure have all rolled out: **15 Points**
  - Milk has all rolled out, but not Manure: **20 Points**
- **More:** The Robot's only movement of the Milk and/or Manure came by moving the red lever: Y/N



*Milking Automation*

**M07 - PANDA RELEASE** - Convert the Panda's scene from facility care and observation to open wilderness.

**EXACT SCORING REQUIREMENT:**

- **Visible at the end of the match:**
  - The slider looks fully open clockwise: **10 Points**



*Setup*



*Score*

**M08 - CAMERA RECOVERY** - Go get the camera and bring it to Base.

**EXACT SCORING REQUIREMENTS:**

- **Visible at the end of the match:**
  - The Camera is completely in Base: **15 Points**

**M09 - TRAINING AND RESEARCH** - Move the Dog & Trainer, Zoologist, and/or Manure Samples to the Training & Research Area.

**EXACT SCORING REQUIREMENTS/OPTIONS:**

- **Visible at the end of the match:**
  - The Dog & Trainer are completely in the Training & Research Area: **12 Points**
  - The Zoologist is completely in the Training & Research Area: **15 Points**
  - Manure \*Samples are completely in the Training & Research Area: **5 Points** Each
- **More:** Only one Manure Sample may be Transported at a time: Y/N

\*Only disc-shaped Manure counts as Samples.

**M10 - BEE KEEPING** - Place the Bee on the Beehive and get the Honey out.

**EXACT SCORING REQUIREMENTS/OPTIONS:**

- **Visible at the end of the match:**
  - The Bee is on the Beehive and there is no Honey in the Beehive: **12 Points** OR
  - The Bee is on the Beehive and the Honey is completely in Base: **15 Points**



*Training & Research Area*

**M11 - PROSTHESIS** - Fit the Prosthesis where the legs of the Pet (Our Little Friend) should be, and send the Pet to its place on the farm.

**EXACT SCORING REQUIREMENTS/OPTIONS:**

- **Visible at the end of the match:**
  - The Prosthesis is fitted to the Pet AND not held by the Ref: **9 Points OR**
  - The Prosthesis is fitted to the Pet AND the Pet is completely in its Farm Target: **15 Points**



*Fitted*

*Farm Target*

**M12 - SEAL IN BASE**

- **Visible at the end of the match:**
  - The Seal is completely in Base and not broken: **1 Point**

**M13 - MILK IN BASE**

- **Visible at the end of the match:**
  - All three Milk are completely in Base: **1 Point**

**M14 - MILK ON RAMP**

- **Visible at the end of the match:**
  - Option 1: **2 Points**
    - All three Milk are completely supported by the Ramp
  - Option 2: **3 Points**
    - All three Milk are completely supported by the Ramp,
    - AND they're the only things supported by the Ramp,
    - AND they're the only things touching the Ramp
  - Option 3: **4 Points**
    - All three Milk are completely supported by the Ramp,
    - AND they're the only things supported by the Ramp,
    - AND they're the only things touching the Ramp,
    - AND they're all standing

**M15 - ALL SAMPLES**

- **Visible at the end of the match:**
  - All seven Manure Samples are completely in the Training And Research Area: **5 Points Added To M09**

**PENALTIES** - Before the match starts, the Referee removes five Manure Samples from Base, and holds on to them, leaving five still there. If you Interrupt the Robot, the Ref places one of the removed Samples in the white triangle, in the southeast, as a permanent/untouchable Interruption Penalty. You can get up to five such penalties, worth **Minus 6 Points Each**

## ROBOT DESIGN EXECUTIVE SUMMARY

An “executive summary” is often used by engineers to briefly outline the key elements of a product or project. The purpose of the Robot Design Executive Summary (RDES) is to give the Robot Design Judges a quick overview of your team’s robot and all that it can do. Teams do not need to create a poster or written material for the RDES. However, if the team would like to share pictures of the design process, records of strategy sessions, or examples of programming (either printed or on a laptop), the RDES presentation is an appropriate time.

Have your team prepare a short presentation (no longer than four (4) minutes) covering the elements below:

1. **Robot Facts:** Share a little bit about your robot, such as the number and type of sensors, drivetrain details, number of parts, and the number of attachments. The Judges also like to know what programming language your team used, the number of programs, and the Robot Game mission where your team had the most success.
2. **Design Details:**
  - a. **Fun:** Describe the most fun or interesting part of robot design as well as the most challenging parts. If your team has a fun story about your robot please feel free to share.
  - b. **Strategy:** Explain your team’s strategy and reasoning for choosing and accomplishing missions. Talk a little bit about how successful the robot was in completing the missions that were chosen.
  - c. **Design Process:** Describe how your team designed their robot and what process they used to make improvements to the design over time. Briefly share how different team members contributed to the design.
  - d. **Mechanical Design:** Explain the robot’s basic structure. Explain to the Judges how the robot moves (drivetrain), what attachments and mechanisms it uses to operate or complete missions, and how your team makes sure it is easy to add/remove attachments.
  - e. **Programming:** Describe how your team programmed the robot to ensure consistent results. Explain how the team organized and documented programs. Mention if the programs use sensors to know the location of the robot on the field.
  - f. **Innovation:** Describe any features of the robot’s design that the team feels are special or clever.
3. **Trial Run:** Run the robot briefly to demonstrate how it completes the mission(s) of your team’s choice. Please do not do an entire robot round. The Judges need time to ask questions after the RDES.

The RDES is a great tool to help your team organize their thoughts about the robot and the design process they used. Check with your event organizer to see if your team is expected to present your RDES in the Robot Design judging session.



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