Eurobot<sup>Open</sup> Junior 2019 Rules

26<sup>th</sup> edition of the robotic contest - Eurobot
OFFICIAL version

ATOM FACTORY

NOTE: all images in this document are provided as a guide to illustrate the various paragraphs. In no case they can serve as a reference. Only the dimensions, colors and materials indicated in the appendix shall be taken into consideration.
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A. NOTICE

WARNING!

General remarks are annotated in the document. Please, pay special attention to these points.

This year the rules have been split up. Most parts remain the same for the Eurobot Open and Eurobot Open Junior contests, but to avoid confusion, each contest has its own rules as a single document.

Thus the particular cases inherent to one of the competitions appear only in the document concerning it.

You will find the Eurobot Open and the Eurobot Open Junior rules and other information on the Eurobot Open website (http://www.eurobot.org/)

Please note that the version of this release is noted down at the end of this page. For any inquiry, only an official version should be considered.

Have a good reading!
B. CONTEST PRESENTATION

EurobotOpen and EurobotOpen Junior are two events addressed to teens and students interested in robotics. Teams are usually composed by students involved in an EurobotOpen school project, a group of friends, or independent robotics clubs. They share the same goal: to offer young people an active learning process, to put into practice their knowledge and know-how during a fun and friendly event.

The rules for both events (EurobotOpen and EurobotOpen Junior) are based on the same concept. As organisers, we intend to provide a common platform for the EurobotOpen event. This platform is dedicated to autonomous robots for EurobotOpen while for EurobotOpen Junior, the robots are wire-guided. In this way, a EurobotOpen organiser can easily set up a EurobotOpen Junior contest and vice versa. Remember this when you will be organizing your official or unofficial event.

You’re currently reading version EurobotOpen Junior OFFICIAL of 2019 rules (this version concerns only the wire-guided robots)

The age limit for participating in the EurobotOpen Junior Finals is 18 years. Each team can have a supervisor to whom the age limit does not apply.

The technical challenge is to build a remote controlled robot as well as an optional autonomous robot.

Be careful, depending on your country’s educational system, this age limit may be slightly different. Check the registration requirements stated by your National Organizing Committee.

A team is a group of young people who have built one or two robots for the event. A person can only represent one team. However, we encourage teams to share their expertise and knowledge.

An organization (club, school, etc.) can supervise and register several teams, if allowed by the registration requirements set by your National Organizing Committee. The acceptance of these requirements is compulsory to validate your registration and your entry.

The project can be supervised by someone over the age limit (teacher, parent, group leader, etc.), but all elements of the robot(s) must be designed by the participants. In this context, robots manufactured from a commercially purchased chassis or rolling base will not be accepted.

In the event that a robot was imagined, built or modified by the tutor alone, organisers can disqualify or reject the participation of the team in the competition. Students must be capable of describing and explaining the manufacture process of their robots. It is strictly forbidden that the tutor modifies the robot during the competition. He can in exchange advise the students and guide them.

The objective of the secondary robot is to allow young people to experiment with programming. It is tolerated to use a commercial robotic base for this robot unlike the main robot. As the work is mainly on programming, it will be asked during the registration that the students present the program and are able to explain it to the referees.

EurobotOpen and EurobotOpen Junior must take place in a friendly, fair-play spirit. As for every sport event, referees’ decisions are pronounced without a possible recourse, except if an agreement between all stakeholders is met.

EurobotOpen and EurobotOpen Junior European Finals gather teams selected after national qualifications. National qualifications take place in Europe, but remain Open to all countries. Countries where more than three teams are registered, must organize a national qualification, in order to select teams that will attend the Euro-
Common parameters can vary from one year to another. Accordingly, please read the rules carefully even if the chapters may seem familiar to you (playing field dimensions, robots dimensions, starting area dimensions etc.).

Robotics contests are public events. Therefore, we ask the teams to respect our rules of decency and safety (electrical, sound level, etiquette, etc.). These rules apply to the participants, their supporters and all the equipment they bring.
150 years ago Dmitri Mendeleev revolutionized our understanding of the matter, by taking a giant leap forward to sciences once he published his work on the classification of elements.

With his famous Periodic Table he pointed out the composition of atoms and introduced the concept of "void". Few new atoms were discovered since he first published his work, guaranteeing Mendeleev’s precision!

Besides the known elements Mendeleev has predicted a century ago, we still have atoms that are unknown. Discovering new atoms can be a difficult task and often requires complex experiments.

Today, we need the help of your robots to do these experiments!

Your missions will be:

- **Classifying atoms.** As in the Periodic Table you’ll have to select and classify atoms.
- **Weighing atoms.** Often the rarest atoms are the ones that weigh most, so be careful what you choose.
- **Creating a new element.** And for that nothing beats a good Particle Accelerator.
- **Do your own experiments.** You’re free to propose your own experiment!
- **Predicting unknown elements.** Since Dmitri Mendeleev predicted the existence of unkown elements, you can also make a prediction… of your own score for example!

Warning! All actions are independent from one another and no specific sequence is imposed whatsoever. No single action is compulsory. Give careful thoughts to your strategy. It is strongly recommended to design simple and reliable systems over a limited number of actions.
Figure 2 – Overview of the playing area
D. PLAYING AREA AND ACTIONS

D.1. IMPORTANT INFORMATION

Organisers intend to build the playing area with as much accuracy as possible. Nevertheless, they reserve the right to do minor modifications and adjustments. In case these modifications are necessary during the fabrication process, please make sure you follow our updates.

No objections regarding differences in dimensions will be taken into account.

Teams are warned that the surface quality may differ from one playing area to another and may also degrade over time.

Some modifications or improvments can be made on the rules during the year. We therefore strongly encourage all participants to check our website regularly (http://www.eurobot.org/) as well as your NOC's own website for news. You can also follow discussions, ask questions or get further assistance on our forum (http://www.planete-sciences.org/forums/).

Possible changes of the technical specifications will be announced on the Eurobot website, (http://www.eurobot.org/) or on the website of the National Organization Committee (NOC) in your country.

All answers from the forum are provided by an official referee and are taken into account during match plays and approval rounds.

D.2. ATOMS

As you know already, atoms are the core of the matter. At first sight, they are all identical but in reality they differ from one to another. We can distinguish them on their atomic mass. The genius of Dmitri Mendeleev is that he realised how to classify their weight according to the atomic mass and explained the rules that govern their interactions. Atoms are the only playing elements present on the playing area. Robots have to collect and differentiate them in order to score a maximum of points.

D.2.a. DESCRIPTION OF THE PLAYING ELEMENTS

![Figure 3 – Playing elements - Atoms](image)
Atoms are represented by rubber ice hockey pucks. There are 4 types of atoms, weighing each a different mass:

- **Redium** (Figure 12), standard, very common and very light, it weighs 60 g.
- **Greenium** (Figure 12), standard, common but a little heavier, it weighs 120 g.
- **Blueium** (Figure 12), standard, rather rare and rather heavy, it weighs about 170 g.
- **Goldenium** (Figure 13), special, extremely rare and heavy, it weighs about 340 g.

There are 36 standard atoms on the playing area, and 2 additional special atoms (Goldenium), with a total of 38 playing elements.

The 38 atoms are shared with both teams, but their initial placement may guarantee the access to some atoms for only one team. For example, some atoms are initially placed in a distributor dedicated to a specific team.

### D.3. PLAYING AREA

The playing area is a horizontal rectangular plan of 3000 mm by 2000 mm with borders on each side. Depending on the carpenters, it may consist of a single piece or several pieces to assemble (e.g., 3 pieces of 1000 mm per 2000 mm).

![Figure 4 – Detailed view of the playing area](image)

1. Starting areas  
2. Periodic table  
3. Particle accelerator  
4. Weighing scale  
5. Access slope for the weighing scale  
6. Experiment area  
7. Chaos area  
8. Oxygen atom  
9. Atom distributors

**Chaos area:** There are two chaos areas drawn on the playing table. Each area contains 4 elements: 2 atoms of “Redium”, 1 atom of “Greenium” and 1 atom of “Blueium”. Those atoms are placed horizontally (one side lying down on the surface) and randomly positionned in the area.
**Atom distributors:** they are linear supports in which the atoms are placed on the edge. There are 4 atom distributors. 2 large ones which are shared with both teams and 2 small ones which are reserved exclusively for one team which is painted in the concerning teams' color. They are composed as follows:

- The small distributor: 1 atom of "Redium", 1 atom of "Greenium" and 1 atom of "Blueium"
- The large distributor: 3 atoms of "Redium", 2 atoms of "Greenium" and 1 atom of "Blueium"

The order of the atoms inside each distributor is given by the Figure 5.

![Figure 5 – The distributors](image)

Full specifications of the playing area and game elements (dimensions, positions at the beginning of the match, colors and other references) are listed in the appendix.
In the rest of this document, horizontal and vertical directions are stated relative to the playing area. Notions of left, right, front and back are stated with respect to the spectator's point of view.

**D.4. STARTING AREAS**

**D.4.a. DESCRIPTION**

Each team has a part of a periodic table, which will serve as a starting point.

![a](image)

(a) A-team starting area

![b](image)

(b) B-team starting area

**D.4.b. CONSTRAINTS**

The starting area of a team is included inside the periodic table of the team. Be careful, the starting area consists only of the two first cells of the periodic table, which are the cells of "Redium" and "Greenium".

Before the beginning of the match, the vertical projection of the robots must not exceed the limits of the starting area.
Make sure your robots can enter the starting area completely. The robots can overtake over the edge of the playing area but not outside the limits.

**D.5. ATOM CLASSIFYING**

Help Dmitri Mendeleev place the atoms in their right compartment of the periodic table.

**D.5.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS**

(a) A-team cells of the periodic table  
(b) B-team cells of the periodic table

**The atoms:** All atoms previously described are at your disposal on the playing area.

**The cells of the periodic table:** For each team, a periodic table is available and placed on each side of the playing area (it includes the starting area). Each of those periodic tables is composed by 3 cells corresponding to the 3 standard elements.

- The red "Redium" cell, to classify atoms of "Redium"
- The green "Greenium" cell, to classify atoms of "Greenium"
- The blue "Blueium" cell, to classify atoms of "Blueium"

**D.5.b. ACTIONS AND CONSTRAINTS**

**Actions:** You must classify the atoms of the playing area on your own cells of the periodic table.

**Constraints:**

- To be valid, the vertical projection of an atom must be located at least partially on any cell of the periodic table. It must be also in contact with the playing area or with another valid atom.
- An atom can be placed in any cell of the periodic table. But, if the atom is located at least partially on the correct cell, it will earn more points.
- The "Goldenium" may be placed in any cell of the periodic table.
- It is strictly forbidden to remove the atoms from the cells of your opponent's periodic table.
- The robots are not allowed to enter the periodic table of the opposing team during the entire match.
- In front of each cell of the periodic table of a team is located an atom on the floor at the beginning of the match. Those three elements are 2 atoms of "Redium" et 1 atom of "Greenium". The arrangement of elements in front of the periodic table cells are random and changed at every new match. The draw is performed by the referees before starting the match, so after the preparation time, and is identical for both teams.
D.6. ATOM WEIGHING

In order to highlight elementary chemical properties, Dmitri Mendeleev had the idea of classifying atoms according to their atomic mass. In order to do this, he needed to know the mass of each element!

This is why, the robots can access of a weighing scale.

D.6.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The weighing scale: In front of the playing area, are placed two weighing trays (one for each team). Each weighing tray can move up and down and remains horizontal as an weighing scale of type “Double-Pan Balance Scale”.

The weighing tray is composed of a flat surface and a border around it. Its movements are limited in amplitude, the altitude of the top of the border compared to the surface of the playing area can vary from 80mm to 150mm.

The ramps Each team has at its disposal a ramp at the front of the playing area, which can help robots to place the atoms into the scale.

D.6.b. ACTIONS AND CONSTRAINTS

Actions: Robots have to pick atoms and place them on the weighing scale. The heavier atoms will bring more points to a team than the lighter ones!

Constraints:

- To be valid the weight of an atom must be completely exerted on the weighing tray.
- Each tray may contain up to 6 atoms.
- In the event that a team dispose more than 6 atoms on the weighing scale, only the 6 lightest atoms will be considered. Consequently, the removed heavier atoms will not be taken into account.
- It is strictly forbidden to place or remove atoms on the tray dedicated to the opponent.
- When climbing the slope, robots are no longer subject to the height constraints of the regulation.
• Any element or robot hindering the proper functioning of the scale after the end of the match (blocked atom, atom controlled by a robot, robot that lingers over...) can be (re)moved by the referee in order to count correctly the points on the scale. A team can be disqualified if it tries to influence the opposing team’s score.

D.7. PARTICLE ACCELERATOR

Usually particle accelerators impart an enormous source of energy to atoms, which has the effect of accelerating them to a speed very close to the speed of light. At this speed, a collision between several atoms can potentially create a new element, until then unknown.

Let’s see if our robots are able to create new elements!

D.7.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The particle accelerator: it’s a linear ramp where it’s possible, on its top surface, to put a atom on its edge. So it’s possible for the atom to accelerate freely towards the bottom of the ramp. Each team has at its disposal its own particle accelerator.

The particle detector: located on top of the particle accelerator. When an atom crosses it, it opens a trapdoor which liberates a new atom, the "Goldenium".

At the beginning of the match, an atom of "Blueium" is pre-positioned at the top of the accelerator, ready to be launched. The atom of "Goldenium" is positioned in the closed particle detector.

D.7.b. ACTIONS AND CONSTRAINTS

Actions:

• Robots can collect standard atoms by placing them into the particle accelerator.
• A standard atom must pass through the detector to unlock access to the "Goldenium".
• Robots can collect the "Goldenium" in their detector, once it’s open, to use it on other actions on the playing area.
Constraints:

- Only the atoms present in the particle accelerator will be taken into account for the counting of the points. The atoms must be in contact with the slope of the particle accelerator, the flat area of the team color at the top of the slope is not part of it.
- It’s strictly forbidden to unlock the mechanism other than by passing an atom through the particle accelerator detector.
- It is strictly forbidden to remove the "Goldenium" without having unlocked the particle accelerator detector.
- It is strictly forbidden to put atoms in the particle accelerator of the opposing team. It is also forbidden to recover the "Goldenium" stored in the opponent's particle accelerator, as well as the pre-positionned atom at the top of the opposing particle accelerator.
- Atoms can be placed from anywhere in the particule accelerator. This is not mandatory to go through the top of the slope of this one.

D.8. PERFORM AN EXPERIMENT

D.8.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The experiment area: located at the back of the playing area, on the same side of the starting area of the team. The horizontal plane of the experiment area is on the same level as the top of the playing area border.

Oxygen atom: it is a decorative part whose design will be left free to the organizers of each contest. It located on the top of masts near the center at the back of the playing area.

Ionic bonding: is represented by a cord, going from the oxygen atom and tight towards the experiment area and fixed to the experiment itself. It is up to the team to provide this cord.

The experiment: it’s an element, designed by the team and put on the experiment area during the preparation phase.

The electron: it’s an element, designed by the team, which is to be moved from the experiment area to the oxygen atom.

D.8.b. ACTIONS AND CONSTRAINTS

Actions:
• The teams must drop off their experiment on the dedicated area during the preparation time.
• During the match the experiment must be activated by any system of the team's choice.
• When the experiment has been activated, an electron, made by the team, must follow the cord until it join
  the oxygen atom in the middle of the playing area.

Constraints:

• The experiment can not be activated by an element external to the playing area (team member, remote
  control from the public, etc.).
• At any time the vertical projection of the experiment must be inside the limits of the experiment area.
• Consequently, the experiment will have the following maximum dimensions:
  – Depth: 222 mm;
  – Length: 450 mm;
  – Height: 200 mm.
• The weight of the experiment must not exceed 2.5 kg.
• The experiment is allowed to be deployed towards the top during the match. The height, after deployment,
  is 460mm maximum from the surface of the experiment area. This deployment can only happen only after
  the experiment has been activated.
• The horizontal plane of the experiment area has to be pierced with a 10mm wide groove, going from the
  center of the support to the middle of the rear side. This groove allows the passage of a threaded rod of
  8 mm diameter, fixed vertically on the experiment. A butterfly nut placed on this threaded rod, will help
  fix the experiment on its support in a fast and reliable way.
• The mast has vertical groove going 70 mm down from the top of the mast.
• The cord must be provided by the team. It must be flexible. Moreover it must not be used as an electrical
  wire.
• The cord must be at least long enough to go from the experiment to the mast.
• On the mast side, a fixation system, or the cord itself, must be slipped into the mast groove. Also, a hole
  may help you for this fixation.
• On the opposing side, the cord, with its fixation system, must be directly attached to the experiment.
• The experiment may contain an electrical power supply source. In that case, an emergency stop button
  directly cutting the power supply must be equipped with the experiment. It must also be clearly visible
  and easily accessible. The experiment may be powered before the beginning of the match; however, it
  cannot be in the activated state. It's allowed to power supply the experiment by connecting it to the power
  supply of the control panel of the robot.
• The activated experiment must be visible from the public. It can be a lighting, a mechanical action or
  other. The public must be able to easily notice that the experiment is activated or not, even after the end
  of the match.
• The electron will have the maximum dimensions of: 120x120x120mm.
• The weight of the union of the electron, the cord and the fixation systems must not exceed 600 g.
• The electron is an independant element from the experiment. It may embed its own power source.
• At the beginning of the match, its vertical projection must be fully inside the experiment area. It may be
  in contact with the experiment.
• The electron must arrive at the oxygen atom (within 50 mm of the mast) before the end of the match and
  remain there. To achieve this, a band of Velcro\textsuperscript{T,M} on the hook side at the top of the mast may help you
  to maintain it after the end of the match. The experiment must have been activated to consider the action
  validated.
• No elements of the experiment (cord, electron, etc.) should interfere with the access or use of the particle accelerator of the opponent team.

• The action should not be dangerous for the public, people around the table, the playground or the robots involved.

• The experience can only be activated during the match.

• The experience may include a screen but is only allowed to display information about the current match. It should not display any video, images, photos that are linked to the current match or advertisements.

**D.9. PREDICT YOUR OWN SCORE**

Just as Dmitri Mendeleev has predicted the existence of unknown elements in the Periodic Table. Also, You will have to predict the unknown. Your own score for example!

**D.9.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS**

The device for displaying the score estimation made during the match must be made by the team:

• It can be static (sheet of paper, slate, etc.).

• Or dynamic (electronic display); located either on the robot or on the experiment (please make sure that the experiment is activated).

**D.9.b. ACTIONS AND CONSTRAINTS**

• The team must evaluate the number of points made in the match by its robot(s). For this, two exclusive options:
  – Pre-match evaluation on a static display: the team writes the score it intends to make during the match.
  – Evaluation during a match on a dynamic display device.

• The display area and its sense of reading must be easily visible and identifiable by the referees.

• The estimated score must be expressed in decimal.

• It is allowed for a team with two robots to design a display for each robot. In this case, his score assessment will be the sum of the values of the two displays.

• In the case of dynamic displays, the estimated score must continue to be displayed after the end of the match.

• The score must not change after the match has finished, otherwise the bonus will be lost!

• In case of a dynamic display, the pilot control box can be used to update the display.

• The copilot is not allowed to update the score estimate.
E. PROJECT PRESENTATION

Both Eurobot\textsuperscript{Open} and Eurobot\textsuperscript{Open} Junior encourage participants to practice science in a funny and original way. Our main objective is to assist and value your projects conceived during the year. To achieve this, participants are asked to create a technical presentation and a technical poster of their robots.

We expect to see attractive, innovative robots that respect this edition’s technical contraints and rules. Being creative and original will add value to your efforts as much as the performance of your robot(s) during the matches. By doing this presentation, you will increase the communication value of your project and the visual effect of your robots, for both the public coming to the events as well as for your own satisfaction. Having created something aesthetically and functionally complete, will strenghten your work attitude during and after the competition.

As for previous years, the presentation of your team’s project (through project management on the long-term, tasks distribution ...) as well of your robots (technical systems implemented, chosen strategies ...) is an integral part of the event. Teams should present their projects in a way that is easily understandable and visible for the general public and the rest of the participants.

E.1. CONSTRAINTS

This presentation must be made on a panel size A1 (594 x 841 mm) at least. If you want to use other visual media than paper it is quite possible. Let your imagination be free!

On the other hand, we advise teams to hold a blog explaining progressively the progress of the realization of their robot (“logbook”). The creation of this blog can be done automatically when the team register on our Poolzor software, and the procedure to be followed is explained in detail on the platform. A blog is not mandatory to validate the registration, but we strongly encourage teams to do so, in order to promote the exchange of ideas around their projects.

E.2. EVALUATION

The project must be exposed to the referees and / or guardian angels during the homologation of the robot to allow the teams to show all their work. This presentation will be taken into account in the homologation sheet.

During the meetings, a jury will pass through each panel and discuss with the teams to award a special prize for the best presentation. Team members must be able to present their project in English and/or in French, in order to compete for these prizes.
F. THE ROBOTS

F.1. FOREWORDS

Each team is allowed to register a maximum of two robots which are referred to as the main robot and the secondary robot. The secondary robot has different dimensional constraints.

For Eurobot\textsuperscript{Open} Junior, the main robot is wire-guided and the secondary robot is autonomous.

The construction of a secondary robot is optional. The aim is to allow teams with a large number of members to work on a second project. It is recommended for beginning teams to concentrate on building a single functional machine. Having one robot that works well is better than having two that do not move.

A secondary robot can compete only with the main robot with which it was designed and approved. However it can compete alone if the main robot cannot participate. It cannot be re-homologated with another main robot.

A team's main or secondary robot must not block the other team's robots. In the event of a voluntary action of this type indicated by the referee, the team may be penalized.

A robot must not intentionally cause damage to the opposing robots or to the playing area and its elements.

Only two members of the team are allowed to enter the backstage and on stage. They transport all the equipment (robots, experience, etc.). The path to the playground may include stairs, especially when entering the stage. It is therefore recommended to design easily transportable equipment.

The main robot and the secondary robot must be composed of independent complementary elements. Robots cannot deposit parts or elements on the playing area, except for the play elements.

Robots must not attach themselves on the playing area (e.g. with a suction cup).

A robot must not prevent the opponent from scoring points. If the robot remains static (e.g. if it has finished an action), it must move as far as possible to a location that does not disturb the opponent, otherwise it risks getting penalties!

A game element can be moved:

- for the purpose of scoring points with;
- if justified by performing another game action (e.g. if a common game element is located on the robot's path). The number of the displaced elements (especially from their starting position of the match) must remain minimal.

Deliberately vibrating the table or any other irregular action exposes the team to a refusal of homologation. If in doubt, contact the refereeing committee!

Be imaginative! For example, as an innovation but also to offer the public and the media an attractive show, your robot can use sounds, display expressions, etc.!

F.2. DIMENSIONS

Warning: the dimensions of the main robot and the secondary robot of Eurobot\textsuperscript{Open} are identical to those of Eurobot\textsuperscript{Open} Junior. Eurobot\textsuperscript{Open} Junior participants can more easily access the Eurobot\textsuperscript{Open} meetings. The Eurobot\textsuperscript{Open} Junior robot will only need modifications to make it stand-alone.
Dimensions of the main robot and the secondary robot:
The perimeter of a robot is measured by surrounding it as shown in the illustrations below:

<table>
<thead>
<tr>
<th></th>
<th>Dimensions of the main robot:</th>
<th>Dimensions of the secondary robot:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not deployed</td>
<td>&lt;= 1200mm</td>
<td>Not deployed</td>
</tr>
<tr>
<td>Deployed</td>
<td>&lt;= 1500mm</td>
<td>Deployed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;= 1050mm</td>
</tr>
</tbody>
</table>

The perimeter of the main robot must not exceed 1200 mm at the departure time. The perimeter of the fully deployed main robot shall not exceed 1500 mm during the match.

The perimeter of the secondary robot is independent of the one of the main robot. It must not exceed 850 mm at the time of the start and 1050 mm when it is fully deployed during the match.

At any time during the match the height of the main robot and the secondary robot shall not exceed 350 mm. However, it can be tolerated that the emergency stop button exceeds this limit height to reach 375 mm.

At the beginning of a match, in the start configuration, the vertical projection of both robots on the playing area must fit inside the starting area and must not exceed its limits.

F.3. ENERGY SOURCES

All potential sources of energy stored in the robots and other secondary systems are permitted (batteries, springs, compressed air, gravitational energy, etc.), with the exception of sources of energy using chemical reactions such as combustion or processes pyrotechnics, which are prohibited for safety reasons. It is obvious that the use of living beings is strictly forbidden.

In addition, the use of corrosive products is strictly prohibited, whereas liquid splashes are not permitted.

If you have any doubt about unconventional energy sources, ask the arbitration committee as soon as possible, providing the corresponding datasheets.

In order to avoid any risk of fire, attention should be paid to the choice of the conductors, depending on the intensity of the currents passing through them. It is also strongly advised to protect the electrical installation with a fuse, wired close to the batteries.

Battery:
If the team chooses a battery power supply, we recall that only sealed batteries can be used.

Teams must be able to play three games in a row. Note that this includes the time required to set up, during which the robot will be powered and awaiting the start.

As a result, we strongly recommend teams to carry several sets of batteries and provide easy access to the batteries in the robot for their change. The teams are reminded that it is essential to have a set of spare batteries, fully charged and available at all times.

Note on the use of Lithium-based batteries:
Lithium batteries are known for their lack of stability and can easily ignite when certain precautions are not taken.
This type of battery is therefore authorized under the following conditions:

- Charger suitable for presenting approvals
- Batteries kept in certified and unmodified fireproof bags: when in the robot or on the stand, even in storage!
- A system for detecting underloads is highly recommended.
- Exception in the case of the following batteries, authorized without the conditions listed above:
  - Lithium batteries for LEGO Mindstorm / laptop / mobile phone, provided that they have not been dismantled and are used for the intended purpose of the manufacturer
  - Lithium-Iron batteries (LifePo4)

Warning! The supply systems must be easily transportable. Teams may have to go up and down the stairs on their way to the stage where the matches take place.

The power source transmitted to the robot can only be electric. The maximum permissible voltage is 13.8 V (measured between any two wires of the cable and the robot). This voltage source is not provided on the day of the meeting. On the other hand, the teams have access to the standard (230 V 50 Hz standard) and can use batteries.

The terminals of the cables must be insulated.

F.4. OTHER DESIGN CONSTRAINTS

Visibility: A rectangular space of 100 x 70 mm per robot must be left free on one of the side faces. As far as possible, this space must be visible from a camera located at the height of the playing field. It must also be visually accessible during the majority of the match. The teams will receive stickers printed by the organization (team number, sponsors etc), which they have to place on these open spaces.

Teams are strongly encouraged to make all element manipulations visible from the outside. By doing this, you allow the audience and the cameras that film the event, to see how the transport of your game elements works.

Starting cord of autonomous robots: Robots must be equipped with a starting device easily accessible. This device has to be triggered by pulling the end of a cord at least 500 mm long. This cord must not stay attached to the robot after departure.

No other starting system (remote control, manual rocker switch, etc.) will be approved.

The start of one robot can launch the other robot.

Emergency stop button of autonomous robots Autonomous robots must be equipped with an emergency stop button at least 20 mm in diameter and red in color. It must be placed on the top of the robot in a visible position and in a non-risking area to be immediately accessible by the referee at any time during the match.

The button, in its state of rest, may exceed the robot’s regulation height of 25 mm. The emergency stop button must be operated by a simple downward movement (for example, by hitting it with the fist).

Pressing this button must stop all robot actuators immediately!

Automatic shutdown Each robot must be equipped with a system that stops the movement of the robot and all its actuators, automatically at the end of the 100 seconds (a match’s duration). The dynamic displays that are present on the robots, can remain on.

The automatic shutdown of the robot(s) is optional for participants in Eurobot Open Junior!
Avoidance system (optional for EurobotOpen Junior)  All teams are required to equip their robot(s) with a system for detecting opposing team’s robots.

This system is intended to prevent collisions between robots, during a match. This point will be systematically checked during the homologation. Referees will pay special attention to non-fairplay teams that deliberately deactivate their avoidance systems after passing the homologation stage.

Voluntary deactivation of robot avoidance systems may result in complete disqualification of the team !

Robot(s) avoidance systems are optional for Eurobot Open Junior participants.

**Warning:** As most of the events are filmed, please adapt your avoidance systems so that it is not disturbed by autofocus cameras and filming.

Control system  For the main robot, each team must have a control console operated by a single driver.

The control system is the housing used for controlling the electrical devices of the robot. It is connected to the robot only by an electric cable. Any other communication type system between the robot and the outside, is strictly forbidden.

Cables  The electrical cable connecting the robot to its control system is not provided: it must be designed and implemented by each team, according to its needs.

The robot executes a lot of movements on the playground, therefore the cable must have a minimum length of: two meters between the power outlet and the power supply and five meters between the robot and the control box.

The cable must come out from the top of the robot, so that it does not touch the playground area.

It is held in the air by the co-pilot using a pole provided by the organizers.

During the match, the co-driver must not interfere in the control or in the settings of the robot (supply voltage for example). Consequently, the departure of the secondary robot can only be triggered by the pilot.

The cable must not be used to guide the robot, or direct it in case of reversal. Penalties can be give to co-pilotes that use the cable to guide their robot !

The control system for the autonomous secondary robot  Teams can use any kind of control system for the robot (analog, microprocessor-based, microcontroller, embedded computer, programmable logic, etc.).

These systems must be fully integrated into the secondary robot.

The control system must allow the robot(s) to play a match with either one of the colors provided to teams. Ideally, it should be configured shortly before the match with any of the two colours.

F.5. SECURITY CONSTRAINTS

F.5.a. GENERAL ASPECTS

All systems (robots and accessories) must comply with the European standards. This is also mandatory for the countries outside the EU that are organizing national meetings or send independant teams for the European Finals. Among other things, these securty standars must respect safety rules and must not endanger participants, organizers nor public.
Robots must not have protruding or pointed parts that could be dangerous or cause damage.

The use of liquid, corrosive, pyrotechnic and living products is prohibited.

All robots must comply with standard "low voltage" regulations. As a result, the on-board voltages must not exceed 48 V.

Potential differences greater than 48 V may exist, but only within closed commercial devices (e.g., lasers, LCD backlights, etc.) and only if these devices have not been modified and comply with national and European regulations.

In general, any system deemed by the refereeing committee as dangerous will not be homologated, and must be replaced, in order to be accepted in the competition.

F.5.b. LASERS

Are considered valid, only laser systems and classes defined according to the IEC60825 international standards. Teams using lasers must provide the manufacturer’s document mentioning the class of the device (this information is normally always available on the system itself).

On the basis of this classification, class lasers:

- 1 and 1M are accepted without restriction
- 2 are tolerated only in case the laser beam do not exceed the play area
- 2M, 3R, 3B and 4 are strictly forbidden.

WARNING: Disassembling or modifying devices using laser sources often results in a change of class. Laser devices must not be altered and only be used in the state of their commercialization (laser device = source + optics + electronics).

F.5.c. HIGH POWER LIGHT SOURCES

When using a high intensity light source, the light intensity must not be dangerous to the human eye in case of direct contact. Note that some types of LEDs have warnings. Be responsible, as your machines are evolving in front of a general audience!

In the case of slightest doubt, the organization reserves the right to request the manufacturer’s specifications to verify the non-dangerous nature of the lighting system used. If it turns out that the system is potentially dangerous, it may result in revocation of lasers class 2M and more.

F.5.d. COMPRESSED AIR SYSTEMS

Compressed air systems should exceed 4 bar !.
**G. MATCHES**

The matches have a duration of 100 seconds.

Only two people per team are permitted to go backstage and on stage to play the matches.

To ensure that the contest runs smoothly, we ask you to be present on the stand with the robot(s) and ready to go in a match 30 minutes before the start of the series and until that your game is played.

In case of a problem, it is tolerated by the organization to ask for a delay to go to the match but this delay can never exceed the end of the current series. At the end of the series, a package will be applied. In case of abuse, a warning will be applied, and if the problem recurs in a subsequent series, a penalty may be awarded.

In any case, you must be present on your stand when the organization comes to pick you up for a game. In the event of non-compliance with this rule, an official may initially give you a warning, and if the absence is repeated on a subsequent series, a penalty may be awarded.

**G.1. PREPARATION PHASE**

At the start of a match, the elements of the playing area and the playing area itself are installed as indicated in the diagrams in the appendix.

Upon arrival on the playing area, each team has a maximum of three minutes to proceed with the placement of the robots and others equipements.

A robot who is not ready at the end of this period exposes the team to a package for the match.

The other team’s robots will still play their own game on the playing field. The team will have to score points to be declared the winner.

When both teams are in place, the referee asks the participants if they are ready. From this moment, teams are no longer allowed to touch their robots. No dispute can be made on the disposition of the elements of play after the beginning of the match.

**G.2. THE MATCH**

At the signal of the referee, each robot is switched on. In no case may robots, play items and playgrounds be allowed to touch during the match. In case of absolute necessity, the arbitrator may however authorize such action. Any manual intervention on a robot, an element of play or the playing area, without the explicit authorization of the referee, may justify the application of a fixed price for the match.

No elements taken out of the playing area can be handed over before the end of the game and the validation of the scores.

At the end of the match, the robots must stop and turn off all the robot’s actuators. It is permissible to keep any dynamic displays giving the rating of the score on.

At the end of the match, no one except the referee can touch the robots and the game elements unless expressly indicated by the latter. The referees count the points; they give the result of the match, including the points to the teams. If they both agree, they sign the match sheet, they can then take back their robot(s) and join their stand. If the teams do not agree, they refer calmly to the referees. The robots remain in place until the dispute is resolved. Arbitration decisions are final.

In case of difficulty judges, the referees reserve the decision to replay the game or not.

The referees are allowed to pronounce the end of a game in advance, before the end of the regulation time if
both teams agree (if the robots are blocked for example).

A team is considered to be **forfeit** for the match:

- if none of the robots have completely left the starting area during the match,
- if one of the two robots had the emergency stop button pressed during the match,
- following arbitration decisions.

**G.3. COUNTING POINTS**

At the end of the match, the referees count the points of each team according to the following scale.

**G.3.a. ATOMS CLASSIFYING**

- 1 point for each standard atom placed on the periodic table;
- 5 additional points for each standard atom correctly placed on its cell of the periodic table;
- 6 points for atom of "Goldenium" if it's placed in any cell of the periodic table.

**G.3.b. ATOMS WEIGHING**

- The atoms present in the weighing scale bring back:
  - 4 points per atom of "Redium";
  - 8 points per atom of "Greenium";
  - 12 points per atom of "Blueium";
  - 24 points for the "Goldenium".

**G.3.c. PARTICLE ACCELERATOR**

- 10 points for each atom present into the particule accelerator;
- 10 additional points when the detector has been unlocked (the "Goldenium" has been revealed)
- 20 additional points if the atom of "Goldenium" has been extracted from the detector.

**G.3.d. PERFORM AN EXPERIMENT**

- 5 points to has put the experiment on the experiment area before the begining of the match;
- 15 additional points to has activated the experiment during the match;
- 20 additional points if the electron reached the oxygen atom before the end of the match.

**G.3.e. EVALUATE ITS PERFORMANCE (BONUS POINTS)**

The assessment is based on all the previous actions (Atoms classifying, atoms weighing, particle accelerator, perform an experiment).

The estimation bonus is calculated as follows: \( \text{Bonus} = 0.3 \times \text{Score} - \text{Delta} \)

- The score is the one made by the team during the match on standard actions.
- The delta is the difference between the score made by the team during the match and the score estimated by the team. This one is always positive (Absolute value).
- The bonus is an integer value (rounded up).
- The bonus is added to the points of the team.
- A negative bonus is reduced to 0.
- A score of zero cannot give right to any bonus.

Warning! An element controlled by a robot, does not yield points. An object is considered to be controlled by a robot, if by moving the robot along its natural axis of movement it is moved.

G.3.f. **THE PENALTIES**

A penalty is a **loss of 40 points** on the result of the match. Several penalties can be applied.

A negative score will be reduced to 0.

**RECALL:**
The penalties are intended to compensate for damage after a possible incident during the course of the game. A penalty situation is considered as non-respect of the rules of the game, this type of situation must remain exceptional!!! A penalty may result in the team's forfeit. The arbitration committee will also be attentive to the penalties distributed between several levels of meeting (region/national/european).

G.3.g. **BONUS POINTS**

During the final phase, a bonus of 30 points will be given to the team who put the most points in the balance.

10 bonus points are awarded to all teams that are not "forfeit".

G.3.h. **FORFEIT CASES**

The score of a forfeit team is reduced to zero.
H. THE CONTESTS

H.1. GENERAL

The Eurobot\textsuperscript{Open} Junior events can be organized on three levels:

- regionals: when they exists (e.g. in France for Eurobot\textsuperscript{Open} Junior), qualify a number of teams for the national final,
- nationals: it allows to qualify the teams for the European final,
- european: this last stage brings together, in the same friendly spirit, teams from different countries in Europe and elsewhere.

H.2. APPROVAL

H.2.a. STATIC APPROVAL:

Before the start of the matches, the robots are subject to the supervision of an arbitrator who verifies their compliance with the rules. Robots must be able to easily show all their mechanisms.
The ancillary systems (accessories, control panel, etc.) will also be subject to static control (size, mass, presence of mandatory elements, etc.).

H.2.b. DYNAMIC APPROVAL:

The robots must, in 100 seconds, validate at least one action. The robots are put in a game situation but without the presence of the opposing team. Certain specific features provided for in the regulation can also be verified (timer, avoidance of opponents, etc.).

If the assembly consisting of the main robot and the optional secondary robot fulfills these conditions, it is declared homologated. If one of the two robots is not homologated, the other robot can play the match alone.

H.2.c. SIGNIFICANT TECHNICAL MODIFICATION AFTER THE APPROVAL

It is essential to inform the referees of any significant modifications (functionals, structural, dimensionals ...) brought to the robot(s) or any other element after homologation. The referees will then check the modifications made and re-approve the robot if they deem it necessary. In the event of a breach, the team may be declared disqualified from the contest.

H.3. QUALIFICATION PHASES

During the qualification phase, the registered teams will have the possibility to play at least three games (often more, depending on the local organizers).
A ranking is established according to the accumulated points in order to select the qualified teams for the final phase.
The tied teams are tied by comparing their scores without taking into account the bonus points. Organizers may also use additional matches. Pairs of teams competing for the same place will be drawn and the resulting matches will be played by knockout. In case of an odd number of teams, an extra match will be drawn at random and played on the same bases.

H.4. THE FINALS

At the end of the qualifying phase, the 4, 8 or 16 first teams (according to the matches) constitute the table of the matches of the final phase.
The matches of the final phase are with knockout, unless otherwise organized on some meetings. In the event of double forfeit, double defeat or tie, the match is replayed immediately; if this second match is still a case of double forfeit, double defeat or equality, the winner will be determined according to the points acquired at the end of the qualifying phases.

The final will be played in two winning games. Be careful to provide batteries accordingly for autonomous robots.

**H.5. QUALIFICATION FOR THE NATIONAL FINALS**

When there are regional meetings (e.g. Eurobot\textsuperscript{Open} Junior France), the number of teams qualified per regional meeting is proportional to the total number of teams registered at the national level.

The best teams in the ranking established at the end of the qualifying phase of each regional meeting, as well as at least one team chosen by the organizers from the special prizes (e.g. creativity, fair play, presentation, etc.).

**H.6. QUALIFICATION FOR THE EUROPEAN FINAL**

Each country participating in Eurobot\textsuperscript{Open} Junior organizes a national competition to determine the qualified teams for the international contest.

The top teams in the final rounds (and not the qualification rounds) as well as the team who receives a special award will qualify for the European finals. The number of qualified teams per country is proportional to the total of international registered teams.

For questions and comments, feel free to visit the forum on Planete Sciences Forum.

http://www.planete-sciences.org/forums/

News and more information about Eurobot\textsuperscript{Open} et Eurobot\textsuperscript{Open} Junior are available on our website

www.eurobot.org

(It also contains links to your local organizations)

The whole organization team of Eurobot\textsuperscript{Open} and Eurobot\textsuperscript{Open} Junior whishes you a lot of fun and success in
the coming months, and looks forward to seeing you soon around our playing areas!

Robotic Regards,

The Eurobot\textsuperscript{Open} Eurobot\textsuperscript{Open} Junior organization committee.
I. APPENDIX

I.1. GENERAL DRAWINGS

Figure 11 – Top view of the playing area and atoms initial location
All the atoms are made from rubber hockey pucks, more or less hollowed out according to their mass. When they are hollowed out, the hole can be filled with polyurethane foam plate. All the atoms are covered with a coloured vinyl on their plane surface.

The Redium (Figure 12) 60g, the Greenium (Figure 12) 120g, the Blueium (Figure 12) 156g to 170g, and the Goldenium (Figure 13) 312g to 340g.
I.1.b. THE SCALES

Figure 14 – The scales - Global view
Figure 15 – The scales - Detailed view 1
Subpart S3 is a threaded steel rod.

Figure 16 – The scales - Detailed view 2
Figure 17 – The scales - Detailed view 3
I.1.c. THE SLOPS

Figure 18 – The slops - Global view
Figure 19 – The slopes - Detailed view 1
Figure 20 – The slops - Detailed view 2
I.1.d. PARTICLES ACCELERATOR

Figure 21 – Particle accelerator - Global view
Figure 22 – Particle accelerator - Detailed view 1
Figure 23 – Particle accelerator - Detailed view 2
Figure 24 – Particle accelerator - Detailed view 3
The end of pin A11, located outside the field, may be attached to a cord to prevent its fall on the playground.
I.1.e. THE EXPERIMENT

Figure 26 – The experiment area
Figure 27 – The left experiment mast
Figure 28 – The right experiment mast
I.1.f. THE ATOMS DISPENSERS

Figure 29 – The small atoms dispenser

Figure 30 – The large atoms dispenser
## I.2. MATERIAL REFERENCES

<table>
<thead>
<tr>
<th>Elements</th>
<th>Material or reference</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atoms</td>
<td>Vulcanized rubber - Polyurethane foam</td>
<td>Ice hockey puck line with international standards of the IIHF</td>
</tr>
<tr>
<td>Game floor</td>
<td>Printed monomeric gripping vinyl</td>
<td>Ordering information will be provided by Planète Sciences</td>
</tr>
<tr>
<td>Weighing scale</td>
<td>Wood - Steel - Cord - Plexiglas</td>
<td></td>
</tr>
<tr>
<td>Experiment area</td>
<td>Mast: Steel</td>
<td></td>
</tr>
<tr>
<td>Slops</td>
<td>Wood - Plexiglas</td>
<td></td>
</tr>
<tr>
<td>Distributors</td>
<td>Wood - Plexiglas</td>
<td></td>
</tr>
<tr>
<td>Particule accelerator</td>
<td>Wood - Steel - Plexiglas</td>
<td></td>
</tr>
</tbody>
</table>

No objections regarding differences in dimensions will be taken into account.

The material’s density can change from one country to another. It is highly recommended that the team tries different types of wood since the weight may differ significantly.

## I.3. MANUFACTURING TOLERANCES

All dimensions are in millimeters (or mm). Manufacturing tolerances shall comply with the following rules, unless otherwise specified directly on the drawings.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>General Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 20</td>
<td>±1.50</td>
</tr>
<tr>
<td>&gt; 20 and ≥ 70</td>
<td>±2.50</td>
</tr>
<tr>
<td>&gt; 70 and ≥ 150</td>
<td>±4.00</td>
</tr>
<tr>
<td>&gt; 150</td>
<td>±5.00</td>
</tr>
</tbody>
</table>

The atom weights can vary from ±10g.
### I.4. PAINTING REFERENCES

<table>
<thead>
<tr>
<th>Colors</th>
<th>References</th>
<th>CMYK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team A</td>
<td>Traffic yellow</td>
<td>Ral 1023 Mat</td>
</tr>
<tr>
<td>Team B</td>
<td>Signal violet</td>
<td>Ral 4008 Mat</td>
</tr>
<tr>
<td>Borders and non-colored elements</td>
<td>Pebble grey</td>
<td>RAL 7032 Mat</td>
</tr>
<tr>
<td>Redium</td>
<td>Traffic red</td>
<td>Ral 3020 Mat</td>
</tr>
<tr>
<td>Greenium</td>
<td>Yellow green</td>
<td>Ral 6018 Mat</td>
</tr>
<tr>
<td>Blueium</td>
<td>Sky blue</td>
<td>Ral 5015 Mat</td>
</tr>
<tr>
<td>Ramps border of the weighing scale</td>
<td>Jet black</td>
<td>Ral 9005 Mat</td>
</tr>
</tbody>
</table>

RAL hues can vary from a printed soil mat to another.