

## International Team Proposal 2023



Institution: Jesco von Puttkamer School  
High School of International Space Education Institute

Address: Wurzner Str. 4  
04215 Leipzig  
Germany

Registered at District Court: #VR 4401

Date: 08/22/2022

Team: Rovernauts (former Team Germany)

1. Adult educator: Mrs. Yvonne Heckel, [yvonne.h@rovernavts.de](mailto:yvonne.h@rovernavts.de)
2. Advisor: Mr. Ralf Heckel, [ralf.heckel@spaceeducation.de](mailto:ralf.heckel@spaceeducation.de)
3. Student team leader: Cosma Heckel (15), [cosma.h@rovernavts.de](mailto:cosma.h@rovernavts.de)
4. Student team safety officer: Arthur Sommer (17), [rthrsommer@gmail.com](mailto:rthrsommer@gmail.com)
5. CAD/Social Media/Translations: Lennox Jones (17), [Lennox.jones@outlook.de](mailto:Lennox.jones@outlook.de)
6. Backup driver: Firine Bugenhagen (17)
7. Youth council: Teresa Vigil (16), [teresaviperez@gmail.com](mailto:teresaviperez@gmail.com)
8. +
9. +
10. +
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12. +

+ more students will be recruited after the beginning of school in September 2022

## 1. Facilities and Equipment

The Jesco von Puttkamer School is a part on the Campus of the International Spaceeducation Institute (ISEI), for high school students. ISEI is a registered association as charitable free institute to support the study- and occupational orientation in engineer's being and aerospace industries. It was founded as non-prof and non-gov institution by the engagement of prof. Dr. Jesco von Puttkamer, Yvonne and Ralf Heckel in 2005.

The Jesco von Puttkamer School was nominated as carrier of free youth welfare by the city-council of Leipzig on 11/13/2020.

The school is host of a 2000 m<sup>2</sup> campus-area for extracurricular activities in science technology engineering and mathematics (STEM). The complete complex is sustainable and environmentally friendly with solar power (saves 50 tons CO<sub>2</sub>/year). The NASA core values are the house rules. The basic pedagogical rules were laid down by prof. Dr. von Puttkamer.

The campus has:

- A rocket park with: rocket, lander, pool, barbecue grill, tree-house and playground
- A workshop with: machine shop, 3D printers, CAD-places, store and assembly-hall.
- A main building with seminar-rooms, accommodation-rooms, kitchen and laundry.
- A Parking lot
- Our own robotic observatory is outside of town. It has 3 floors and a 400 mm refractor.

A test course with 1000-meter length and skate-park is available for training sessions near the school. The region around the city offers excellent bike-trails, lakes, forests and a clean nature. Not far for daily excursions is a 3000 years old historic sun-observatory, the oldest drawing of the sky (4600 years), brand new BMW- and Porsche plants for e-mobility, the Tesla-battery-plant, the former V2-plant Mittelbau and Peenemuende as historic research place for the 1st liquid series rockets.

The school has still 100 regional partners (godfather companies) as supportive small and middle business companies for the student-projects. Here are turning shops, CNC-shops, laser cutters, coating companies, engineering part dealers, and many more. Students are able to manufacture their ideas here under professional attention or in practical units.

There are collaborations with universities, schools and vocational training centers of the chamber of handcraft. The personnel of the student projects consists of 2 full time employees for the management, 5 halftime employees for the facilities, 5 volunteers for the different educational sections, 3 students in internship, 15 active members and 23.000 supportive members. Local students work on their projects on weekdays in the afternoon. They only need a membership, like in a sports club. National students travel by train or bus from all regions of Germany to the institution on the weekends and on their holidays. International students are invited to regional and international challenges, summer camps, science festivals and excursions. External students get full board and accommodation. According to the concept for sustainable development, the Jesco von Puttkamer school motivates the students through excursions and practice. The parts for the rover are designed in-house, produced outside under supervision and then reassembled and tested on the campus.

## 2. Safety

### 2.1. Safety plans

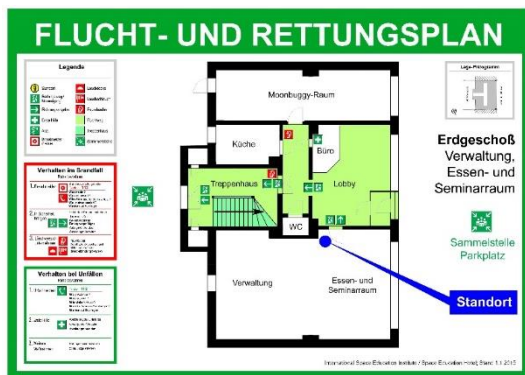
#### 2.1.1. Occupational safety in the workshop

In all areas of the workshop and godfather companies there are boards with the written safety rules and pictograms. The responsibility lies with the teachers and volunteers (age over 18) of the group or the company leaders. On machines there are descriptions and storage for safety goggles, gloves, helmets or safety hats. Students must put on their overalls (space suits) for increased safety.



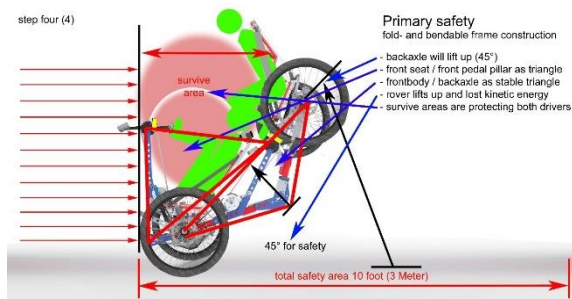
#### 2.1.2. Fire security and evacuation plan

In all areas of the campus there are boards with the evacuation route, fire extinguishers and a meeting point on the parking lot. The Jesco von Puttkamer School makes an annual fire security instruction.



#### 2.1.3. Safety-rules on the rover

Drivers on the rover have to know the traffic-rules for bicycles, use safety goggles, helmets, their training clothing and gloves. Safety belt is required (from car) and no sharp edges on the rover. For training, the rover must have an air-horn, head- and back-lights, as well as brakes in good conditions.



graphic from System Safety Award- application 2018, honored by ISSS-TVC, April 14, 2018

### 2.1.4. COVID-19 hygienic rules

All students and teacher have to be vaccinated and disinfect their hands. For longer meetings and excursions or travels external non-vaccinated people need a fresh negative COVID-19 test result. In closed rooms, we use masks. External people are proved by ID and vaccination certificate.



### 2.1.5. Travel rules

The responsibility lays with the adult educator and his instructions must be followed. Volunteers, chaperons and student leaders act as a team and follow the rules of the travel-guidelines of the Jesco von Puttkamer School, the rules of the host of the competition, regional law and the instructions of the responsible. Students have to follow advice of their team leader, volunteers, chaperons and the travel guide. For long-distance travels, only healthy travelers are allowed, those who have no symptoms of COVID-19 and have a negative test result 48h before travel.

### 2.1.6. Safety officers

The 1<sup>st</sup> student safety officer is Arthur Sommer (17), high school student, basketball player, copilot, Parents are working at the police and government

Cosma Heckel (15) is pilot, attends the Roverchallenge as visitor for many years and has also responsibility for safety.



Arthur Sommer  
→ NASA VIP guest for Artemis 1



Cosma Heckel  
→ Member of the Youth Council of the U.S. General Const.  
→ NASA VIP guest for Artemis 1

## **2.2. Plan for briefing students on hazard recognition and accident avoidance**

### **2.2.1. Written forms and signs**

Every new member must get a safety instruction when he gets the membership. Parents and students have to sign it. Also, before all travels to international challenges a special guideline-agreement with 10 points of rules must be signed. Parents have to sign a power of attorney for the Jesco von Puttkamer School and its representatives. An insurance must be taken out.

### **2.2.2. Verbal safety instructions**

The safety officer or responsible instructs the students every month and before entering a new company or working on a new process. We call it “Arbeitsschutzbelehrung“ (health and safety instruction).

### **2.2.3. Hazard recognition and accident avoidance**

Exuberance, showing off, hyperactivity and nonacceptance of hygienic rules are not part of team behavior. All activities must be carefully considered and done with foresight. Students who do not accept this integrity will be disqualified. All team members have to pay attention to their teammates and must consult the safety officer or the available representatives in case of problems. Before using a rover, it must be double checked by 2 different teams (mechanic-team + driver-team). We are using the Buddy System for Scuba-Diving-rules. For the rules and the checks, the safety officer is responsible. Instability, loose screws, non-working brakes, sharp edges and non-working safety belts are signs for a grounding of the rover.

## **2.3. Methods to include necessary caution statements in plans, procedures, documents, including the use of proper personal protective equipment (PPE)**

- Safety rules on boards with text and pictograms.
- Regular safety instructions include hygienic instructions.
- Annual fire safety instructions.
- Signed instructions of each student will be stored for the duration of the membership.
- All personal protective equipment (ppe) has fixed places with descriptions.
- First aid box has to be always available in a workshop, car or travel-luggage.
- Safety on a rover: “finger off the chain”

### 3. Technical Design

#### 3.1. Basic overview of the rover and its components



CAD-Design by Cosma Heckel for Rovernauts 2023

We will build a completely new rover with outer measures of about 1,5m x 2,5m. With the help of the sketches of successful components used by our previous teams, we are making new and improved components, which follow the current rules. For digital construction, we use the CAD software SolidWorks. Our hardware consists of self-designed and self-made parts, as well as some standard parts used in the industry

Parts that we make ourselves at first need to go through a prototyping phase (with the help of models and 3D-printing). We use these models to discuss the production of these parts with our industrial partners (CNC-turnery, milling, laser-cutting) and then make them during an internship.

The most important changes consist of:

- Weight reduction by means of new seats
- Completely new front suspension
- New gear-concept
- Introduction of a new belt drive
- acoustic and optical aid for the drivers
- new tool for the collection of samples

For the new rover, no components that have been used in previous competitions will be used.

#### 3.2. Wheel design and fabrication plans

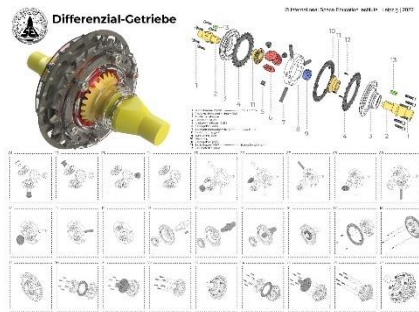
During the pandemic, we have been improving and building the design of our new wheels. The wheels consist of a lasered aluminum cage with hub. Around this cage there are 26 pipe segments made from plastic, which, with the help of a net structure that is reinforced with glass fibre, is protected against dust and sand. The wheel tread consists of rubber, which has been cut with the use water jet, in a pattern designed by us.



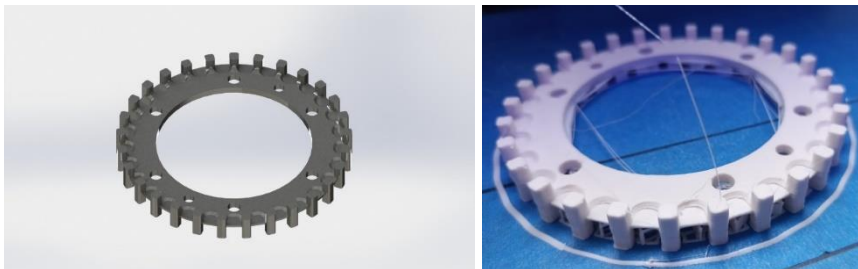
Production of the wheel segments by Cosma and Lennox, Water Jetting of the treads

### 3.3. Drivetrain concept and design with fabrication plans

Due to the new rules of the NASA Rover Challenge, we plan on using belt drives. These consist of toothed belts used in the cycle industry that will be modified by us to serve our needs. For this, a new differential gear must be built. Additionally, we plan on using different gears, yet we haven't met a final decision.



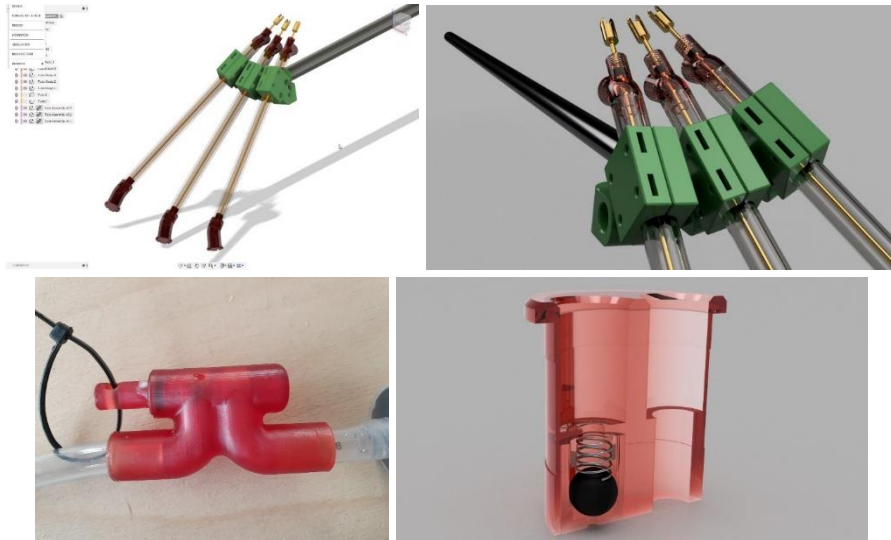
Instructions for the assembly of our self-designed differential gear



Design and prototype (3D-Print) of the strap wheel

### 3.4. Task sites that the team intends to attempt and design of the task tool

The tools for the tasks are extensive and will be designed by our team after the beginning of school in September. There are already early designs from our summer camp. We mainly plan on using vacuum tubes.



### 3.5. Major technical challenges and possible solutions

The biggest challenge will be the changes to the front axle, since it is subject to a lot of force that has to be controlled with a good construction. A good balance between the reduction of weight and stability is key. To have success, we are planning frequent training sessions that include modified parts and newly built components. This way, we hope to find the weaknesses of our constructions and plan to remove them with briefings and new constructions

Another challenge is understanding the task for the collection of liquid ground samples and the realization of this with the right tool. For this, we use the motto:

Learning by doing.



→ Cosma und Arthur mit einem Trainingsrover beim Hindernistraining (Sand), Leander und Cosma beim Tasktraining mit Vakuumkammer.



## 4. Project Plan

### 4.1. development schedule/timeline, deadlines

|              |   |
|--------------|---|
| Aug/Sept 22  | launch of Artemis 1 and VIP-tour at KSC, invitation by NASA-HQ  |
| September 22 | promotion and STEM activities to create the final team          |
| October 22   | Deadline for application of team members when fall break starts |
| December 22  | CAD-design ready, starting hardware, currently working on tools |
| February 23  | Hardware ready, beginning of testing and tuning                 |
| March 23     | Testing and tuning finished                                     |
| April 23     | packing of luggage  |

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### Timetable for Huntsville 2023

|          |  |
|----------|--|
| 04/15/23 | Flight to Huntsville   |
| 04/16/23 | Team begins assembly of rover  |
| 04/17/23 | Tuning, controlling, Team clothings finished   |
| 04/18/23 | Assembly of rover finished   |
| 04/19/23 | Excursion to UAH and partner schools in the name of Youth Council (US generalconsulate of Leipzig/US embassy Berlin) |
| 04/20/23 | Competition Day 1, Registration, assembly of pit box   |
| 04/21/23 | Competition Day 2, Excursion 1 & 2   |
| 04/22/23 | Competition Day—Rain date  |
| 04/23/23 | Packing of luggage, cultural excursion   |
| 04/24/23 | Flight to Germany  |

### 4.2. budget plan

**Material-costs** are at about 15.000 € (ca. \$ 18.000) per rover and year. However, all used materials will be financed by donations, so the material costs are zero.

**Education-costs** for teaching the team are paid by the Jesco von Puttkamer School and its corporate citizenship supporters

#### **US-travel costs are 1.332\$/participant**

|        |  |
|--------|--|
| 850 \$ | Flight                                     |
| 262 \$ | Hotel (2 weeks)                            |
| 150 \$ | Rental car (part per participant, 3 weeks) |
| 20 \$  | Fuel                                       |
| 50 \$  | Fees and entrance                          |

All travel costs will be individually collected by the participants with supportive units from the Jesco von Puttkamer School. Food and beverages have to be paid by the parents of each participant.

### 4.3. funding plan

Our school is teaching us crowdfunding. That is why we are able to collect our travel costs by ourselves and with help of our school as an educational unit. The calculation is easy. Every student has to collect 4×300 \$ from different industrial partners. This budget is a limit for leading employees in companies. Every student asks the boss of the godfather companies for financial support. If a team member has problems to collect the money, other teammates will help or guide them. Every student also gets a travel flat rate from their home school – therefore they have to write a report for the school website.

Additionally, the Space Hotel in Leipzig allows donations to the roverteam from their visitors. More than 5000 guests a year pay total donations add up to quite a considerable amount. With the average guest paying 3 euro per night for education, that adds up to 15.000\$ from donations per year that is available to the roverteam.

## 5. STEM Engagement

### STEM-activity-plan

Our team intends on building a “hall of fame” within the Jesco von Puttkamer school, which will be visible for the guests visiting the campus. The hall of fame will include the 44 Moonbuggys/NASA-Rovers that have been built by our past teams over the past 15 years. Additionally, there will be written explanations and texts talking about the race for the guests to read. We even plan on making a digital touchpad, on which you can scroll through a slideshow that explains the race in detail. Customers would thereby be able to inform themselves on this topic and get a good understanding. Everyday our teammates will present the ideas and answer to questions.

Many of the visitors of our campus are families with children, which would be a good opportunity to get a new generation of young interested engineers. Since we plan on putting up a sign, on which one can see how to be part of our team, the number of participants would surely grow. A weekly list of contacted visitors will be available for the STEM Engagement Report. Our goal is to contact ca 3000 people in person.



## Social media

All students taking part of team need to post on social media about what they did that day. With about six students on average and a summer camp of about 4 weeks that makes for about 148 articles per summer per year. The Rovernauts have their own fan page on Facebook, which gets update daily and reaches a lot of people. Over the summer camp of 2022, the Facebook page had an increase of 500 people that show interest in the subject, some of them even want to join the Rover challenge. It is clearly evident that our team has a growing fanbase that attracts attention towards space exploration and the race.

## Events

- 09/09/2022 Unveiling of a plaque to Jesco von Puttkamer in Huntsville
- 09/22/2022 Event for 89 years Jesco von Puttkamer in Leipzig
- Sept 2022 Presentations in schools about Artemis 1 Launch and NASA Rover Challenge
- Oct 2022 Several official presentations at space conferences
- Nov 2022 “Day of space flight” science conference for Europe in Germany
- Jan-Apr 22 Social network, work with the press, exhibitions



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- 1 Cosma in Berlin, same room where Albert Einstein presented his theory of relativity, July 8<sup>th</sup> 2022
- 2 Team at US-Generalconsulate Leipzig, Independence Day 2022
- 3 Visit of the US Generalconsul on our campus April 22<sup>nd</sup> 2022
- 4 125 years rocketpionier Johannes

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