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Training astronauts for space – under water

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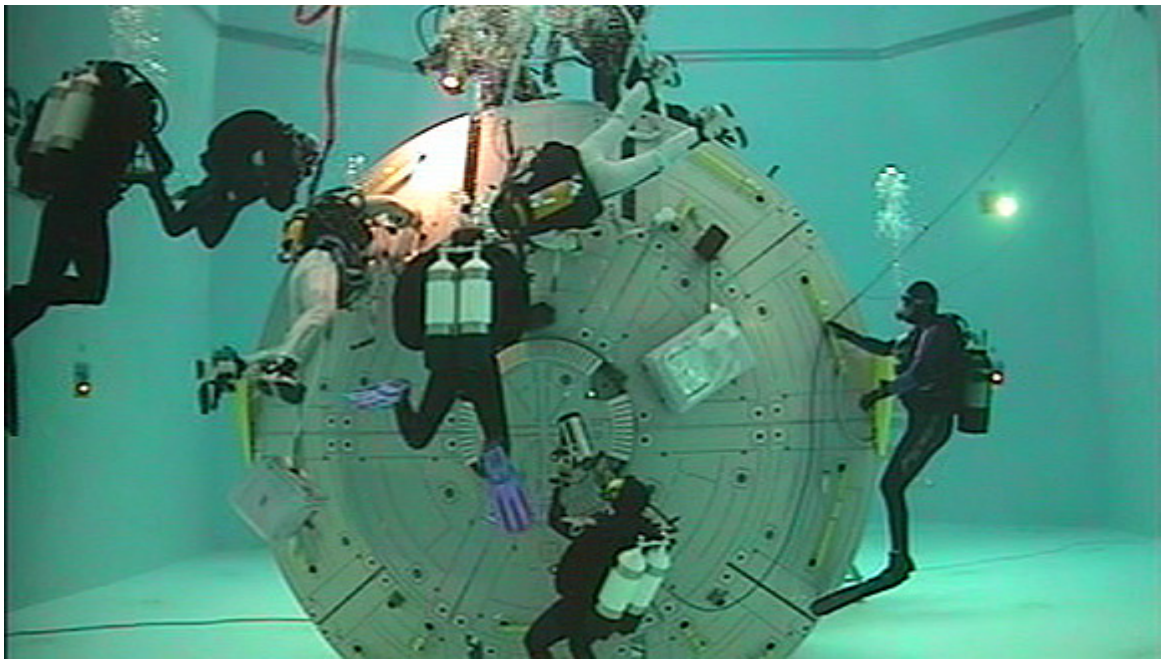
Their hands are inside unwieldy spacesuit gloves, their feet in clunky boots, and the air they breathe comes through a tube. German astronaut candidate Alexander Gerst and his Italian colleague Samantha Cristoforetti are floating in a water tank designed for weightlessness training. The tank is located at the European Astronaut Centre (EAC) of the European Space Agency (ESA), on the grounds of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) in Cologne. What neither of them knows yet is that trainer Hervé Stevenin has prepared a number of surprises for this 'excursion into space'. These include swapped tools and a fainting fit.



For the first time in this training run, Alexander Gerst might have got into a sweat had he not been submerged in water at 26 degrees Celsius in the Neutral Buoyancy Facility (NBF). Things in the toolbox do not look as was planned in the preliminary meeting an hour ago. There is no slot for tool 1C – instead there are other, unfamiliar tools. The little helmet camera transmits every movement of the 34-year-old's head to the screens in the control room. Gerst's gloved hand moves from tool to tool. "Test conductor, the arrangement of the tools doesn't match the plan," he says through the microphone built into his helmet. Trainer Hervé Stevenin smiles. Even during real extra vehicular activity (EVA) – a spacewalk – an astronaut can come across something unexpected.

Alexander Gerst, just before the dive

Assistance finally comes from his colleague Samantha Cristoforetti, "2B is the correct tool." Stevenin gave her this information earlier through a voice loop that only she could hear. The two astronauts need to stay in touch constantly during the EVA. "It is important that they work as a team," says Stevenin. Stevenin himself participated in NASA's underwater EVA training in a spacesuit in 2004. He knows what his students need to be prepared for. In the morning, he dived down to the Columbus module to ensure that problems like this were waiting for Gerst and Cristoforetti. "An EVA is the most complicated thing you can do in space." Prospective astronauts need to be prepared for it. Today, two payloads need to be taken out of the airlock into space and installed on the Columbus module; another payload needs to be detached and taken into the 'space station'.

"It will take forever," said Gerst matter-of-factly to the trainer in the preliminary meeting with a twinkle in his eyes. The astronauts must not work for a single second without being secured to the module or to a colleague; every payload, every tool must be attached to either the module or a person. Anything unsecured will disappear into space, never to be seen again. For Gerst and Cristoforetti, this means unhooking, hooking up and exchanging every tether and safety line on the module again and again during the exercise. Every individual step in the process is carefully worked out in advance and discussed with Hervé Stevenin. Alexander Gerst is the leader on this dive and will set the agenda. "If you see me make a mistake, please tell me, and don't worry – feel free to be persistent!", Gerst tells his colleague with a smile.

Astronaut candidates and their trainer

After more than an hour, the two finally reach the point at which the two payloads need to be attached. The various camera images appear on 11 screens in the control centre. Eight divers busy themselves in the water around the two astronauts, filming the operation and ready for action in the event of an emergency. Time and again Stevenin intervenes with instructions. "Sunrise in one minute, switch on your suit cooling system, lower the sun visor on your helmet, check the tethers and safety lines." So it goes on for the astronauts. During an actual spacewalk, a colleague on the International Space Station (ISS) would maintain contact with astronauts outside the station.

As in space, the two self-built payloads have push-fit clasps and sensitive parts that cannot be touched. Indeed, the practice models are made of thin aluminium sheets. "Later on, one can tell from any deformations whether the astronauts have damaged this area," says Stevenin. Not a problem in training, but in space this could render a valuable payload unusable. Then Cristoforetti has bad news, "The electrical connector is defective." Stevenin nods approvingly. She did not fall for his trick, having checked before installation whether all the connections were working. He pulls the microphone in front of his mouth, "One minute. The control centre specialists are considering what to do with the payload." Shortly afterwards Gerst and Cristoforetti get a message, "The control centre has reached a decision. Dismount the payload again and bring it back to the space station - we can’t use it like this." This means the work carried out with this payload was in vain.

Inside the weightlessness training control room

However, there is no point in a candidate astronaut getting annoyed by something like this. Not just because unexpected situations are a part of any training module – and make it more interesting, according to Gerst – but also because teamwork and good cooperation are important for work later on. As part of their training, the candidates will also undergo a similar course run by NASA, who will decide who will be selected for EVAs. The US space agency’s programme is run according to 15 criteria: besides assessing teamwork and situational awareness, it includes the future astronauts' general attitude and flexibility.

Finally it happens. Stevenin makes a critical announcement that only Samantha Cristoforetti can hear: "You have now fainted, don’t say anything and don't move." On the screen you can see the astronaut floating lifelessly in the water, still tethered to the Columbus module by her safety line. Gerst notices immediately that she is not moving any more and understands what needs to be done now – rescue his unconscious colleague. From Stevenin he hears, "Alex, she only has 20 minutes of air left. Bring her straight to the airlock." After two hours of training in the water, the most stressful 20 minutes of the exercise are beginning now. As quickly as he can, he gets his colleague to the airlock. Everything has to be done smoothly under intense pressure – disentangle safety lines, open hooks, secure the payload, make decisions. Instead of routine work procedures, fast reactions and a cool head are needed. "It lasts three seconds, but you have to adapt yourself to this new situation as well," says Gerst later. And these are the very things that improve the effectiveness of the training. "The trainers put a lot of obstacles in your path, but that's a good thing."

Then they are done. Both astronauts safely reach the airlock. "Good work," says Stevenin over the microphone. Then he presses a button on his laptop. "I gotta feeling" by the Black Eyed Peas is now playing in the water tank: "I gotta feeling, that tonight's gonna be a good night…!" Good mood music for two future astronauts, who have spent the morning crunching orbital mechanics and Russian, so they can spend the afternoon carrying out a simulated trip into space.

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