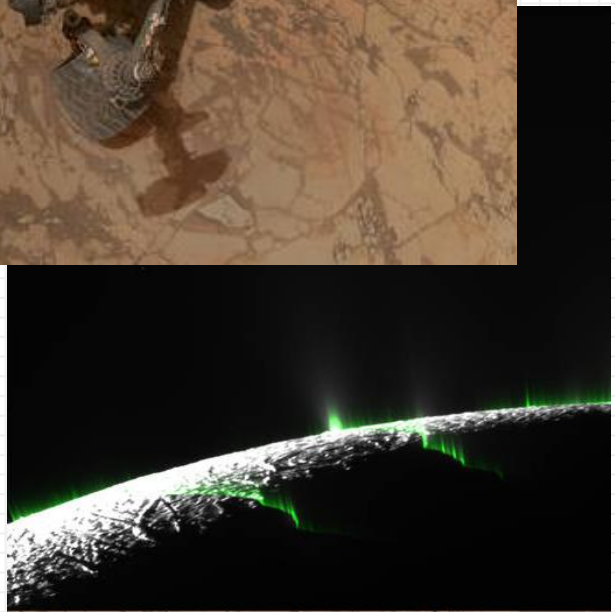
Robots on Ice

“Follow the water!”



Images from NASA.gov

Alien Ocean: NASA's Mission to Europa

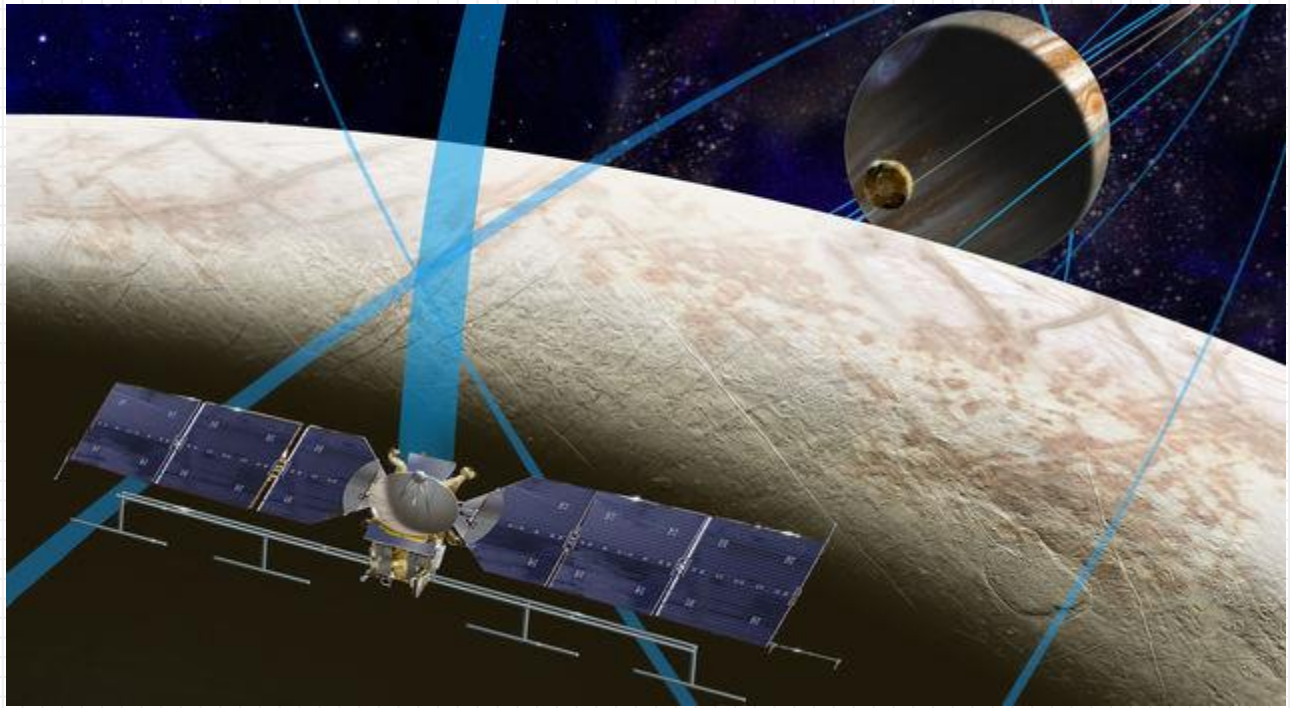
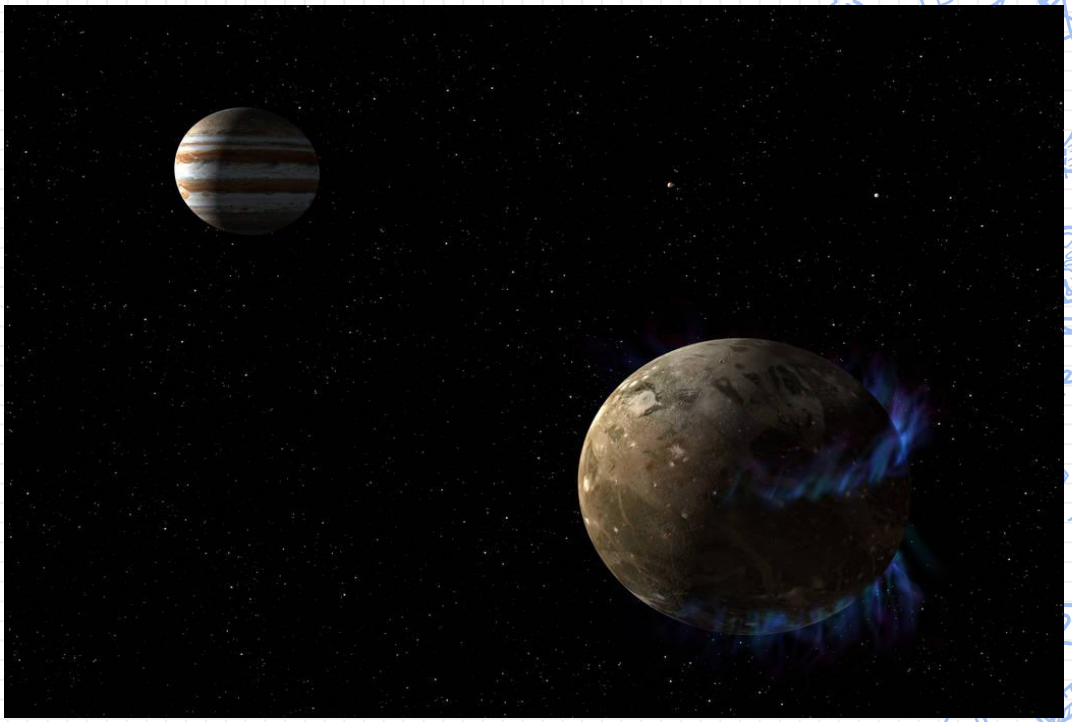


Image from NASA.gov

Watch this video:

http://solarsystem.nasa.gov/europa/alienocean.cfm

What do we know about Europa?



Watch these video clips:

http://solarsystem.nasa.gov/europa/oceanworld.cfm (4:13 minutes)

http://solarsystem.nasa.gov/europa/cooldestination.cfm (3:43 minutes)

Europa 101

- Europa was discovered by Galileo in 1610 and is slightly smaller than the Earth's moon. It is Jupiter's sixth-closest moon and the sixth-largest moon in our solar system.
- It has an icy shell with a liquid ocean beneath it, a rocky interior and an iron-nickel core. It is believed that the ocean is salt water and the atmosphere is oxygen.
- Due to its proximity to the giant planet Jupiter, Europa has very strong tides. It's believed that the tides cause the moon to flex significantly, resulting in heat that causes its ocean to be liquid water instead of frozen water.
- The flexing causes the icy shell to crack, resulting in large fractures across the surface. The fractures might also be caused by volcanic activity.
- The scars across Europa are called chaos terrain because they are random and the lines often crisscross each other. It is the smoothest surface of any solid in the solar system, despite the all of the cracks. It does not have many craters.

Layers of Europa

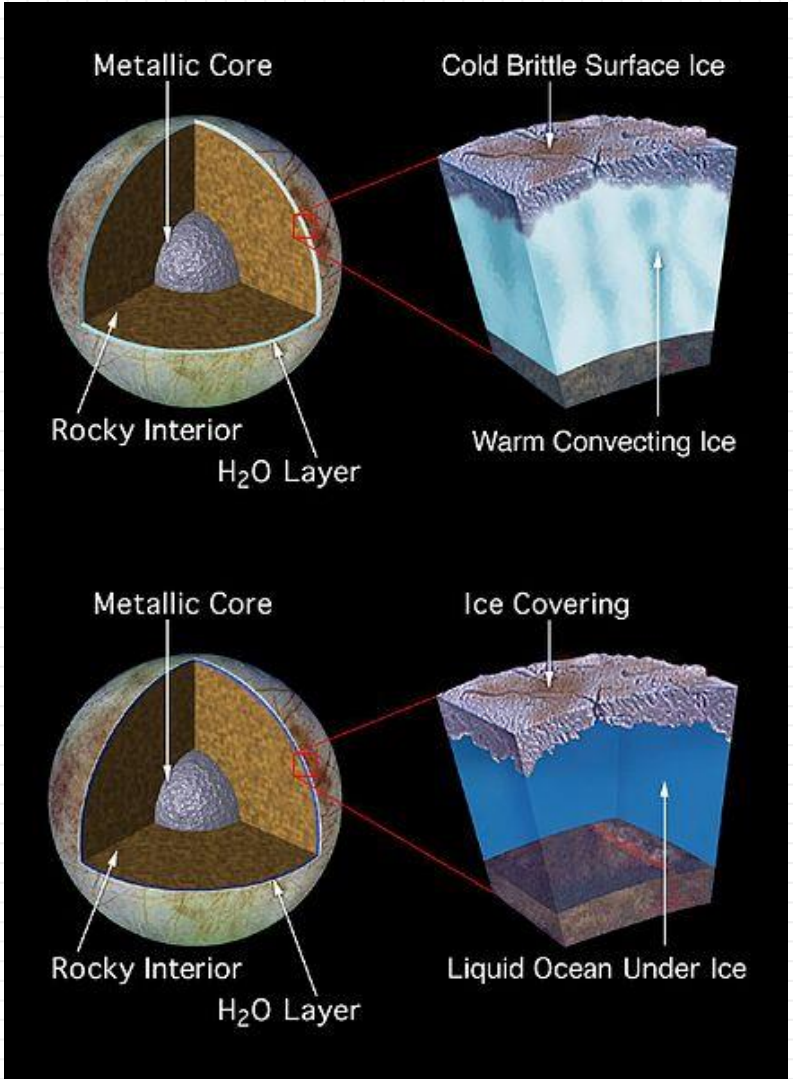
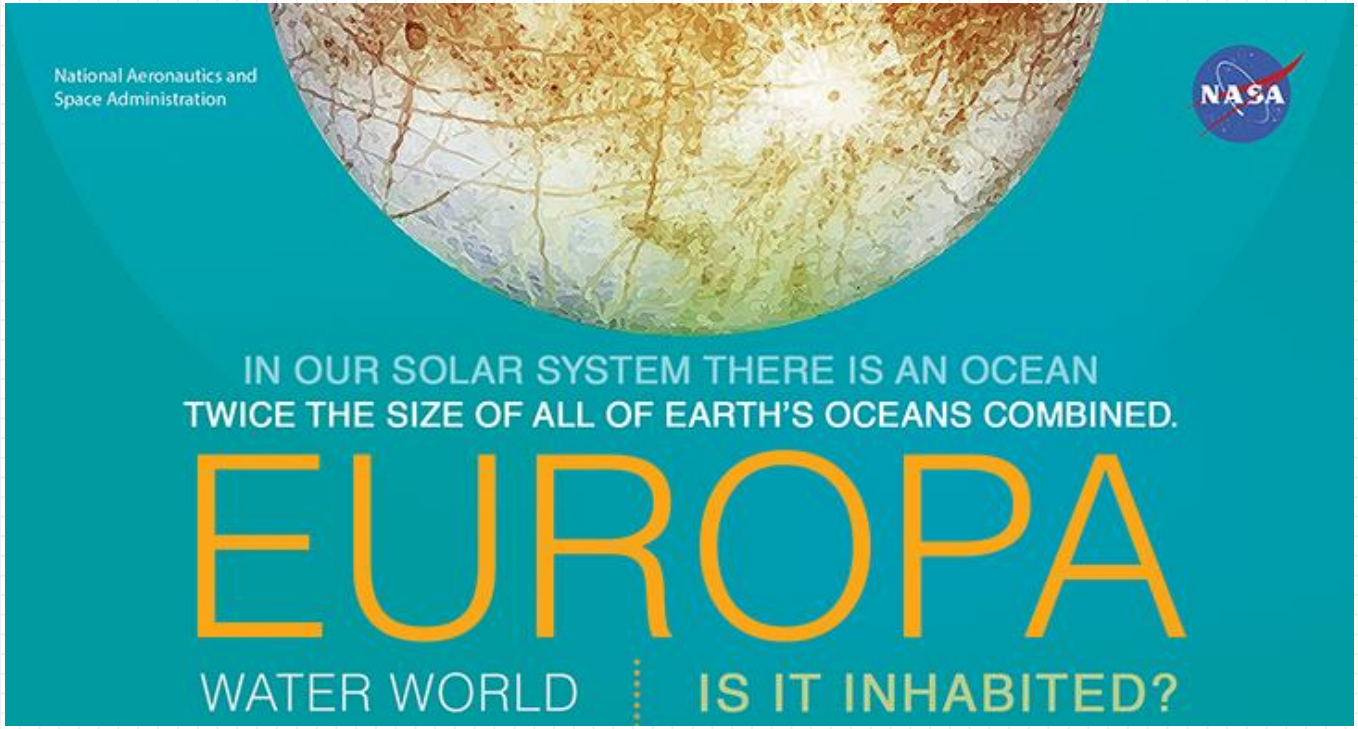


Image from NASA.gov

Comparing Earth and Europa

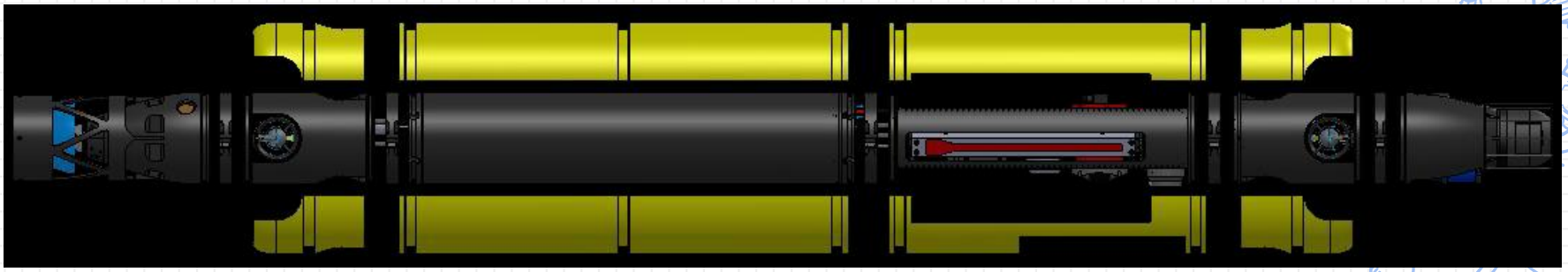


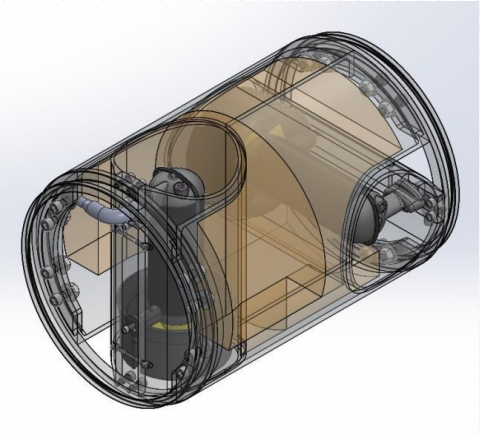
Click on this link to see an infographic comparing the Earth and Europa:
https://solarsystem.nasa.gov/europa/multimediaimagedetails.cfm?Subsite=JM_ID=8421&SiteID=4

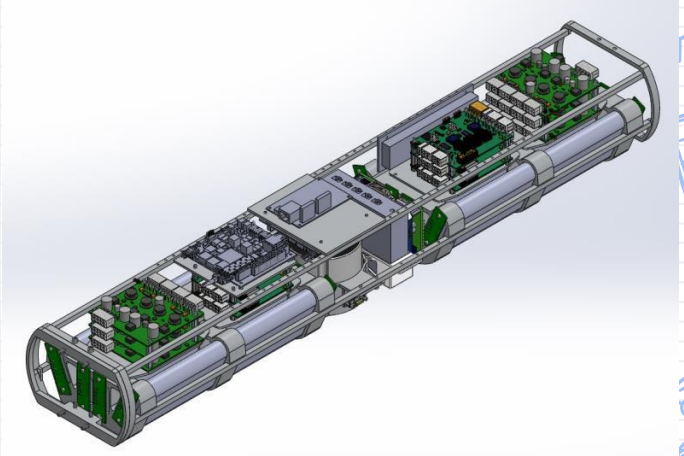
Meet Icefin!

Image courtesy of Georgia Tech Research Institute. Photo credit: Jacob Buffo

Icefin CAD designs

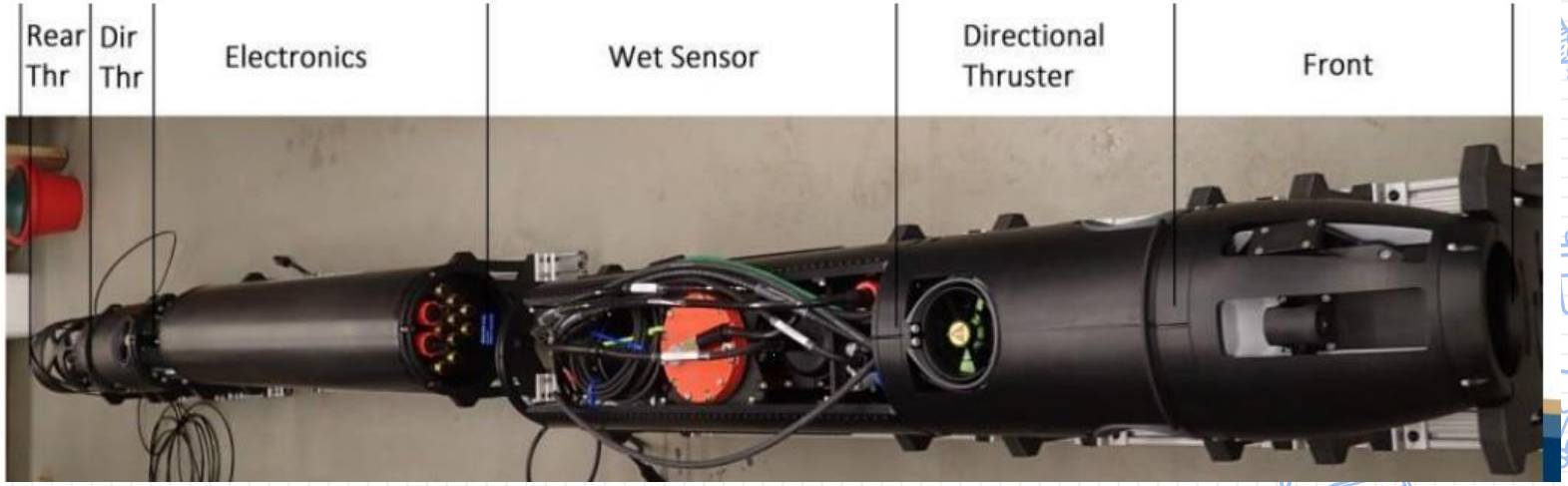






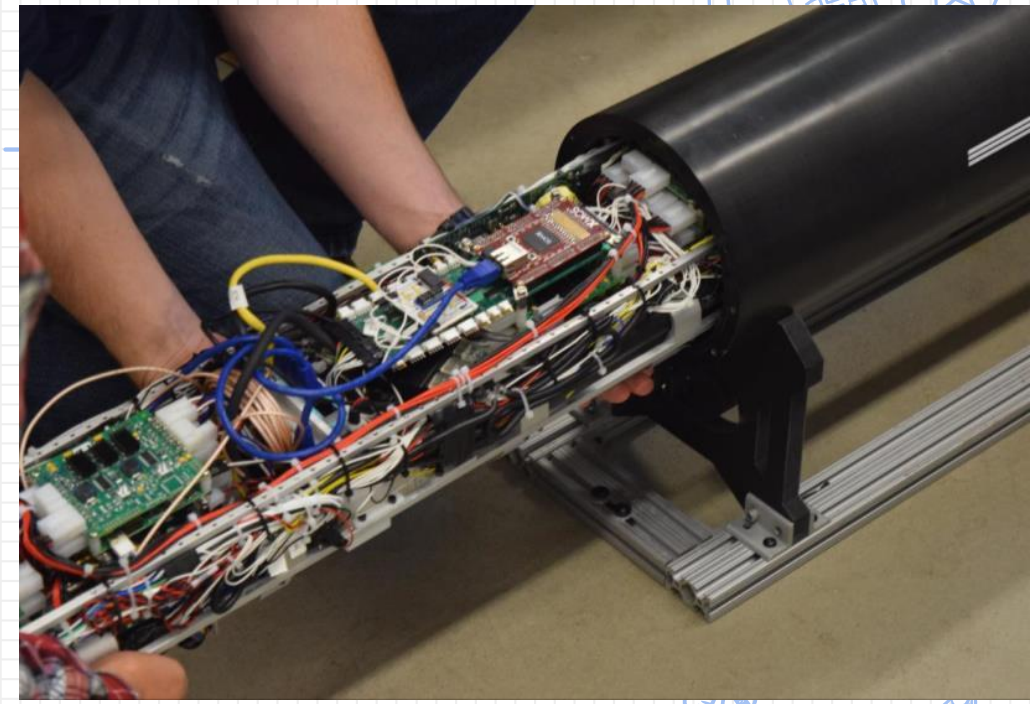
Images courtesy of Georgia Tech Research Institute

The real Icefin!



Images courtesy of Georgia Tech Research Institute

The real Icefin!



Images courtesy of Georgia Tech Research Institute

Icefin Mission Control!

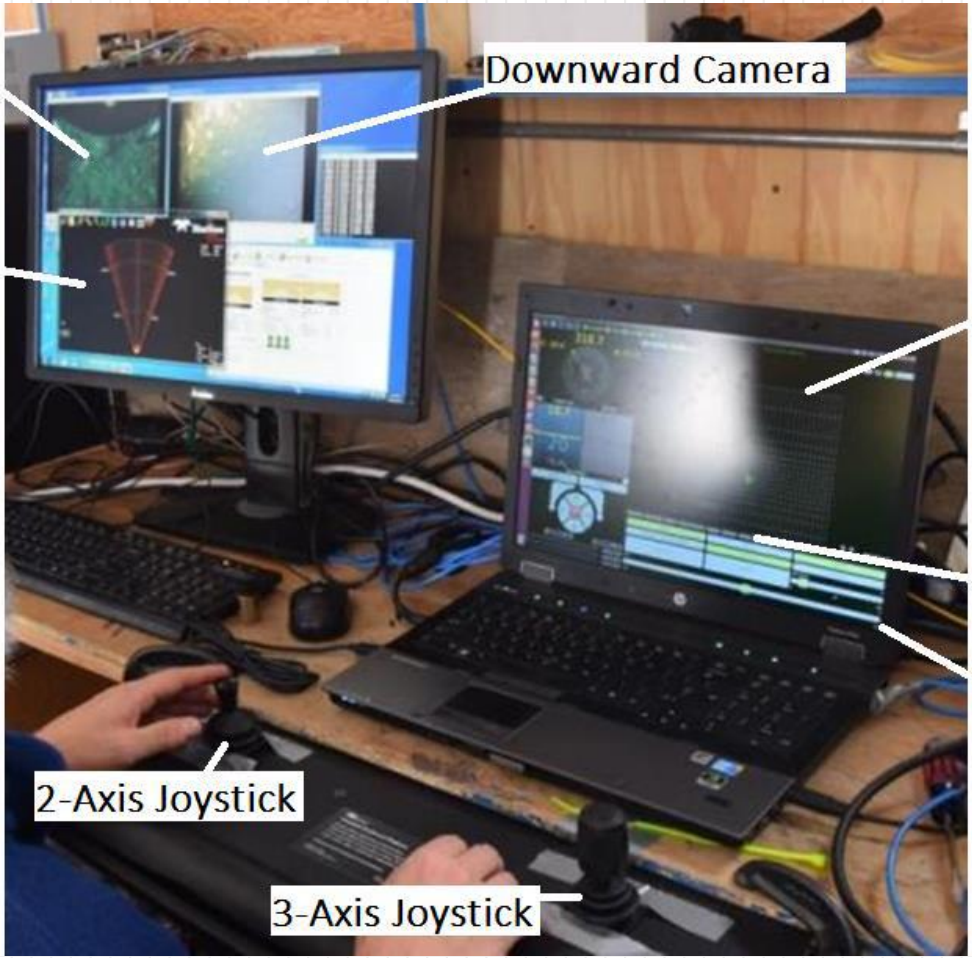


Image courtesy of Georgia Tech Research Institute.

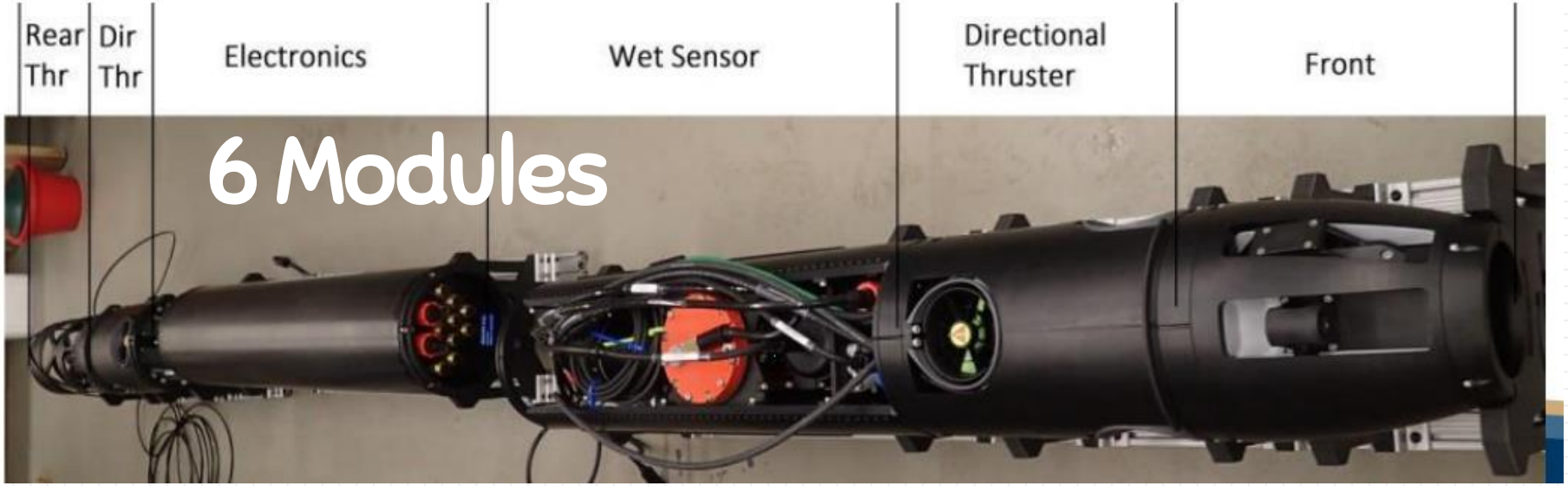
Icefin Stats

- 3 meters long
- Weighs ~230 pounds
- Can travel 2+ meters per second
- 6 modules
- Foam outer casing helps buoyancy
- Fiber optic tether aids in communication relay and deployment/recovery

Icefin takes a test swim in a pool!

Image courtesy of Georgia Tech Research Institute.

As the Icefin swims under water, researchers watch its progress from the surface and steer the robot with two joysticks. They can see live feeds from its cameras and a visual representation of sonar data in real time. Other sensor data is downloaded for later analysis.



Front: sonar sensor, conductivity temperature sensor, camera and a special mechanism to temporarily hold a weight to keep the robot vertical during launch

Thruster modules: allow the robot to move in five different ways

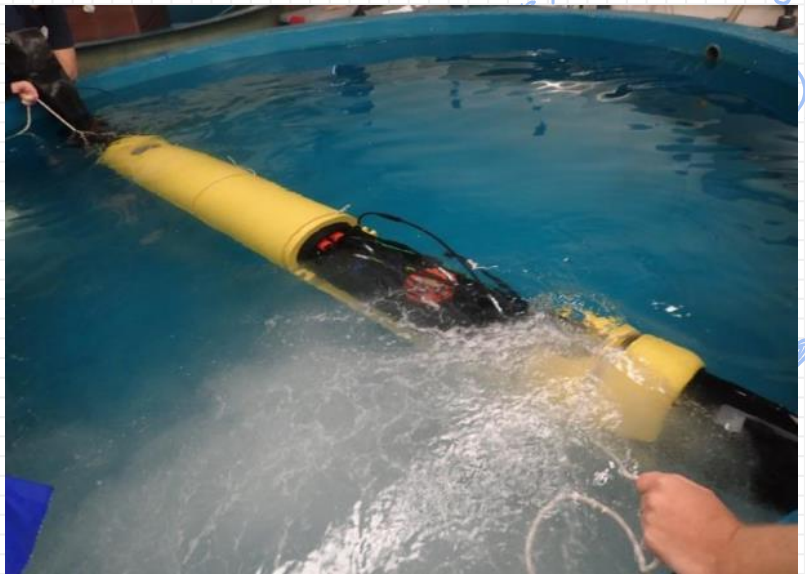
Wet Sensors: cameras, doppler velocity log, current profiler, depth sensor, altimeter and additional sonar

Image courtesy of Georgia Tech Research Institute

Electronics: computer, an ethernet port, 15 batteries, custom-printed circuit board

Why Icefin is boss

- Can operate face up or face down.
- Electronics are designed for cold temperatures, salty water and great depths.
- Modules can be separated so they are easier to transport and deploy.
- Light weight, considering its many capabilities.
- Narrow, so as to fit easily through small ice holes.
- Can deploy it anywhere on a vast ice sheet.



Icefin takes a test swim in a pool!

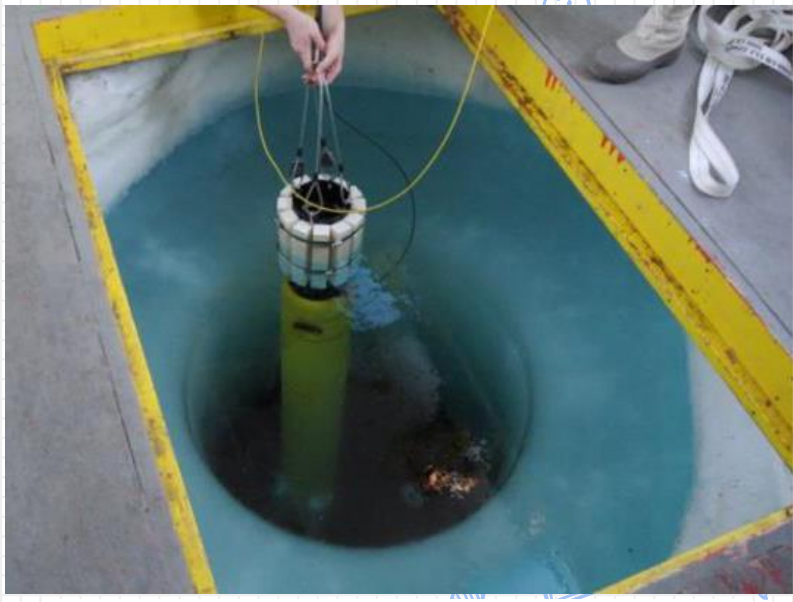
Image courtesy of Georgia Tech Research Institute.

Let it go!

Scary thought:

Imagine you work on a project really, really hard. You spend lots of time and money on it. And then you toss it in the ocean and you don't really know where your project is going. *Ahh!*

This is similar to what happens with Icefin when it is deployed on its missions.



Icefin gets deployed down a hole in an ice sheet.

Image courtesy of Georgia Tech Research Institute.

Let it go!

One major challenge with exploring under ice is that **you cannot see the robot after it is deployed**. While GPS is great on land, the signal is not strong enough to work in water or under thick ice. *So how do engineers know if Icefin is okay, or if it's having a troublefree time in the water?*

In the future, Icefin will use a navigation system called SLAM, which estimates the robot's position based on the seafloor features. SLAM uses lasers, landmarks and odometers to aid the robot in moving around and **making a map of its surroundings while using the map at the same time!** The computation is made using special algorithms, but it is not necessarily very accurate. Icefin is already outfitted for using SLAM, but it has not been tested yet in the field.

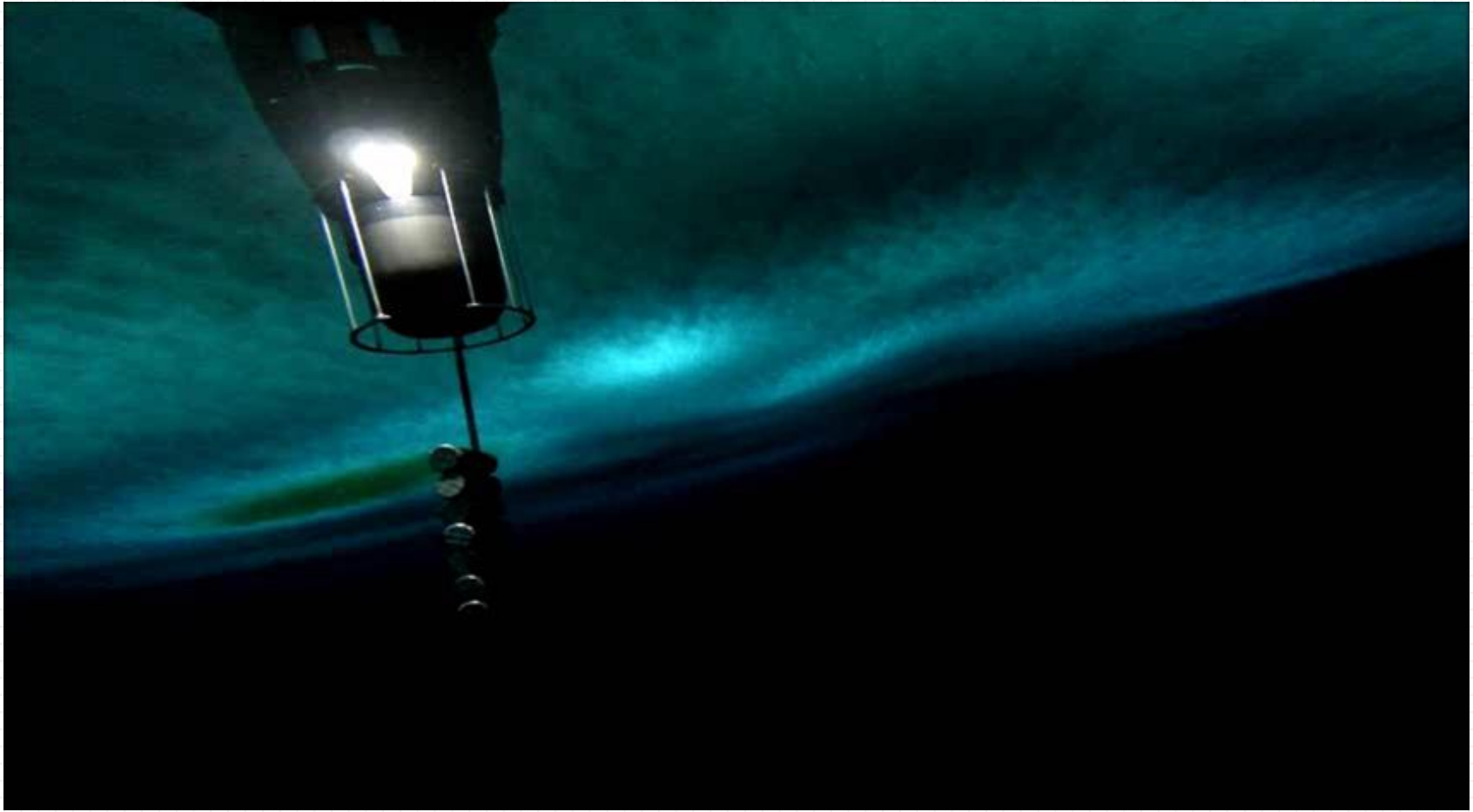
SLAM = simultaneous localization and mapping

As you can imagine, dropping Icefin into the water is slightly nerve wracking, but really rewarding! *To the inventors, it is like a baby bird leaving the nest for the first time.*

Icefin goes on a field trip!

Icefin goes to Antarctica to explore under the ice!

Images courtesy of Georgia Tech Research Institute. Photo credit: Jacob Buffo

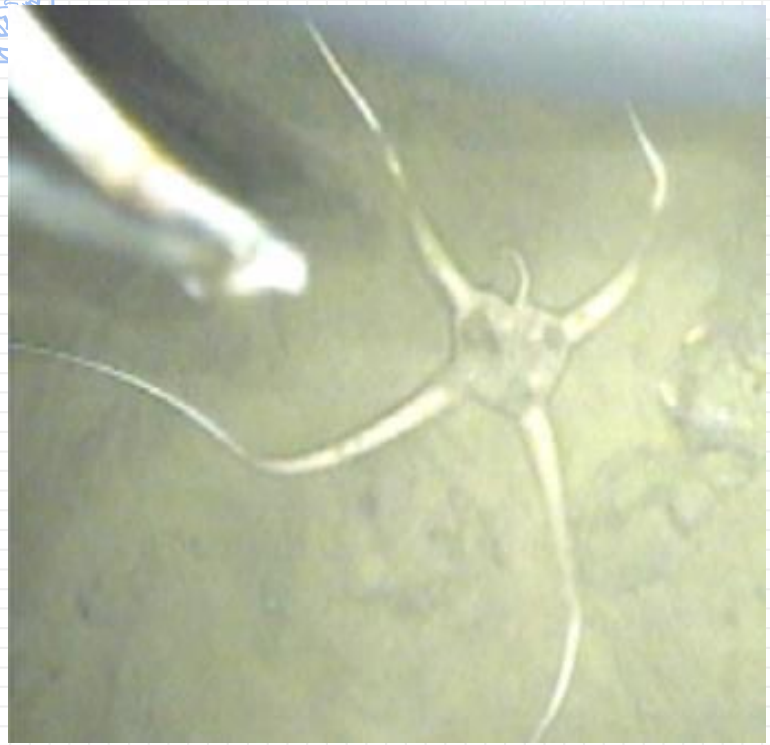


Icefin dropping into the cold water. The ice sheet is above.

Image courtesy of Georgia Tech Research Institute.

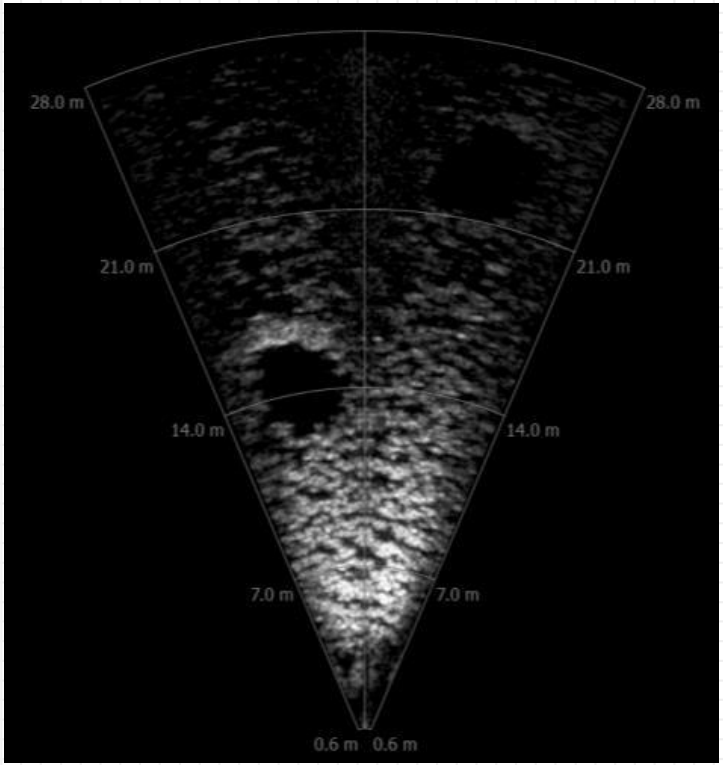
Engineers and scientists monitoring Icefin as it swims.

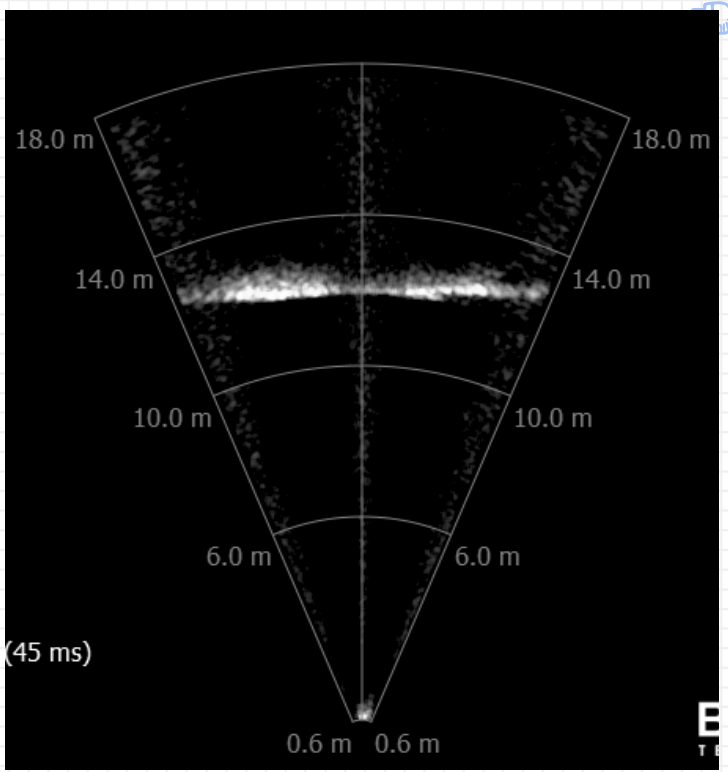
Image courtesy of Georgia Tech Research Institute. Photo credit: Jacob Buffo.



With its cameras, Icefin found life in an extreme environment!

Images courtesy of Georgia Tech Research Institute





Using sonar, Icefin measured the seafloor and the ice above it.

Images courtesy of Georgia Tech Research Institute

Are you ready for Europa???