**1-minute videos script to explain many facets of JUICE**

**Mission overview**

*ESA is going to Jupiter!*

*The Jupiter Icy Moons Explorer, or Juice for short, is humanity’s next ambitious outer Solar System mission.*

*More than a decade in the making, Juice is getting ready for launch this April.*

*Juice will study Jupiter and its three largest ocean moons Ganymede, Callisto and Europa with its ten powerful instruments.*

*Europa and Ganymede have more than eight times the volume of Earth’s oceans between them and we want to know: Could life ever exist in an icy ocean world in such an extreme environment so far from the Sun? What can the Jupiter system tell us about alien solar systems being discovered elsewhere in our Universe?*

*Juice is set to find out.*

*Launching on an Ariane 5 from Europe’s Spaceport Juice will cruise for eight years to Jupiter using Earth and Venus for gravity slingshots. It will carry out 35 flybys of the three large moons while orbiting Jupiter. And, in a space exploration first, it will switch orbits from Jupiter to Ganymede, to complete a close-up analysis of this intriguing planet-sized moon.*

*Stay tuned as we follow ESA’s incredible Juice mission.*

**The trajectory**

*The Jupiter Icy Moons Explorer trajectory is simple.*

*2 launch opportunities in April and August 2023 merge one year later to reach Jupiter after gravity assists with the Earth and Venus. For part of the launch windows, there is even a novel Lunar-Earth gravity assist.*

*The Jupiter tour begins in 2031, including 35 flybys of icy moons Europa, Ganymede and Callisto. After a first orbit around Jupiter of several months long, a series of Ganymede and Callisto flybys lead to two Europa encounters. The spacecraft will then orbit at higher latitudes -via Callisto fly-bys- to explore further Jupiter’s magnetosphere and atmosphere.*

*Later Ganymede and Callisto flybys are used to prepare for an efficient orbit insertion around Ganymede - a space exploration first.*

*During a 9-month phase, JUICE will go closer and closer to the surface of this planet-sized moon, reaching 500 km altitude.*

*The trajectory might not be so simple after all.*

**The spacecraft**

*How do you build a spacecraft to survive and perform great science in the extreme temperature and radiation environment around Jupiter?*

*A huge industrial consortium led by Airbus Defense and Space rose to the challenge and built ESA’s amazing JUICE spacecraft, the Jupiter Icy Moons Explorer.*

*JUICE is big and heavy, weighing around 6 tons. All the manoeuvers needed to fly JUICE in the right direction requires about 3 tons of propellant, half of its mass.*

*With solar arrays deployed it is 27 metres long; its longest instrument boom is 10 metres long and its biggest antenna 2.5 metres across to relay precious data to Earth.*

*Its distinctive cross-shaped solar arrays of 85 square metres are needed to provide power far from the Sun.*

*JUICE must survive in both a hot environment during its flyby at Venus, and in a cold one at Jupiter. The radiation environment around Jupiter is another headache for engineers, necessitating to shield properly all its equipment.*

*With ten instruments JUICE is ready to perform new and exciting science!*

**The payload**

*ESA’s JUICE mission, the Jupiter Icy Moons Explorer, has a powerful set of instruments. They will work together to unlock the biggest secrets of Jupiter and its ocean moons Europa, Callisto and Ganymede.*

*The eyes of JUICE include a camera, a visible-infrared imaging spectrometer, an ultraviolet spectrograph and a sub-millimeter wave instrument to image Jupiter’s atmosphere and the surfaces of the icy moons.*

*The ears of JUICE are a laser altimeter, an ice penetrating radar and a radio science experiment to probe the interiors of the moons. Telescopes on Earth will also listen to Juice from afar to determine its exact position and then the positions of Jupiter’s moons.*

*Juice’s nose and mouth is made up of particle, plasma, radio, magnetic and radiation monitors to sniff out and taste the environment immediately around the spacecraft.*

*Together they will build up an unprecedented profile of Jupiter and its ocean-moons in greater detail than ever before possible.*

**JUICE observations**

*ESA is going to Jupiter with JUICE, its Jupiter Icy Moons Explorer.*

*It will arrive at Jupiter in 2031 but we’re already planning the observation sequences now.*

*This is mainly dependent on the trajectory that the spacecraft will fly, starting with six months of observations while approaching Jupiter.*

*Once in Jupiter orbit, the focus will be on the icy moons Europa, Ganymede and Callisto during flybys, on the magnetosphere and on Jupiter when Juice gets close to the giant planet. There will also be the chance to observe volcanic moon Io, Jupiter’s smaller moons, and its dust rings.*

*Finally, Juice will orbit Ganymede, where the planning of the observations will be adjusted to fully map the moon.*

*For each opportunity, the sequence of observations depends on the scientific objective, where to point the instruments, the available power, and the volume of data that we want to allocate.*

*All this planning is done by the JUICE science operations team at ESA’s European Space Astronomy Centre close to Madrid, Spain.*

*Exciting science ahead!*

**The teams**

*ESA is going to Jupiter with the Jupiter Icy Moons Explorer. It’s been a decades-long road with thousands of people making this dream come alive.*

*Our story started before the change of the millennium with an idea, which was then supported by a formal proposal to ESA in 2007. Europe’s diverse hivemind of scientists, engineers and mission analysts came up with a plan, and in 2012, ESA selected the mission.*

*The next ten years needed more than 1000 people to build this incredible machine. Experts from a large industrial team led by Airbus Defence and Space, ESA and our international partners NASA, JAXA and ISA, the science teams for each of the 11 instruments and ArianeEspace have worked hard together to be ready for launch this April.*

*Our expert flight team are poised to fly Juice on its long and challenging journey to Jupiter, arriving in 2031. And the mission’s scientific treasures will be enjoyed for decades beyond.*

*It’s certainly not a sprint, but in the end, JUICE is thousands of people who pass the baton in a 30-year relay. A wonderful human adventure.*

**Challenges**

*ESA is going to Jupiter with JUICE, its Jupiter Icy Moons Explorer. And this, presents a lot of technical challenges.*

*We needed to build a spacecraft that can survive in both cold and hot environments. Cold at Jupiter, hot during the Venus flyby. About 500 thermal blankets will help keep the internal temperatures stable.*

*Jupiter is far from the Sun so the spacecraft has to operate with limited power - around 900 Watts. Therefore, it needs vast solar panels to collect as much sunlight as possible.*

*Being hundreds of millions of kilometres away, it requires a navigation system which is autonomous, allowing 4 gravity assists during the 8 years cruise, two orbit insertions at Jupiter and Ganymede, and one Jupiter moon flyby nearly every month.*

*In addition, a large 2.4 metre-wide antenna will enable sending back to Earth 2 Gigabytes of data per day.*

*Last but not least, the spacecraft’s sensitive instruments and electronic units shall also be protected from the extreme radiation environment around Jupiter and be overall electromagnetically clean, to allow very precise measurements around the icy moons.*

*But our spacecraft is ready to face these challenges!*

**Moons’ science 1**

*Are there oceans under the icy shells of Jupiter’s moons?*

*ESA’s JUICE mission, the Jupiter Icy Moons Explorer, is set to find out just how thick the ice is, how deep their oceans, and what their composition is to learn if life-friendly conditions ever have arisen there.*

*While exploring and comparing these three icy worlds, JUICE will pay special attention to Ganymede, the largest moon in the Solar System and the only moon to have an intrinsic magnetic field.*

*JUICE will study its orbit, gravity, surface, shape, interior, and its magnetic field to uncover the secrets of this mysterious moon. It will also explore Ganymede’s connection with Jupiter’s magnetic field, and the gravitational interplay with Jupiter and the other large moons.*

*In understanding more about the Jupiter system as a mini solar system, we will better understand other planetary systems in the Universe.*

**Moons’ science 2**

*Ocean worlds with different characteristics? Jupiter’s moons are also very different from each other! A big focus of ESA’s JUICE mission is digging deeper into understanding the geology and surface composition of the three large icy moons: Europa, Ganymede, and Callisto.*

*Europa is geologically active and its smooth surface is very young, as it is actively resurfaced from a subsurface ocean.*

*Callisto’s surface is very rich in impact craters and therefore very ancient.*

*Ganymede is in the middle, with old geological regions alternating with much younger ones.*

*JUICE will study these moons in greater detail than ever before, to understand their different evolutions.*

*It will shed new light on what are they made of, what are the connections between the moon’s interior, subsurface, surface, tenuous atmospheres and space environment, and ultimately whether these worlds could ever have been habitable.*

**Jupiter-Moons Interactions**

*The ESA JUICE mission is going to be the first spacecraft to orbit an icy moon. The moon that JUICE will focus on is the largest of the four Galilean moons – known as Ganymede.*

*Two important interactions are taking place in the Jupiter system – one relates to gravity and one relates to electromagnetism.*

*Io, Europa, and Ganymede orbit around the giant planet Jupiter in a coordinated dance – or a resonance pattern. For each orbit that Ganymede completes around Jupiter, Europa completes exactly two, and Io completes exactly one. This pattern means that these moons often line up with each other and the extra gravitational pull keeps their orbits in an elliptical shape rather than a perfect circle. Now the gravitational tug on Ganymede from Jupiter changes throughout each orbit as the moon is sometimes closer to Jupiter, sometimes further away. This squeezes and releases the moon’s surface creating a “solid tide” (like our ocean’s tides) of up to 10m. This movement of the surface produces heat inside the moon that allows liquid water to be present underneath the ice crust.*

*Electromagnetic interactions are key to being able to measure the presence of an ocean. Jupiter has the strongest magnetic field of all the planets, which is tilted from the rotation axis. This creates a wobbling magnetic field at Ganymede’s orbit, while the underground ocean acts as a large conductor. A famous law in physics named after Michael Faraday helps us to understand that this interaction will produce an extra magnetic field that JUICE will measure! Data from the JUICE instruments will help us to work out deep the ocean is and how thick the ice crust must be, based on the changes we can measure in the magnetic field.*

*These two key interactions in turn create the ocean we think is present and allows us to work out its key properties!*

**Space environment**

*ESA’s Jupiter Icy Moons Explorer, JUICE, will take Jupiter exploration to the next level.*

*To understand the conditions that may make Jupiter’s icy ocean-moons habitable, we need to know the particles and fields radiation environment of the giant planet.*

*And it’s a harsh place to live.*

*JUICE will study the acceleration of particles by Jupiter’s fast-rotating magnetic field and their impact on the moons’ surface, the reaction of Jupiter’s magnetosphere to the solar wind, and auroras on both Jupiter and Ganymede.*

*JUICE will be the first spacecraft in orbit around a moon of a giant planet. This allows us for the first time to study in detail the interaction of the radiation environment of Jupiter with Ganymede.*

*JUICE enables us to study Ganymede, the only moon with its own magnetic field and located in the gigantic magnetosphere of Jupiter. The study will shed new light on the moons’ interior, ocean and icy crust and maybe leads us to discover active regions on the moon.*

*JUICE will arrive in the Jovian system nearly at the same time as the Europa Clipper mission of NASA. Therefore, we will have the opportunity for the first time to have two spacecraft near Jupiter and the Galilean moons which will be get us unprecedented new Jupiter science.*

**Jupiter’s Atmosphere**

*Jupiter is our closest and best example of a gas giant world, an enormous planet of hydrogen and helium that is 11 times wider than Earth.*

*From our Earthly vantage point some 800 million kilometres away, Jupiter’s swirling storms, colourful stripes, and ever-changing weather patterns have captivated our imagination for centuries.*

*But what makes its climate so different, so exotic and extreme, compared to our own, and could we someday forecast the weather on this distant world?*

*Now, JUICE is about to embark on the most comprehensive characterisation of a giant planet’s atmosphere to date. With a sophisticated suite of cameras and spectrometers that span the electromagnetic spectrum, JUICE will reveal the dynamics, meteorology, and climate of this bottomless atmosphere; probing regions high above the clouds that no spacecraft has accessed before.*

*It will explore how energy flows through the different atmospheric layers, from the powerful storms and wind that sculpt the colourful clouds; to the dancing auroral lightshows hundreds of kilometres above.*

*As the first European mission to orbit Jupiter, JUICE will build on the legacy of the Galileo and Juno missions, revealing new insights into processes shaping the Jovian environment, and providing the archetype for gas giant worlds both in our solar system, and beyond.*