

# ThumbScience

Contributors:  
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## ThumbSat – the little satellite that could

You can do some great science with a tiny satellite, especially one that has:

- A high definition camera
- A variety of lenses to turn it into a microscope or a telescope, in different wavelengths, and
- A very capable on-board computer with practically every interface known to mankind, so that you can hook up whatever fancy sensors you need to use!

## Into orbit

Apart from providing a great view, Earth orbit is a fantastic place to do science, because it offers:

- Weightlessness, or what rocket scientists call “microgravity”
- Vacuum
- Radiation – ultraviolet, X-ray and ionising
- A platform to look towards space without the effects of the atmosphere
- A unique vantage point on Earth

On Earth, gravity can hide what is really going on in a process. If you remove gravity, temperature differences in a fluid do not produce convection, buoyancy or sedimentation. Vacuum is useful for making very pure materials. Radiation can have all sorts of interesting effects on materials, and who can doubt that orbit gives us an amazing ability to look at space and the Earth in different ways?

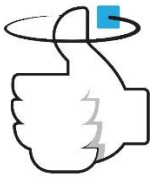
We’re even working on ways to return samples from space, so that space-flown items can be used and analysed on Earth.

## Materials science

- The thermo-physical properties of materials (e.g. metals, foams, emulsions, high-quality crystals and high-performance alloys) can be measured more accurately in space.
- On Earth, melting and solidification are strongly influenced by gravity-driven processes. The opportunity to investigate these processes under microgravity can help us to understand them better, to improve product quality or leading to the introduction of new products.
- Perhaps your experiment will be part of the road towards nanotechnology?

## Biology

- Some cells and unicellular organisms function differently in condition of weightlessness than they do on Earth. Free from gravity, life scientists and



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biomedical researchers can study fundamental life processes down to the cellular level.

- Cells grown in space can produce longer-lived cultures to help us understand the growth of tumours and perhaps give insight into how we might control this growth process.
- You can grow bigger and better and near-perfect protein crystals. Crystals grown in space are larger and more neatly ordered, so they are easier to analyse to help us to understand how they work, leading to better and more targeted drugs in the future.
- How do other organisms behave in space? - Sea monkey eggs, a dinosaur plant, algae? [1]
- We know that Salmonella bacteria get more virulent in space, perhaps because they are tricked into behaving as if they're inside the human gut. Understanding the behaviour of Salmonella or MRSA bacteria or other nasty things can help to develop further vaccines.
- The absence of gravity effects provides new ways of isolating the various mechanisms inherent in the evolution of tissue structure. This can help us to create improved artificial organs and bioreactors on Earth.

## Astronomy

- You're a scientist. You don't need us to tell you the benefits of being in space to do astronomy, do you?

## Earth Observation Science

- NASA and NOAA spend a lot of money on this. We bet you can do plenty with a lot less money and a ThumbSat or two to play with.

## Radio science

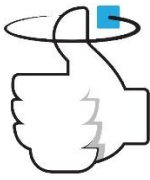
- If you're a radio HAM you've probably got a lot more ideas than we have about the great radio science you can do in, and from space.

## Nobel Prize-winning science

- How could you use a constellation of ThumbSats to discover gravitational waves?
- How about dark matter?
- Something else we haven't even thought of yet? We're only rocket scientists!

## Helping towards a Star Trek future

- Synthetic aperture experiments for astronomy? If we can carefully synchronize images... [2]



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- New space components can be tested and developed more cheaply than it costs to simulate space on Earth!
- Development of fault-tolerant high speed computers [2]
- We don't really know how drag works in Low Earth Orbit. How do we find out using ThumbSats?
- Can we generate electricity in space using space tethers? [2]
- Experiments with laser communication.
- We need to use deployable structures and materials if we want to assemble large starships in Earth orbit. ThumbSats are the perfect small-scale test beds for these future giants.
- How does expanding insulation react in space? Could it be used to line a Mylar balloon and build outposts? Could it provide radiation shielding? [1]
- Can we gather data to improve models of space radiation versus solar cycles etc? How does this help us to work out ways to protect astronauts who are travelling back to the Moon and on to Mars and beyond?

## Other stuff

- Can the properties of space be used to generate true random numbers for data encryption? [3]
- Can we solve the problem of space junk?
  - Using miniature radar to determine how many small pieces, that can't be detected by Earthbound radar, are floating around near ThumbSat orbits.
  - Testing out the Space Surveillance Network and Space Fence.
  - Methods to rendezvous with and add aerodynamic decelerators to dead satellites and other junk.

## It's not just geeky

- Can art be combined with science for the benefit of the Earth? How?

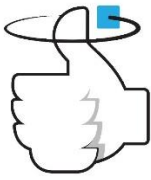
## Be bold

If space scares you a little, be assured that we cross-check everything that you do, and provide you with everything but the experiment<sup>1</sup> - including the launch, data retrieval and all of the paperwork.

And there's more... For just a small cost, we can provide potential Experiment.com experimenters with a small breadboard that is almost identical to a ThumbSat. You can use that to experiment with, to build confidence in your experiment. As well as that, we will periodically run a competition where the best breadboard experiments

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<sup>1</sup> Well... we can provide the experiment too, of course.



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are flown to space on a ThumbSat for **free**. And even if you don't win a free ride, Experiment.com users will get a preferential rate for a ThumbSat flight.