International Space Experimental Program
from Kibo for General Participation

SSAF2013

Space Seeds for Asian Future 2013

Let's approach the mystery of zero gra with an astronaut!

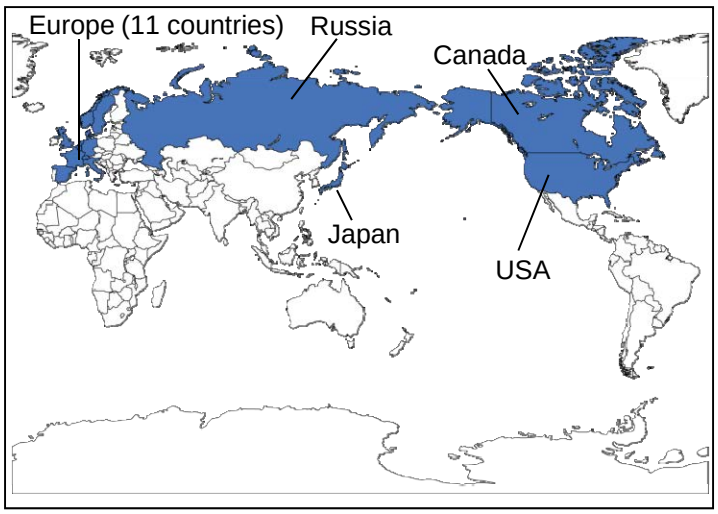
宇宙航空研究開発機構

Japan Aerospace Exploration Agency

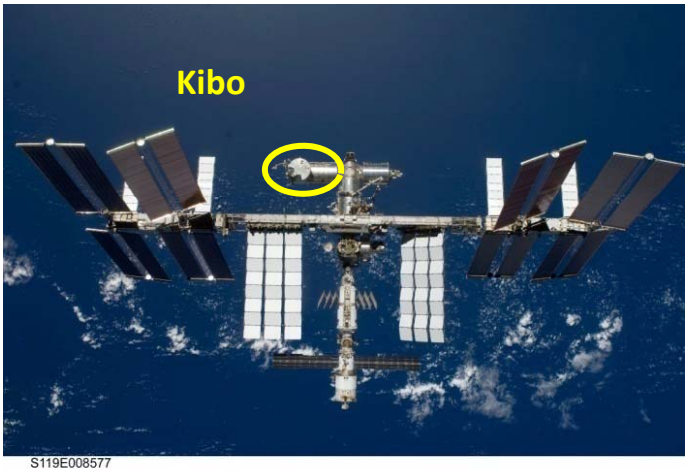
What is the “International Space Station”?

The International Space Station is a facility where astronauts live in for long periods of time and perform various space experiments.

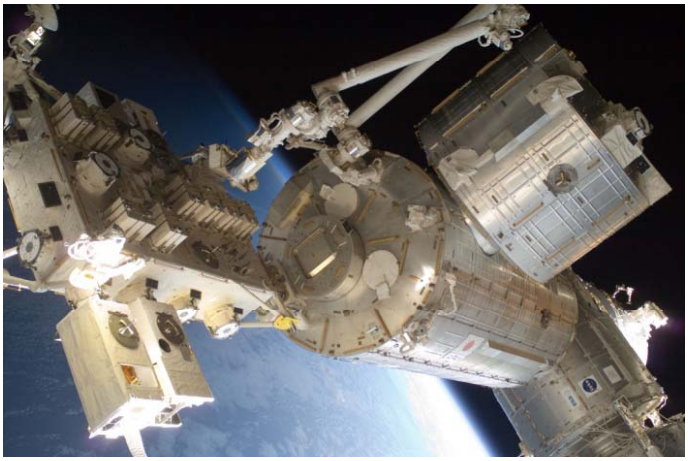
Currently, 15 countries participate in this program.



ISS partner nations



International Space Station



Japanese Experiment Module “Kibo”

What is “Kibo”?

"Kibo" is an experimental facility of the International Space Station built by Japan. Since summer of 2008, "Kibo" has been widely used for conducting experiments to investigate the effect of gravity by using plants and Rice-fish, medical experiments, scientific experiments such as study of materials, and for the development of technologies toward future activities in space.

Why are plant experiments performed in space?

There are two major objectives.

The first objective is to investigate the response of plants against gravity.

Present day plants that live on land used to live under water a long time ago. When plants evolved to the land, they developed a mechanism to respond to gravity through the process of evolution. What type of response do plants exhibit when the strength of gravity is diminished? On the other hand, we can investigate a plant's response toward gravity by studying the type of changes that occur when gravity is increased.

The second objective is to confirm if plants can grow in space the same way that they grow on earth.

If we are able to grow plants in space, the astronauts will be able to eat fresh vegetables during any time. Also, plants not only serve as food source but they can convert carbon dioxide produced by human beings into oxygen through photosynthesis. In addition, plants have an effect that relaxes people. We perform experiments using different plants in order to achieve a comfortable living in space.

The International Space Station is useful to conduct such experiments.

Plant experiments performed in “Kibo" to date

Subject: Life cycle

Plant: Thale cress (Arabidopsis thaliana)

(related to Sheperd's purse)

The process starting from seed germination, to flowering, to seed production is called life cycle. We performed experiments to investigate if plants can make seeds in space.

Thale cress was grown in space approximately for one month.

Subject: Anti-gravity

Plant: Thale cress (Arabidopsis thaliana), rice plant (Oryza sativa)

We performed experiments to investigate the mechanism of a plant's structure to withstand the force of gravity.

Astronaut Hoshide watering Thale cress

NASA astronauts performing experiments with rice plants

Subject: Hydrotropism, morphogenesis

Plant: Cucumber

We performed experiments to investigate the mechanism of a plant's roots to grow towards water, and study the relationship between the distribution and transportation of plant hormones (substances that regulate the plant's growth) and their effect on the shaping of a plant.

Astronaut Furukawa watering a cucumber plant

International Collaborations

JAXA aims to maximize the value of "Kibo" by spreading the word of "Kibo" to other people around the world, and by sharing the use of "Kibo" with other Asia-Pacific countries in order to promote the distribution of its many progress around the world. We are in preparations for developing an international collaboration program using "Kibo", and eight Asia-Pacific countries including Japan are working together towards this program which we named "Kibo-ABC".

"Space Seeds" and astronauts in the ISS

KIBO-ABC
Asian Beneficial Collaboration through Kibo Utilization

Logo of Kibo-ABC
(Designed by ANGKASA)

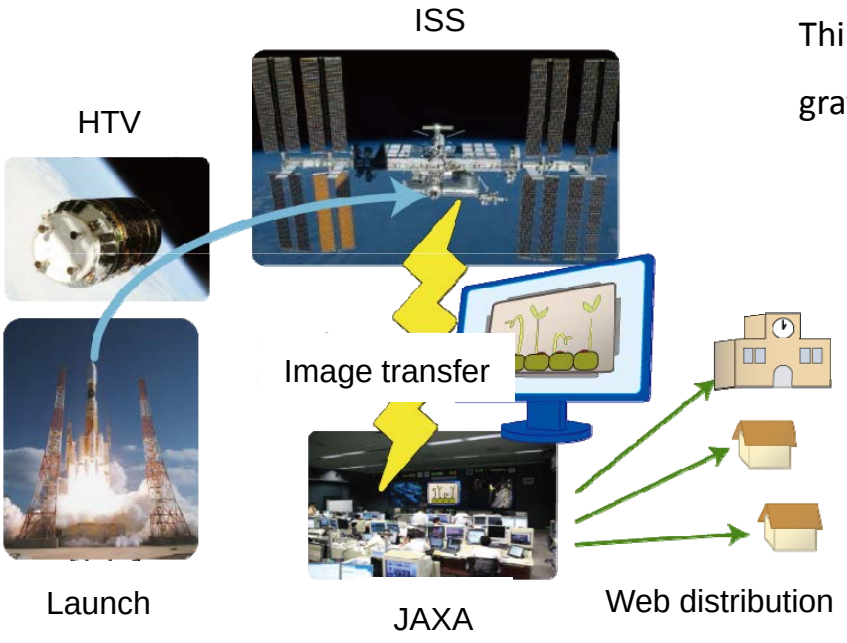
Kibo-ABC member countries as of April, 2013:
Australia, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Thailand, Vietnam

In 2011, as a first attempt to use "Kibo" in collaboration with other Asian countries, an "Asian Seeds" program was launched, where seeds from plants collected in Indonesia, Malaysia, Thailand, and Vietnam were transported to "Kibo" and returned to earth after a few months. The "space seeds" brought back to earth were used in cultivation contests with students participating from all over Asia, increasing people's interest in the International Space Station and zero gravity. Also, experiments were performed to compare the germination and growth of the space seeds with seeds that were not transported into space.

What is SSAF2013?

The second "Asian seeds" program is planned for 2013. An experiment will be performed to grow Azuki beans for seven days at “Kibo" in the International Space Station. Astronauts will film the sprouting of Azuki beans grown in space and transmit the images to earth.

General public participation will be encouraged in this program. The participants will grow Azuki beans on earth the same way as the astronauts.
Growth patterns will be compared with the images transmitted from space. Your recorded observations can be submitted to us by e-mail and compared with other people's results.



Following countries will participate in this program.

- Australia
- Indonesia
- Japan
- Malaysia
- New Zealand
- Thailand
- Vietnam

You are also invited to participate in this space experiment.

Compare the growth pattern of plants on earth with the observed growth pattern of plants in space. Compare your results with the results from people in other countries. Think of how the environment of zero gravity in space affects the plants.

Logo of SSAF2013
(Designed by NSTDA)

*SSAF2013: Space Seeds for Asian Future 2013

Azuki bean space experiment conducted in “Kibo”

* Time scheduled: Summer 2013 (scheduled)
Please check our website for further updates.
http://iss.jaxa.jp/en/kuoa/ssaf/

Container used

* Azuki bean variety: Erimoshouzu

** Container: Plastic
Size: 21 cm wide, 15 cm tall, 4 cm deep

* Material for planting seed: Rock wool

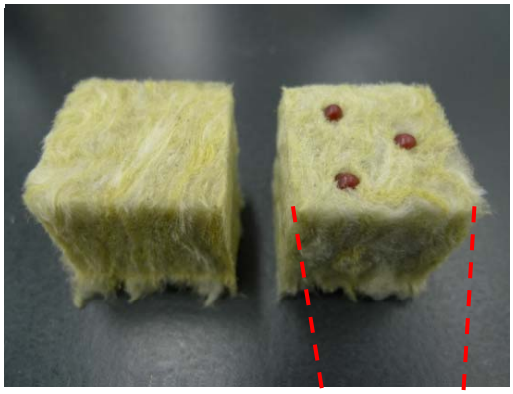
* Experimental procedure in space:
1) 18 Azuki bean seeds will be planted into rock wool and sent to space in a dehydrated condition.

2) A syringe will be used to water the seeds and they will be cultivated inside an opaque plastic bag aboard “Kibo".

3) After 7 days (scheduled), the sprouts (developing Azuki plant) will be taken out and filmed with a video camera to transmit the images to earth.

4) The sprouts will be taken out and their stems bent or pulled to determine their suppleness.

Azuki bean seeds buried in rock wool



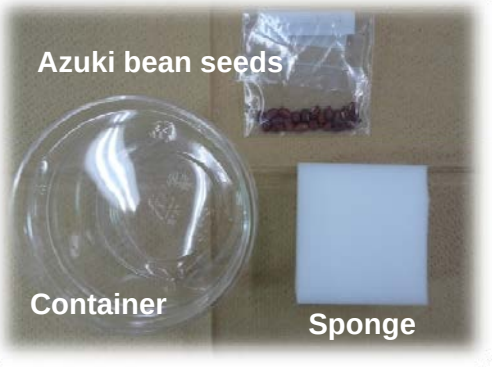
Experimental kit used in the space experiment

Contents of the experiment may be partially changed.

Guide for SSAF2013 ground experiment

1. Materials to prepare

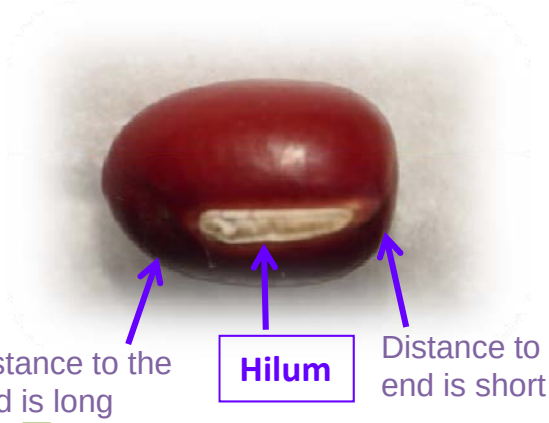
* Experimental guide (this booklet)
* Azuki bean seeds
* Material for planting seeds (sponge, etc.)
* Container
* Cutter knife
* Permanent marker
* Aluminum foil

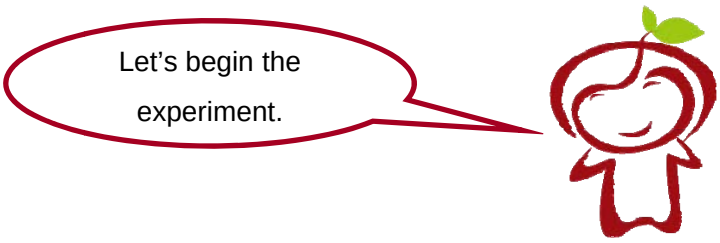


2. Let's observe the Azuki bean seed

The size of an Azuki bean seed is 7 mm × 5 mm long.
The white line in the center is called the "hilum".

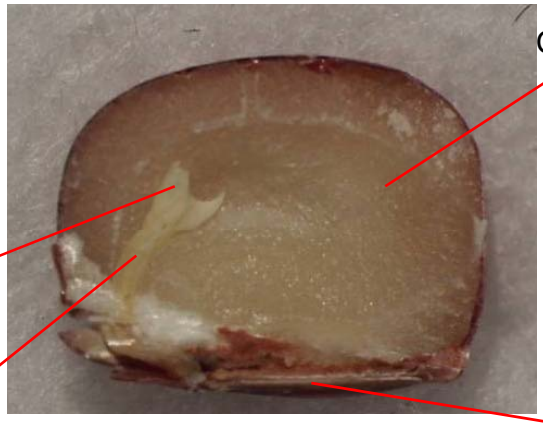
Use of a clear container will be convenient to make observations from the outside.





The sprout emerges from here.
Planting this side up will result in a straight sprout.

Cross section



The leaves and stem are inside the seed.

3. How to plant seeds

①Cut the sponge in half using the cutter knife. By cutting it into two pieces, the experiment can be done twice.

②Use the permanent marker to mark the sponge where the seed will be planted.

③Use the cutter knife to cut a hole on the mark deep enough to bury the seed.

④Plant the seed inside the hole. Place the seeded sponge inside the container.

⑤Add sufficient water to the sponge.

⑥Cover the container with the lid, wrap the container with aluminum foil to keep it dark, and grow the Azuki bean. (The growing temperature in “Kibo" is approximately 22-23 degrees.)

①

It is easier to cut from either side with the cutter knife. Ask an adult to help you if you find this difficult.

Be careful not to cut yourself when using the cutter knife.

②

Three horizontal holes and three vertical holes were made for a total of nine holes.

③

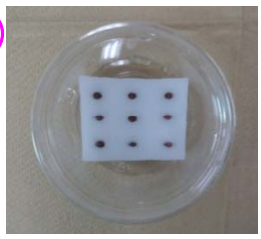
④

Securely insert the seed in the sponge with the sprouting end face up.

⑤

Tilt the container to discard any extra water not absorbed by the sponge.

⑥



When the Azuki bean starts to sprout, remove the lid so that it does not bend the sprout, and re-cover the container with aluminum foil to keep it dark. You can also use a box to cover it to keep the light out.

You can find how to observe the seeds in the next page.

4. How to make observations

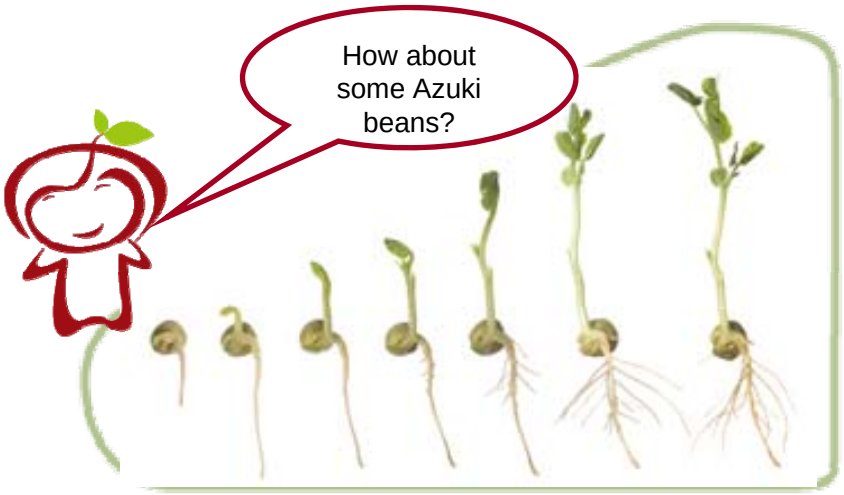
First, the root emerges followed by the growing stem. Take different recordings by measuring its length using a ruler, make sketches, and take photos. If the plant was grown in the dark, keep the observation time brief to prevent prolonged light exposure.

When will it start to sprout after watering? Observe any changes after the seeds start to sprout.

First, the root emerges from the seed.

Next, the stem emerges from the seed.

【Tip】 When making observations in the dark, use a flashlight that is covered with a green cellophane wrap.



Appearance of a growing pea

When you have finished with the Azuki bean experiment, transplant it in a planter or the ground and continue growing it.

5. Application guide

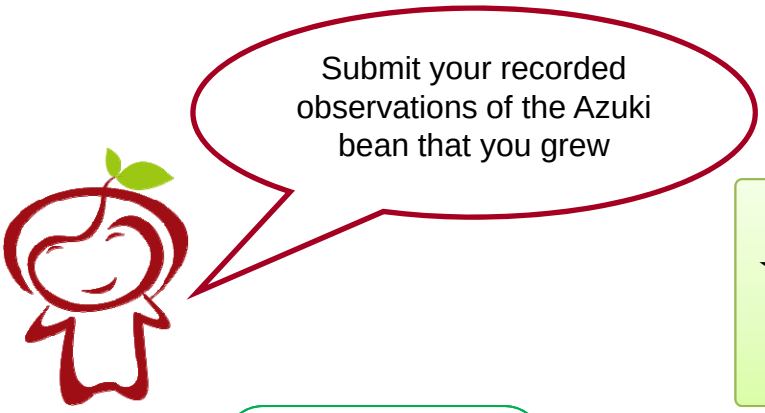
In this guide, the Azuki bean seed was planted in the sponge with the sprouting side up as in the space experiment, but consider:

• What type of changes would occur if the hilum's planting direction is changed by positioning it downwards or horizontally? Would there be any changes in the direction of growth of the root or stem?

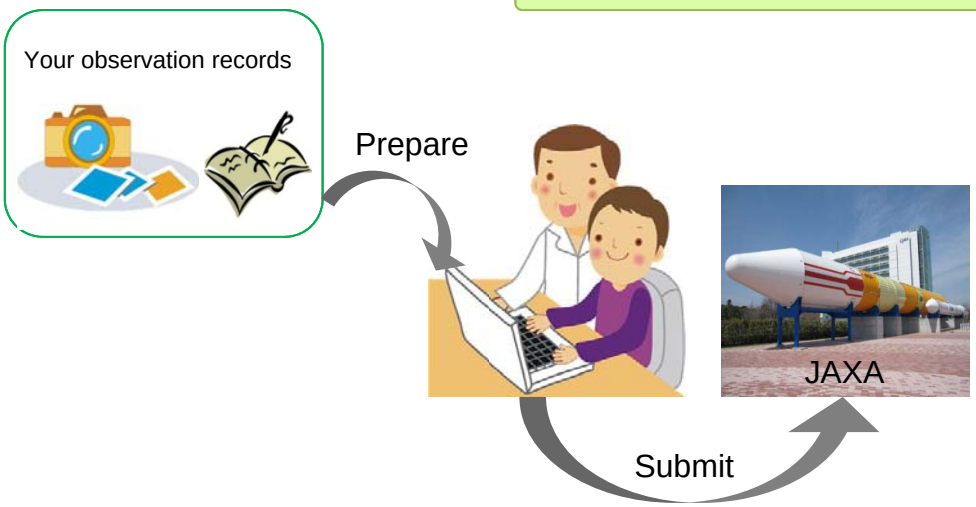
• Would there be any changes in the growth between placing it in a light or dark environment?

Come up with other different ideas to investigate some more!!

How to submit your experimental results



★ Submit your results to:
SSAF2013@jaxa.jp

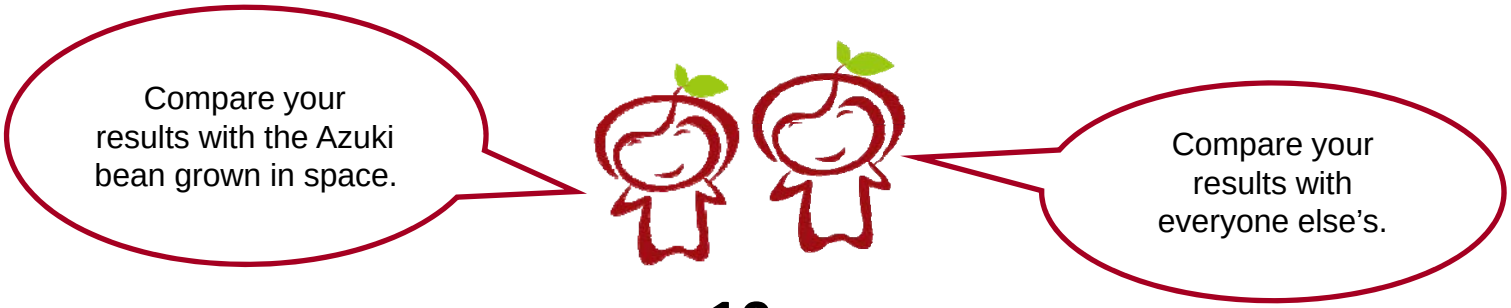


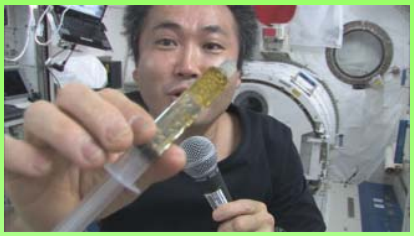
1) Prepare your report and save it in PDF format.
*Your report may appear on JAXA website as it is. Please do not include any information that you do not want to disclose in your report.

2) Attach the file to e-mail and send to SSAF2013@jaxa.jp

Note: JAXA is not responsible for direct, indirect, incidental, or consequential damages resulting from any defect, error, or failure in the report.

Observe the differences in color, shape and size to the space experiment's, and think of the reasons for these differences.





There are people from different countries in the International Space Station and they are having fun.

Astronaut Wakata will be the new captain of the International Space Station. Nice to meet you!

They are the new astronauts in training. Let's give them a cheer!

JAXA

Join the plant experiment in space!

Note

Please visit the JAXA website for updated information.

http://iss.jaxa.jp/en/kuoa/ssaf/

KIBO-ABC
Asian Beneficial Collaboration through Kibo Utilization

SSAF 2013

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