CALL FOR PROPOSAL FOR ASIAN TRY ZERO-G EXPERIMENTATION 2017

INTRODUCTION

1. Singapore Space and Technology Association (SSTA) in collaboration with Japan Aerospace Exploration Agency (JAXA) invite school and university students to propose idea of experiment to be conducted onboard the International Space Station (ISS) Japan Experiment Module (a.k.a. Kibo).

2. JAXA astronaut Norishige Kanai who will be serving onboard the ISS will execute the experiment that will be narrated and video recorded. The astronaut will also give his opinion and shares his experience with regard to the performance and outcome of the experiment. The recorded video will be transmitted from the ISS to JAXA’s ground station in Japan, and sent to SSTA and the student who proposed the experiment.

SPACE ENVIRONMENT FOR EDUCATION

3. Space is the new frontier for educating our school and universities students. As all physical phenomena on Earth are subjected to gravity, hence, it is usual for one to accept that water flows from high to low places on the ground. However, this type of behavior does not apply in microgravity. A volume of water forms a spherical liquid ball that floats free in space. This is due to the water surface tension and the lack of the usual gravity.

4. Weightlessness means that buoyancy, sedimentation, static pressure, and thermal convection are all negated. Thus, it becomes possible to allow students to design simple experiment to test and observe newton laws, forces and moments without disturbances under micro-gravity conditions. Such experiment enhances the understanding of physics and encourages learning too. Through this Space Environment For Education program SSTA’s goal is to attract more students to science, technology, and space development.

TRY ZERO-G FOR ASIAN YOUTH EDUCATION

5. Try Zero-G for Asian Youth is an educational program aims to promote manned space experiment activities onboard Kibo performed by a Japanese astronaut. This is an Asia-Pacific Regional Space Agency Forum (APRSAF) Space Environment Utilisation Working Group (SEUWG) initiative known as the Asian Beneficial Collaboration (ABC). Hence, the name Kibo-ABC was created for this education program. SSTA, being the Singapore member of the SEUWG is Singapore’s point-of-contact and administrator for Singapore students’ participation in the Kibo-ABC and Try Zero-G experiment.
EXPERIMENT PROPOSAL SUBMISSION CRITERIA

6. Proposed experiment has to be unique, novel and has not been conducted during previous Kibo-ABC program. For information on passed experiments selected, please visit: http://iss.jaxa.jp/en/kuoa/tryzerog/index.html

7. Two categories of student participation are invited,
   - Category 1: Under 18 Years Old Student
   - Category 2: Young Scientist & Engineer Up to 27 Years Old.

8. Experiment shall be designed for micro-gravity condition to be conducted within the Kibo module and visually observable. This module is pressurized at earth level atmosphere which allows the astronaut to live and operate with the need for a space suit.

9. The experiment has to utilise the items already delivered to the Kibo. The available items are:
   a) Office supplies such as paper, pen, scissors, ruler, binder, clip, zip-lock bag etc.
   b) Tools such as driver, wrench, tweezer, inspection mirror, etc
   c) Designated items (Please see Annex A for the list of items)

   * Some items may not be available depending on work schedule/situation.

   While proposed experiment is encouraged to use the items as shown in Annex A, new items may be suggested. However, any new item has to fulfil following conditions:
   I. Mass: less than about 950 g.
   II. Dimensions: within about 35 x 30 x 10 centimeters, when folded.
   III. Specifications: non-flammability, no sharp edges, not included any motive power (electric, magnetic), no living thing and no chemicals.

   NOTE: The mass/dimensions indicated above are the total values which is allocated to Asian Try Zero-G 2017-2018. Therefore, an individual item is preferred small and light. The proposed items may not be used for the experiments with various reasons. Also, launch items are not returned to the ground.

10. The time to complete the experiment should not be more than ten (10) minutes.

11. The instructions to the astronaut to prepare the props and step-by-step procedure to carry out the experiment should be simple and easy to understand and follow.

12. Proposal with experiment that financially benefits a specific organisation or agency is not allowed.
13. Each experiment proposal should be from one (1) student. For the Under 18 years Old Category 1, group submission for up to five (5) students per group is allowed. However, the average age of the students shall be under 18 years old. Teacher is allowed to supervise the group.

14. For Young Scientist & Engineers Category 2 submission, in addition to the experiment design and instructions, mathematical and theoretical assumptions must be included in the proposal. Writing a technical paper about the experiment observation and results is highly recommendation. Only one person is allowed for each proposal.

15. As the Kibo module operates in space is highly risky, the following types of experiment actions are not allowed due to safety considerations. These unsafe and not allowed actions are:

- Usage of dangerous materials/objects.
- Sprinkling of large amount of water (1 liter or more) within Kibo cabin.
- Releasing of certain amount of gaseous, e.g. N2.
- Scattering of tiny articles such as bolts, nuts, bits of papers.
- Usage of high speed spinning objects with large mass.
- Items with sharp edges.
- Task requiring two (2) astronauts.
- Long duration of astronaut time (so long as it’s within 10 minutes it’s ok).
- Sacrificing astronaut’s rights and privacy.
- Requires astronaut to terminate airflow in Kibo cabin for a long duration of time
- Block astronaut’s emergency evacuation path e.g. closing hatches

APPLICATION FORMAT

16. Applicant shall furnish the following information in the application format (please click this link to download the application form https://www.space.org.sg/education-and-outreach/try-zero-g-asia/try-zero-g-registration ; refer examples shown in Annex B.)

- Applicant information
- Experiment Title/Theme
- Hypothesis and Theory
  o Hypothesis
  o Schematic Model
  o Mathematical Assumption (for Category 2 only)
- Verification method and requirement
- Items required (including the proposed launch items) and how to construct

IMPORTANT DATES

17. Proposal application submission to SSTA not later than 21st April 2017. Shortlisted proposals will be submitted for JAXA’s selection.
18. Announcement of selected experiment by JAXA to be conducted onboard Kibo is expected between July – August 2017. The actual experiment is scheduled in Jan 2017 subjected to the ISS operational routine. JAXA’s decision is final and no correspondence will be entered into https://www.space.org.sg/education-and-outreach/try-zero-g-asia

PARTICIPATION CONDITIONS

19. Applicant must agree to the following terms of conditions:

- JAXA has the right to modify the idea, conduct the experiment in space, and apply the result to the public and educational purposes.

- Images and pictures in the submitted proposal will be opened to the public via JAXA website. The images/pictures may be utilised for public/educational purposes.

- JAXA may use the submitted proposal for public/educational purposes even if the idea is not conducted in space.

- If any of the requirements are violated, even after the idea is accepted as a proposed experiment, the acceptance can be withdrawn.

20. Applicant must guarantee that the submitted proposal does not violate any legal rights, such as intellectual property rights. If a legal problem related to the submitted proposal arises, the applicants will take full responsibility and must solve the problem.

21. The personal information collected through this application will be used only for informing the applicant of the selection results, publication, and events related to this project.

CERTIFICATE OF PARTICIPATION

22. Certificate will be awarded to student(s) whose experiment is selected to be performed by the Kibo-ABC astronaut. Student(s) whose experiment is accepted but not carried out onboard the Kibo-ABC will be awarded with a letter of participation.

ENQUIRES AND CLARIFICATIONS

23. Interested student or teacher may contact Mr Tan Cheng Hai, Exco SSTA, at chenghai.tan@space.org.sg or peggy.fang@space.org.sg for any query or clarification. Mr Tan is also available to provide assistance to the student or group to assist with the design of the experiment.
## ANNEX A

### List of Available Experiment Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weight Kit (Blocks)</td>
<td>1 set</td>
</tr>
<tr>
<td>2</td>
<td>Mass Comparison Kit (Balls)</td>
<td>2 sets</td>
</tr>
<tr>
<td>3</td>
<td>Compass</td>
<td>1 set</td>
</tr>
<tr>
<td>4</td>
<td>Yo-Yo</td>
<td>1 set</td>
</tr>
<tr>
<td>5</td>
<td>Slinky</td>
<td>1 set</td>
</tr>
<tr>
<td>6</td>
<td>Spring Kit (Springs, Weights)</td>
<td>1 set</td>
</tr>
</tbody>
</table>

#### Data:

- **No. 1**
  - **Material:** Aluminum, Steel, Polymer, Wood
  - **Size:** L 30 x W 30 x H 30 [mm]
  - **Mass:**
    - Aluminum: 72 [g]
    - Steel: 210 [g]
    - Polymer: 39 [g]
    - Wood: 15 [g]

- **No. 2**
  - **Material:** Aluminum, Polyethylene, Vinyl, Rubber, Wood, Steel
  - **Size:** dia. 37 [mm]
  - **Mass:**
    - Aluminum: 72 [g]
    - Polyethylene: 26 [g]
    - Vinyl: 37 [g]
    - Rubber: 27 [g]
    - Wood: 15 [g]
    - Steel: 207 [g]

- **No. 3**
  - **Material:** Aluminum
  - **Size:** L 77 x W 57 x H 25 [mm]
  - **Mass:** 65 [g]

- **No. 4**
  - **Material:** Plastic
  - **Size:** dia. 57 x L 38 [mm]
  - **Mass:** 47 [g]

- **No. 5**
  - **Material:** Steel
  - **Size:** dia. 70 x L 58 [mm]
  - **Mass:** 220 [g]

- **No. 6**
  - **Material:** Steel
  - **Size:**
    - Large Spring: dia. 14 x L 100 [mm]
    - Medium Spring: dia. 9 x L 85 [mm]
    - Small Spring: dia. 6 x L 57 [mm]
  - **Weight:**
    - Large Spring: 10 [g]
    - Medium Spring: 8 [g]
    - Small Spring: 6 [g]
  - **Quantity:** 1 set
## ANNEX A

### List of Available Experiment Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Case:</th>
<th>Size</th>
<th>Mass</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.7</td>
<td>Spring Balance</td>
<td>Acrylic</td>
<td>Resin</td>
<td>L 30 x W 255 x H 20 [mm]</td>
<td>58 [g]</td>
<td>1</td>
</tr>
<tr>
<td>No.8</td>
<td>Ink Brush</td>
<td>Polyester</td>
<td></td>
<td>L 234 x W 5 x H 5 [mm]</td>
<td>5 [g]</td>
<td>1</td>
</tr>
<tr>
<td>No.9</td>
<td>Origami Paper</td>
<td>Paper</td>
<td></td>
<td>L 150 x W 150 x H 0.1 [mm]</td>
<td>1 [g]</td>
<td>3 sets</td>
</tr>
<tr>
<td>No.10</td>
<td>Moon Chart</td>
<td>Plastic</td>
<td></td>
<td>L 275 x W 280 x H 1 [mm]</td>
<td>70 [g]</td>
<td>1</td>
</tr>
<tr>
<td>No.11</td>
<td>Tape Measure</td>
<td>Plastic, Tape: Vinyl</td>
<td></td>
<td>L 52 x W 52 x H 17 [mm] (Tape length: 1.5 [m])</td>
<td>27 [g]</td>
<td>1</td>
</tr>
<tr>
<td>No.12</td>
<td>Tippe Top</td>
<td>Wood</td>
<td></td>
<td>dia. 20 x L 35 [mm]</td>
<td>5 [g]</td>
<td>3</td>
</tr>
</tbody>
</table>
### ANNEX A

**List of Available Experiment Items**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Material</th>
<th>Size</th>
<th>Mass</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Gyroscope</td>
<td>Steel</td>
<td>dia. 64 x L 89 [mm]</td>
<td>80 [g]</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Sponge Ball</td>
<td>Polyurethane</td>
<td>Yellow : dia. 68 [mm]  Orange : dia. 45 [mm]</td>
<td>6.3 [g]  1.2 [g]</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Plastic Syringe</td>
<td>Plastic</td>
<td>Size (TBD) dia. 30 x L 148 [mm]  30 [ml]</td>
<td>9 [g]</td>
<td>TBD</td>
</tr>
<tr>
<td>17</td>
<td>Spool Pack (Spool)</td>
<td>Wood, Aluminum</td>
<td>Size dia. 90 x L 56 [mm]</td>
<td>Wood : 45 [g]  Aluminum : 129 [g]</td>
<td>3</td>
</tr>
<tr>
<td>18</td>
<td>Parachute Pack (Parachute, Weights)</td>
<td>Parachute: Nylon, Weight: Wood and Brass</td>
<td>Size dia. 430 x L 530 [mm]</td>
<td>Parachute : 12 [g]  Wood Weight : 9 [g]  Brass Weight : 119 [g]</td>
<td>1 set</td>
</tr>
</tbody>
</table>
List of Available Experiment Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Material</th>
<th>Size (mm)</th>
<th>Mass (g)</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Flapping Bird</td>
<td>Plastic</td>
<td>L 260 x W 160 x H 3</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>
Example 1

Application Form 2
Asian Try Zero-G

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**ID (Official Use Only):**

**1. Activity Title:** Transition of center of Gravity

**2. Hypothesis and Theory**

- Hypothesis:
  The shapes of objects are the same, but they have different centers of gravity. The object 1 and 2 are assembled to cross, and the center of gravity is moved and it will rotate at the point of new center. It is supposed to be simple rotation around the axis because the center of gravity is transit on the same plane. Next, the object 3 is additionally assembled to object 1 and 2. The center of gravity is moved again and it will rotate at the point of new center. It is supposed to be complicated rotation because the center of gravity has coordinates on triaxial.

- Schematic Model:

  ![Schematic Diagram]

  **Object 1**
  - Plastic ball
  - Plastic ball
  - L = 245mm
  - Center of gravity, G

  **Object 2**
  - Plastic ball
  - Center of bar
  - L2 = L(W2 - W1) / (2(W2 + W1)) = 43.6 [mm]
  - Aluminum

  **Object 3**
  - Plastic ball
  - Brass ball
  - L1 = L(W2 - W1) / (2(W2 + W1)) = 80.5 [mm]

**3. Verification method and Requirement**

- Mathematical Assumption: (For Category 2; young scientists and engineers up to 27 years old)
  1. Measure distances from the center of bar to the centers of gravity
  2. Verify the centers of rotations via video camera step by step.
  3. Observe and compare the changes of rotations with the hypothesis

- Break down of procedure and estimated crew time:
  1. Measure distances from the center of bar to the centers of gravity for Object 2 and 3: 3 min
  2. Assemble Object 1 and 2: 30 sec
  3. Rotation 1: 1 min
  4. Assemble all Object: 30 sec
  5. Rotation 2: 1 min
  6. Change cross angle of Object 3: 30 sec
  7. Rotation 3: 1 min
## Example 1

**Application Form 2**  
**Asian Try Zero-G**  
**Sample**

### 4. Tool, Item

<Designated item(s) from Available onboard items list>

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Rotator Pack (Weights attached bar’s both ends)</td>
<td>Use all 3 types</td>
</tr>
</tbody>
</table>

<Proposed launch item(s) *If applicable, some photos/illustrations shall be attached>*

<table>
<thead>
<tr>
<th>Name</th>
<th>Quantity</th>
<th>Description (e.g. size, weight, material)</th>
<th>Photo/illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strings</td>
<td>2</td>
<td>Diameter 1.0m, Length 30cm, Cotton</td>
<td></td>
</tr>
</tbody>
</table>

<Others>

- Video camera, Scale
**Example 2**

**Application Form 2**

**Asian Try Zero-G**

**Sample**

<table>
<thead>
<tr>
<th>ID (Official Use Only):</th>
</tr>
</thead>
</table>

1. **Activity Title:** *Capillary in Zero gravity*

2. **Hypothesis and Theory**

   **Hypothesis**
   
   Surface tension is the force which makes fluid surface acquired the least area possible. It direction is parallel with fluid surface and perpendicular with the edge of surface is act by force in any direction. In molecules at the surface is act by force in only under direction. So, that made fluid have surface force act into center. We can see it normally in daily life when we drain water into tube. Then, water surface is concave down because water in tube have surface tension with surface adhesion force and cohesion force. It’s call capillary action. And gravity is also one of variable that can affect to capillary action. So, I think that if we drain water into a small tube such as plastic syringe and then observe it in zero gravity condition how difference of surface by compare with a syringe in normal gravity condition.

   **Schematic Model**

   ![Schematic Diagram](Diagram.png)

   **Mathematical Assumption** (For Category 2; young scientists and engineers up to 27 years old)

   The height of liquid column is given by
   
   $$ h = \frac{2\gamma \cos \theta}{\rho g} $$

   where we can apply this equation to find $h$

   $\gamma$ is the liquid-air surface tension (energy/area)
   
   $\theta$ is the contact angle
   
   $\rho$ is the density of liquid (mass/volume)
   
   $g$ is acceleration due to gravity (length/time$^2$)
   
   $r$ is radius of tube (length)

3. **Verification method and Requirement**

   *Compare and analysis syringe in zero gravity condition and compare contact angle($\theta$) from equation with contact angle from experiment.*

   **Break down of procedure and estimated crew time**

   1. Drain air into syringe to 5 ml scale
   2. Drain water into syringe 10 ml scale
   3. Observe it and take photo and video
   4. Measure contact angle and compare with syringe in normal condition

   Estimated crew time: 10 minutes
### Example 2

**Application Form 2**  
**Asian Try Zero-G**

**Sample**

<table>
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#### 4. Tool, Item

**<Designated item(s) from Available onboard items list >**

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<tbody>
<tr>
<td>15</td>
<td>Plastic Syringe</td>
<td></td>
</tr>
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</table>

**<Proposed launch item(s) *If applicable, some photos/illustrations shall be attached>*

<table>
<thead>
<tr>
<th>Name</th>
<th>Quantity</th>
<th>Description (e.g. size, weight, material)</th>
<th>Photo/ Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera and video camera</td>
<td>Water</td>
<td>Tape measure</td>
<td></td>
</tr>
</tbody>
</table>

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