

# CAPILLARY FLOW CHALLENGE FAQ

**Q: What is our team expected to design and build and what is NASA building?**

**A:** You are expected to design and build a capillary device to eject droplets as far as possible as the device falls down NASA's 2.2 Second Drop Tower. NASA will provide the rest of the experiment hardware including the housing that will hold the silicone oil and a holder that will secure your capillary device.

**Q: How are microgravity conditions created?**

**A:** An experiment is dropped in free-fall for 2.2 seconds in a drop tower at NASA Glenn Research Center in Cleveland, Ohio. During that time, the experiment 'feels' like there is no gravity, just as if it were in orbit on the International Space Station. For information, read this page: <http://facilities.grc.nasa.gov/drop/quick.html>

**Q: How big can our capillary device be?**

**A:** The student's capillary device must be less than 20 mm wide, between 40-150 mm tall, and less than 20 mm thick (Figure 1).

**Q: How far should the silicone oil travel in our capillary device during microgravity?**

**A:** The student team should define the length, D, of the device in which the oil will flow to create a droplet to be ejected (Fig. 2).

**Q: How far is our capillary device dipped into the silicone oil?**

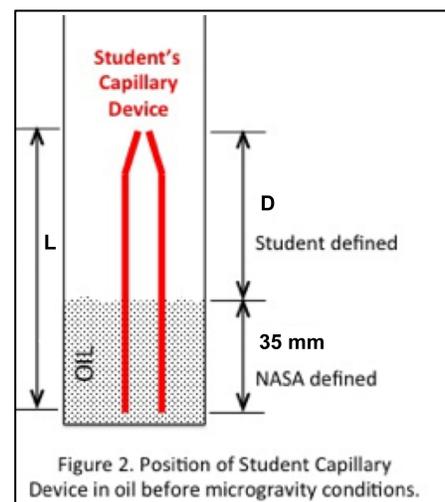
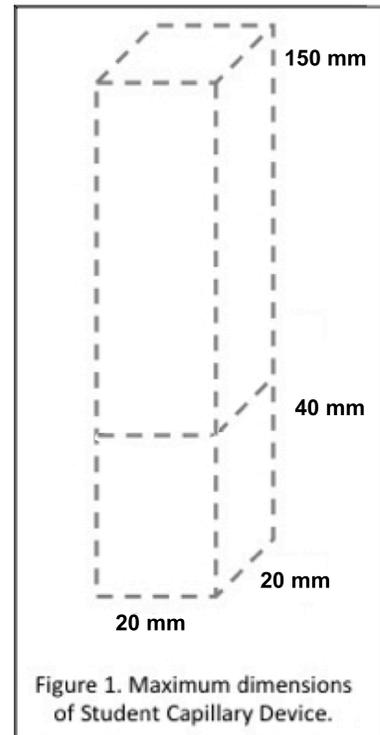
**A:** The lower 35 mm of the student's capillary device will be immersed vertically into a silicone oil reservoir before being subjected to 2.2 seconds of microgravity (Fig. 2). This is to ensure the bottom end of the capillary device stays in contact with the silicone oil.

**Q: How long should we make our capillary device?**

**A:** The total length of the device to be made by the students will be  $L = (D + 35)$  mm and should not exceed 150 mm (Figs. 1 & 2).

**Q: What materials are okay for our capillary device?**

**A:** The student's capillary device will be immersed in silicone oil and must be constructed of compatible materials, such as, plastic, glass, ceramic, aluminum, steel, etc. Materials such as cardboard, paper, wood, etc. are not acceptable.



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**Q: What oil will be used by NASA?**

**A:** The silicone oil is also known as PDMS or Polydimethylsiloxane.

- viscosity 1.5 centiStoke (cSt) at 25 °C
- density 0.851 grams per milliliter (g/mL) at 25°C
- surface tension 18.0 milliNewton per meter (mN/m) at 25°C.

**Q: Does our capillary device have to be transparent?**

**A:** A transparent or translucent device will allow a team to observe the motion of the silicone oil inside the team's capillary device. Such observations will assist in the interpretation of the video.

**Q: What holds our capillary device in the oil?**

**A:** The student capillary device will be attached to a bracket supplied by NASA during drop tower operations.

**Q: How many proposals can an organization submit?**

**A:** Each organization (e.g. school) may submit a maximum of five proposals. It is envisioned that up to two of those proposals will be selected.

**Q: How many proposals can a team submit?**

**A:** 1 (one).

**Q: How many students can belong to a team?**

**A:** Any number, but preference in selection will go to teams over individuals.

**Q: On how many teams can a student belong?**

**A:** 1 (one).

**Q: How many devices can a selected team submit and how many drops will the team have?**

**A:** Each team can submit up to four capillary devices for one drop-operation.

**Q: What is a conceptual drawing?**

**A:** A conceptual drawing could be called a sketch. For the Capillary Flow Challenge, it should show the approximate size and shape of the team's capillary device. It can be drawn with a computer (e.g. CAD) but also can be simply drawn by hand on paper. Identification of the team should be included on each page or image.

**Q: Can we build the capillary device using a 3-D printer?**

**A:** Yes. It is not necessary to create the team's capillary device using a 3-D printer, but such a printer could be used. Bear in mind that a surface printed with a 3-D printer may not be smooth enough for efficient capillary flow.

**Q: If we use a 3-D printer, how do we get transparent material?**

**A:** Check with the manufacturer of the 3-D printer or other users of the printer for suggestions.

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**Q: When are our designs due?**

**A:** Proposals can be submitted at any time up to October 1, however if you can submit the designs sooner, it will give the NASA team more time to review your design and provide feedback. Once we receive your capillary device, no modifications can be made.

**Q: When are the capillary devices due to NASA?**

**A:** The student's capillary device must arrive at NASA by no later than Friday, October 7. But note that the proposal submission deadline is Oct. 1.

**Q: What address should be used to send our capillary device?**

**A:** CFC c/o Nancy R. Hall  
NASA Glenn Research Center  
21000 Brookpark Road, MS 77-7  
Cleveland, OH 44135

**Q: Do we get our experiment back?**

**A:** The team's capillary device(s) will be returned to the team if the team participates in the ASGSR conference, otherwise the device(s) will not be returned to the team.

**Q: How can our team ask a question?**

**A:** Send your question in an e-mail to: [celere@lists.nasa.gov](mailto:celere@lists.nasa.gov)

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