**ACTIVITY: Walking on custard**

**Activity idea**

In this activity, students watch the Brainiac video [John Tickle walks on custard](https://www.youtube.com/watch?v=BN2D5y-AxIY) on YouTube to learn more about non-Newtonian fluids at work. The activity includes a number of strategies to deepen student interaction with video content.

By the end of this activity, students should be able to:

* discuss the differences between Newtonian fluids (‘normal liquids’) and non-Newtonian fluids
* explain the scientific meanings of stress and strain as they relate to fluids
* discuss how non-Newtonian fluids change their viscosity or flow behaviour under stress
* explain why John Tickle is able to walk on custard but not on water.

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**Background information for teachers**

Non-Newtonian fluids change their viscosity or flow behaviour under stress as explained in the article [Non-Newtonian fluids](https://www.sciencelearn.org.nz/resources/1502-non-newtonian-fluids). The YouTube video [John Tickle walks on custard](https://www.youtube.com/watch?v=BN2D5y-AxIY) demonstrates the difference between a pool filled with water (a Newtonian fluid) and a pool filled with cornflour-based custard (a non-Newtonian fluid).

Videos are a useful media to demonstrate aspects that cannot be recreated in the classroom. The article [Using videos in the classroom](https://www.sciencelearn.org.nz/resources/2568-using-videos-in-the-classroom) provides a number of strategies that assist students to become more actively involved with the video.

This activity uses two of the strategies – worksheets and question dice.

***Worksheets and diagrams***

This activity has [three worksheets](#student). One contains short, factual questions to answer. A second has diagrams to complete and a third has multichoice. Students should have the opportunity to view these beforehand.

Consider using one or more of the worksheets before and after watching the video to identify changes in student understanding. Note that completing a task while watching a video can be difficult for some students and distract them from the learning within the video.

***Question dice***

Use the [template provided](https://www.sciencelearn.org.nz/images/1850-question-dice-template) to make the dice – you can make the dice out of coloured card or wooden blocks.

Each student takes a turn rolling the first question dice (What, why, how etc.) and uses the question starter facing upwards to make up a question related to the video to ask the group.

Each student then takes a turn rolling both question dice and uses the question starters facing upwards to make up a question related to the video to ask the group (How could …? Why might …?).

This question dice activity can also be used to generate questions for investigation or questions for before or after reading some text.

**Teacher instructions**

1. As a class, read the article [Non-Newtonian fluids](https://www.sciencelearn.org.nz/resources/1502-non-newtonian-fluids).
2. Discuss the terms ‘stress’ and ‘strain’ as they relate to fluids.
3. Discuss the effect of stress on a non-Newtonian fluid.
4. Use one or more of the [worksheets](#student) to gauge student understanding.
5. Watch the YouTube video [John Tickle walks on custard](https://www.youtube.com/watch?v=BN2D5y-AxIY).
6. Use one or more of the worksheets to see if student understanding has changed or use the [question dice](https://www.sciencelearn.org.nz/images/1850-question-dice-template).

You could follow on with the activity [Danger – quicksand!](https://www.sciencelearn.org.nz/resources/1507-danger-quicksand) and the YouTube video [John Tickle walks on quicksand](https://www.youtube.com/watch?v=G_gQKDByUd0) for more non-Newtonian interactions.

***Answers to the worksheets***

*Questions*

1. We are too heavy and break the surface tension.
2. Starch.
3. When stressed, the non-Newtonian fluid acts like a solid.
4. Without stress, the non-Newtonian fluid acts like a liquid.
5. Move slowly to release the grip. In actual quicksand, the recommendation is that you try to float on your back and slowly swim out to more solid ground.

*Diagrams*

1. In the pool with water, the foot rests on the bottom because surface tension is not strong enough to hold heavy objects like humans.
2. In the pool of custard, the foot (briefly) rests on the surface of the custard while walking quickly. When under stress, the non-Newtonian fluid acts like a solid.
3. In the pool of custard, the foot rests under the surface of the custard while standing. When not under stress, the non-Newtonian fluid acts like a liquid and the foot sinks.

*Multichoice*

1. b
2. c
3. a
4. c
5. b
6. a

**Student instructions**

***Walking on custard: questions***

1. Why can’t humans walk on water?
2. What is the component of the custard that gives it the characteristics of a non-Newtonian fluid?
3. What happens when you stress (apply pressure) to a non-Newtonian fluid?
4. What happens when you stop stressing (applying pressure) to a non-Newtonian fluid?
5. If you find yourself stuck in a non-Newtonian fluid like custard or quicksand, how do you get out?

***Walking on custard: diagrams***

|  |  |
| --- | --- |
| Each cylinder represents a swimming pool.  |  |
| 1. Draw where your foot would be if the pool is filled with water. Explain why.
 |  |
| 1. Draw where your foot would be if you are quickly walking across a pool filled with non-Newtonian custard. Explain why.
 |  |
| 1. Draw where your foot would be if you were standing for a minute in a pool filled with non-Newtonian custard. Explain why.
 |  |

***Walking on custard: multichoice***

Choose the best option to complete each sentence.

1. Humans can’t walk on water because:
2. our bodies are too dense to float
3. our bodies are too big and heavy to be supported by the surface tension of the water
4. our feet are too narrow to support our weight on liquid
5. Non-Newtonian fluids have the properties of:
6. a liquid
7. a solid
8. a liquid and a solid
9. A non-Newtonian fluid acts like a solid when you apply:
10. stress or pressure
11. custard powder
12. less water
13. If you stand still on a non-Newtonian fluid like custard, you
14. get sticky
15. float
16. sink
17. When stuck in a non-Newtonian fluid like custard, the harder you pull:
18. the faster you get out
19. the tighter it grips you
20. the bigger the splash
21. To get out of a pool of non-Newtonian custard, you need to exit:
22. slowly
23. with your arms
24. by leaping