|  |  |  |  |
| --- | --- | --- | --- |
| Video Title | **Topology: Moebius strips and Moebius crosses** | | |
| Topic | Geometry | | |
| Aim(s) | Discover shapes arising from gluing and cutting Moebius strips and Moebius crosses. To think geometrically and develop an intuition as well as prediction skills in relation with topological spaces. | | |
| Length | 45min | | |
| Camp Location | ... | | |
| Facilitators | ... | | |
| N. of students | ... | | |
| Date | ... | | |
| Resources  needed | Blanck paper (100), scissors, rolls of tape, pen (one per group of students) | | |
| Preparations | Ask the groups of students to cut the paper into long strips 3cm wide  before start watching the video | | |
|  | | |  |
| **Video time** | **What facilitator does** | **What learners do** | **Comments** |
| 00:00 - 00:26 | General VMC Video Introduction | | |
| 00:27 - 00:37 | Video Introduction | | |
| 00:38 - 00:48 | Material | | |
| 00:46 - 01:42 | Introduction of the first experiment | | |
| VIDEO PAUSE Experiment: Cutting the cylinder in the middle | * Assist the process, provoke thoughts | * Make an untwisted strip, draw with a pen through the middle and cut though the drawn line. * Imagine and predict the result, then share their ideas with other learners. |  |
| 01:48 - 2:03 | Solution of the first experiment | | |
| 2:04 - 2:59 | Introduction of the second experiment | | |
| VIDEO PAUSE Experiment: Cutting the Moebius strip in the middle | * Assist the process, provoke thoughts | * Make a strip twisted once, draw with a pen through the middle and cut though the drawn line. * Imagine and predict the result, then share their ideas with other learners. |  |
| 3:03 - 3:33 | Solution of second experiment and invitation to discussion | | |
| VIDEO PAUSE Discussion: counterintuitive aspects of the Moebius strip | * Facilitate the discussion: why just one connected strip? How many twists are there (4)? * Suggestion for discussion: how many borders did the cylinder have and how many the Moebius? (BEFORE cutting..) | * Try out guesses and share ideas * Try to count the twists! | The goal here is not to explain exactly why, but simply thinking about it. |
| 3:37 - 4:10 | Solution of second experiment and invitation to discussion | | |
| 4:11 - 5:20 | Introduction of the third experiment | | |
| VIDEO PAUSE Experiment: Cutting the Moebius strip **at one third** | * Assist the process, provoke thoughts | * Make a strip twisted once, draw with a pen **at one third** of the width and cut though the drawn line. * Imagine and predict the result, then share their ideas with other learners. |  |
| 5:26 - 5:51 | Solution of the third experiment and invitation to discussion | | |
| VIDEO PAUSE Discussion: counterintuitive aspects of the Moebius strip cut **at one third** | * Facilitate the discussion: why two connected strips? One way to figure out is to do it again slowly and keep track of the components. * How many twists are there? | * Try out guesses and share ideas * Try to count the twists on both components | The goal here is not to explain exactly why, but simply thinking about it. |
| 5:56 - 6:22 | Introduction of the fourth experiment | | |
| VIDEO PAUSE Experiment: Cutting the strip **twisted twice in the middle** | * Assist the process, provoke thoughts | * Make a strip twisted **twice**, draw with a pen **in the middle** and cut though the drawn line. * Imagine and predict the result, then share their ideas with other learners. |  |
| 6:27 - 6:42 | Solution of the fourth experiment and invitation to discussion | | |
| VIDEO PAUSE Discussion: counterintuitive aspects of the strip **twisted twice in the middle** | * Facilitate the discussion: why two connected strips? One way to figure out is to do it again slowly and keep track of the components. * How many twists are there? | * Try out guesses and share ideas * Try to count the twists on both components | The goal here is not to explain exactly why, but simply thinking about it. |
| 6:47 - 7:04 | Introduction of the fifth experiment | | |
| VIDEO PAUSE Experiment: Cutting the strip **twisted twice at one third** | * Assist the process, provoke thoughts | * Make a strip twisted **twice**, draw with a pen **at one third** of the width, and cut though the drawn line. * Imagine and predict the result, then share their ideas with other learners. |  |
| 7:09 - 9:00 | Introduction of Moebius crosses | | |
| 9:01 - 10:08 | All four Moebius crosses folding, one by one | | |
| 10:09 - 10:44 | Explanation of the Moebius crosses experiment | | |
| 10:45 - 11:28 | Example: solution for the first cross | | |
| VIDEO PAUSE Experiment: Cutting the four Moebius crosses | * Assist the process, provoke thoughts * This step may require reinforced supervision on the glueing part as it can be easily confusing. It may be useful to show the class once more the glueing of all crosses and then assist each group especially for the crosses 3 and 4. | * In groups, make the four crosses and cut thought the middle of each strip of each cross:   CROSS 1: each pair is taped normally  CROSS 2: one pair is glued normally, one pair with a twist.  CROSS 3: both pairs are glued with a twist, both twists are made clockwise  CROSS 4: both pairs are glued with a twist, one twists is clockwise and the other twist is counterclockwise. | It may be useful to colour the four crosses with four different colours, so that it is easier to reconstruct which one is which after the cutting. |
| 11:34 - 12:44 | Solution of the Moebius crosses experiment | | |
| VIDEO PAUSE Discussion: counterintuitive aspects of the Moebius crosses | * Facilitate the discussion: why two crosses give the same result? Why in general the results are so? One way to figure out is to do it again slowly and keep track of the components. * How many twists are there? | * Try out guesses and share ideas * Track why two crosses give the same * Try to count the twists the components | The goal here is not to explain exactly why, but simply thinking about it. |
| 12:49 - 13:11 | Conclusion | | |