

- 1.) If I were to describe S^2 to a two-dimensional being, I would start by having them consider particular circle in the xy -plane. If you think of every point on this circle as a portal to another universe that contains its own circle, you can start to think of ways for a two-dimensional being to navigate S^2 . For example, consider how a two-dimensional being would use the portals to navigate to the pole of the sphere lying on the positive z -axis. Find the point on the circle that corresponds to the circle lying on the yz -plane. Then, have the being travel through the point to the other circle. Now this being, despite having never perceived a third dimension, has moved from the xy -plane to the yz -plane, and thus through the third dimension. Expanding this idea to every point on the circle, and defining a surjection that each point on the circle to a circle that is orthogonal the xy -plane. The union of all of these circles would form S^2 , and for our two-dimensional being, would be fully traversable using the above portal system.
- 2.) The four-dimensional being can use a similar method that was used for the two-dimensional being. Consider every point in S^2 as a portal that brings you to another universe containing its own sphere orthogonal to the original. Using these portals, a three-dimensional being would be able to travel to these spheres, and consequently every point in S^3 . The difference between a three-dimensional and four-dimensional being, however, is the fact that a four-dimensional being can exist in multiple of these other spheres at once, while doing so is impossible for the three-dimensional being