Taste the Marine Sciences

Take the opportunity of a snack to talk a little about ocean physics.



Make the recipes at home, with your family, share them, and experiment for yourself. There's something for all ages.

Do you have a little brother? A cousin? An invitation somewhere, and you don't know what to bring as a gift? Then try preparing a mathematical recipe and share a cake that's good for both the body and the mind.

You don't need to understand everything to enjoy it.

"A delightful and scholarly invitation to explore mathematics in a new light."

Hugo Duminil-Copin, French mathematician, who received the most prestigious distinction in mathematics in 2022, the Fields Medal.

How water arrived on earth ?

Meteorites brought a significant portion of the water on Earth as they traveled through the solar system from distant and cold regions. Indeed, when the Earth formed, it was too hot to retain all the water that we now find in the oceans. To travel, meteorites follow elliptical trajectories in accordance with Kepler's law: accelerating when they approach the Sun and slowing down as they move away.



Ingredients:

80g butter 100g egg 100g flour 80g sugar Baking powder

6 breadsticks 1 grape 50g sugar Powdered sugar 1 egg white

Mix the butter, egg, flour, sugar, and baking powder. Pour into a round mold and bake at 180°C. It is done when the tip of a knife comes out clean. Let it cool, unmold, cut off the domed top, and cut an ellipse from the round shape.

In a saucepan, pour the sugar and remove it from the heat as soon as it turns a light brown color. Using this hot and malleable caramel, assemble four breadsticks so that the two in the center are shorter, as shown in the photo. With the remaining sugar, create a stopper on a fifth breadstick. Mix the powdered sugar with a bit of egg white for the icing. Place the sun at one focal point and make a hole at the other focal point to insert the breadsticks. Assemble as shown in the photo.

When the breadsticks are turned evenly, the grape follows the elliptical trajectory. It covers equal areas with the focal point in equal time intervals. Therefore, cut equal portions of the cake starting from the sun.

What shape does an ellipse have ?



Answers: □: 2 □ = B = A : 2 □, 8 : ↑



When water arrived on earth ?

The massive meteorite bombardment that brought some of the water to Earth can be dated to 4 billion years ago by studying the craters on the Moon. The shape of the craters, whether simple or complex—meaning bowl-shaped or with a mountain at the center—provides information about the meteor that impacted the Moon. The overlaps of the craters order the impacts.



Cook the zucchinis, blend them into a puree, and season them. Fill shallow plates or large bowls with varying depths from 3 to 8 cm. On the smooth surface, use a tablespoon to project the puree more or less forcefully. Upon impact, the energy causes the puree to become liquid, similar to meteorites.

Depending on the conditions, you will see bowl-shaped craters and others with a mountain at the center. Ejecta may also fall nearby, forming secondary craters. Successive impacts may overlap, resulting in craters stacked on top of each other.

Above right, a simple crater in a bowl-shaped plate. Above left, a complex crater with a mountain at the center and a small secondary crater overlapping at the top, created in a bowl.

What is the order in which the craters below occurred ?



Here is a close-up of the Tycho crater on the Moon, which has a diameter of 85 km and a central mountain 1,500 meters high. Is this a *simple* or *complex* crater?



Answers:

1 :A,C,B,EFG,D 2 : B. Energy is like mass times velocity squared, so velocity is more important. 3: Complex crater.



Subduction des plaques océaniques

The center of the Earth is hot. The surface cools in space. Convection movements cause the continental and oceanic plates to move on the Earth's surface.

As the rock on the surface is colder, it is denser (meaning heavier compared to the rock in the Earth's mantle), and thus it sinks. When it sinks, it not only drags the rest of its plate but also neighboring plates along with it.

When the oceanic slab on the right sinks, the right slab moves to the left, and the upper continental slab on the left also moves to the right.



Ingredients:

Milk Slices of sandwich bread Eggs Sugar

Use either stale or fresh bread. Mix the egg and sugar and dip the sandwich bread in the mixture. Cook in a pan with butter.

In a bowl of milk, place the slices on top of each other to model the subduction zone, with the upper continental plate and the lower oceanic plate.

If you push the bottom slice with a fork to make it sink at the subduction zone (arrow on the side), in which direction will the two plates move?



Slices seen from the side.



Aswers :

it disappears from the surface moves to the right. in its fall. 2: B. As the left side of the right plate sinks, the area where 1: A. The lower plate does not push the upper plate but rather drags it



Buoyancy & Floating Island

An iceberg floats because ice is less dense than seawater. 90% of the iceberg is submerged and therefore invisible. It is dangerous to approach it because it is sometimes unstable and can overturn, creating large waves and currents. In which position does an iceberg float?

An iceberg can have several equilibrium positions, not to mention that its shape changes as it melts. Let's play with icebergs for a delicious dessert.



Ingredients:

6 Eggs 200g of sugar 1L of milk Vanilla

Mix the egg yolks and sugar in a bowl until the yolks turn pale. In a saucepan, bring

the milk to a boil. As soon as the milk starts to simmer, reduce the heat and slowly pour in the egg-sugar mixture while stirring continuously. Stir until the cream thickens, then let it cool.

Whisk the egg whites into stiff peaks. Heat the egg whites in the microwave for a few seconds.

The density of the whipped egg whites is 10% that of the cream, so 90% of the egg whites float above the cream. It's like seeing an iceberg from below, as if you were a fish. The density can be increased to 90% by adding crushed pieces of hard-boiled egg whites and mixing them into the whipped whites.

Cut or mold cylinders from the whipped egg whites. In which positions do they float?





Ripples currents

On the sand at the bottom of the sea, near the beaches, you can see small ripples like tiny waves. These patterns are evidence of ocean currents.

The lines of the ripples are perpendicular to the currents. They are found fossilized in the Alps. This helps determine the depth of the sea and the strength of past currents, before the Alps were uplifted to become this European mountain range. These ripples are also found on Mars, as evidence of lakes and currents that once existed there.



Ingredients:

6 earthy potatoes

In a large pot of water, cook the potatoes. Once cooked, remove the potatoes. Observe the ripples at the bottom of the water.

After different movements to shake the pot for a brief moment, observe the movement of the water and the formation of patterns. You can tap the pot on one side or the other, give it a sharp turn, set it down, etc.

How were these ripple patterns created?



- 1: By tapping the left side of the pot.
- 2: By briefly spinning the pot on its own.
- 3: By tapping the top of the pot.
- 4: By tapping the top of a pot tilted to the left.
- 5: By dipping and removing a large ladle from the left side.
- 6: By tapping a square pot.
- 7: By dipping and removing a small ladle from the left side.

What is it?

- 1 Sand on a vibrating plate
- 2 Ripples on Mars
- 3 An electronic cloud

Answers :



1B' 5D' 3F' 4G' 2E' 8H' 1E - 1B' 51' 3C



Voronoï to get Models

To forecast the weather, stations measure meteorological parameters, but they are unevenly distributed across the Earth. Around each point, a so-called Voronoi cell can be defined, within which a homogeneous value can be assigned for modeling.

The edges of the cells are the bisectors between the closest points.



Ingrédients for Bread Dough

250 mL of milk
50 mL of water
2 tablespoons of oil
1 tablespoons of salt
1 tablespoons of sugar
Yeast
300g of wheat flour

Mix milk, water, oil, salt, and sugar. Heat (in the microwave) to about 43°C.

Add yeast. Stir, and let the yeast develop for 10 minutes. Add flour. Knead in a large bowl, adding more flour until the dough detaches easily from the sides.

Let the dough rest for 1 hour, during which it will rise. Cover the bowl with plastic wrap to prevent the dough from drying out.

Divide the dough into balls and place them on parchment paper ready for the oven.

Let them rest, and in the meantime, prepare the craquelin.

Ingredients for Craquelin:

125 mL of warm water, 150 g of rice flour

The idea is to replace the flour that contains elastic gluten with rice flour (dry rice ground into powder) that does not contain gluten and will crack when the bread balls expand. Mix warm water with a pinch of salt, sugar, and the yeast.

Then mix with rice flour. You can add food coloring to the dough if desired.

The dough should be solid enough not to run but not too thick to be spread with the back of a spoon.

Spread a 2 to 3 mm layer on the bread balls. Preheat the oven to 200°C for 10 minutes, then bake until cooked (check by inserting a knife that should come out clean) and golden.

Complete the drawing:



Connect the points that are in adjacent Voronoi cells to achieve a proper triangulation of the space..





Cascade de Vortex

In a turbulent flow, energy is initially introduced at large scales through large vortices. This energy is then transferred to progressively smaller scales via a process known as the energy cascade. At each stage, smaller vortices are formed, and energy continues to be transferred to smaller scales until it is ultimately dissipated as heat by viscosity at the smallest scale, known as the Kolmogorov scale.



Ingredients: Mussels Cream Herbs Green laser pointer Lenticular lens (can be obtained from a postcard with a 3D photo)

In a large pot, fill it halfway with mussels, add 1 cm of water. cream. and herbs. Cover the pot. Once the mussels open, they are cooked. In dim place the liaht. lenticular lens in front of the laser at the edge of the pot and eat the mussels one by one.

Each time you dip your hand into the pot, new vortices will be generated in the air. The water droplets condensed from the steam rising from the pot intercept the laser in the plane. The vortices are then visible. There are few large vortices, more of medium size, and many small ones, following a power-law distribution. What vortex distribution is the most realistic?





Draw your vortices while respecting the conditions:

- 1) Draw twice as many vortices of half the size. (power law)
- 2) Vortices that touch must go in the same direction:



Otherwise, you must insert another vortex between them.





