

The background is a dark blue gradient. It features several abstract elements: a dotted line at the top that curves across the width; a thick, wavy line that starts from the left and curves downwards towards the right; another thick, wavy line below it that starts from the right and curves downwards towards the left; and a dotted line at the bottom that curves upwards towards the right.

Two voyages

3D Globe: guidelines for didactic exploration

This map intersects two great voyages of humanity. Between and after these, countless other trips and migrations took place, creating our species's complex genetic heritage. The first major voyage represents the expansion of modern humans (*Homo sapiens*) across the globe. Since their origin in Africa 300 000 – 200 000 years ago, it is only about 70 000 years ago that the successful migration of a small group of modern humans out of Africa occurred, taking advantage of the favourable conditions to expand over the immense landmass. In evolutionary terms, this expansion was quick and was carried out in waves by small groups, who multiplied in the new territories. One of the genetic effects of this expansion process completed by small founding groups was the decrease of populations' genetic diversity the farther they were from the original region.

The second voyage depicted on the map circled the vast "archipelago" of continents, from 1519 to 1522. Fernão de Magalhães and Juan Sebastián Elcano undertook a sea voyage mostly throughout the southern hemisphere. This journey goes in the opposite direction to the human expansion effected for the most part by land and initiated 70 000 years ago. Many of that second voyage's landmarks were, at the time, vital and dynamic commercial points and a meeting ground of different cultures and lineages. After all, many generations of modern humans built, destroyed and rebuilt geographies, cultures and knowledge. This expedition, however, proved that global seafaring travels were possible.

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Two voyages

Project “Human diversity along the Magalhães circum-navigation space: genetics, history and culture”

Didactic Object: 3D globe



Figure 1.

This object is at the crossroads of two great voyages of humanity: the human voyage and the journey undertaken by Magalhães. The human journey follows the expansion of modern man (Homo Sapiens) across the globe from its origin in Africa 300,000 – 200,000 years ago up to their arrival in South America 15,000 - 10,000 years ago. Magalhães's voyage, carried out between 1519 and 1522 by Fernão Magalhães and Juan Sebastián Elcano, was the first expedition that crossed the three great oceans - the Atlantic, the Pacific, and the Indian Ocean - then returning to the starting point

The best way to understand these two voyages is through spatial visualization, which is why a three-dimensional object was created. It is a story map (see figure 1), whose goal is playful and didactic exploration, in association with the informative text.

Characterization of the printed material

On its first page, the document presents a generic description of these two voyages, as well as a planispherical representation of a **3D model** depicting both the map of the world and the courses followed in the journeys undertaken by humans and Magalhães (Figure 2).

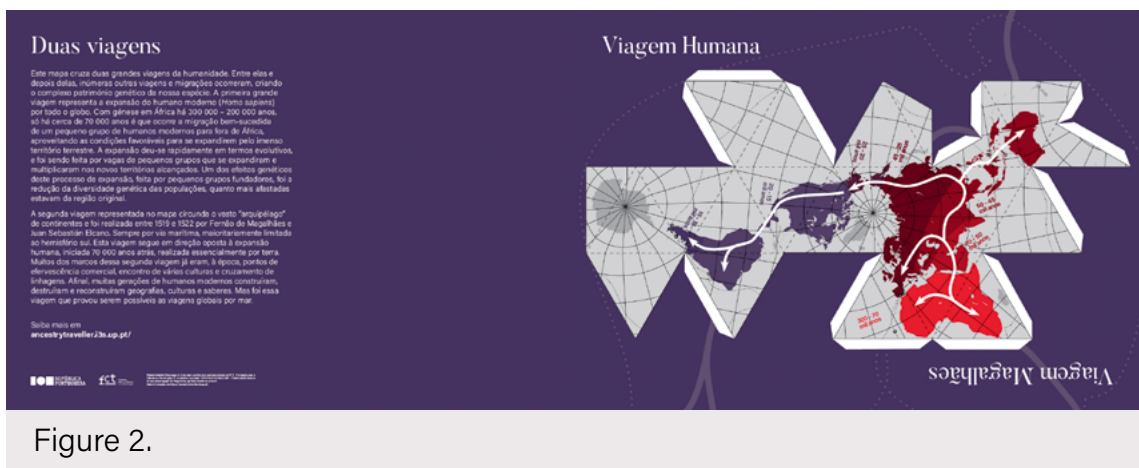


Figure 2.



Figure 3.

The back of the document displays detailed chronological descriptions of the voyages (figure 3): the “human voyage” started 70,000 years ago and essentially carried out by land; and Magalhães’s voyage in the 16th century, mostly by sea (circumnavigation). Students of different ages and education cycles can manipulate and explore the globe. Exploring this tool requires the construction of the 3D model, meaning that the planisphere is to be printed, cut, folded and glued to obtain the polyhedron in which the two voyages can be observed in continuity.

Didactic exploration with students of the 1st and 2nd Cycles

EXPLORATION PROPOSAL:

We propose some didactic exploration activities that intersect with school curricula. Two of them are linked to the field of Geometry and the other two relate to journey exploration resorting to the representation and information etched on the globe.

1. Recognize and represent geometric shapes by building 3D models

To build the polyhedron, students must cut and glue the model. Instructions are simple: cut only along the outer line, then fold all the lines. The narrower flaps marked with a thinner line indicate the glue zones to build the polyhedron in its final shape. The glue should only be applied to the flaps.

2. Recognize properties of a geometric solid (object) and characterize it

Students can explore the object’s features by counting faces, edges, and vertices. They can calculate the area of the faces, as well as the volume of the object. Discuss the polyhedra in a general way and characterize the geometry of the object.

3. Explore both voyages through object manipulation

Identify and describe what the object represents, taking into account the information in the leaflet. Identify continents and oceans in the 3D object. Follow the points in Magalhães' trip featured in the information leaflet. Compare and describe the direction each voyage has taken. Compare the direction followed in the *human voyage* with that of Magalhães's.

Discuss with students topics such as:

- Human origin and expansion;
- The great circumnavigation voyage helmed by Fernão Magalhães and Elcano.

4. Outline a comic (a short book or just a few strips) that tells the story of the circumnavigation voyage of Fernão de Magalhães and Sebastián Elcano, based on the points described in the brochure.

Didactic exploration with 3rd cycle and high school students

EXPLORATION PROPOSAL: Maps and cartography

Fernão Magalhães's voyage was the first to circumnavigate the globe, which entailed significant challenges for geographical representation. At the time, cartography was still developing and the accuracy of maps was limited. Magalhães's voyage tested and expanded the limits of geographical knowledge, contributing to the improvement of cartographic techniques.

1. Discuss with students the polyhedral 3D object as a representation of the two voyages, the human and the Magalhães's

The use of a 3D polyhedron makes spatial visualization tangible, allowing students to physically manipulate the object, helping them understand the voyages' extent and trajectory, and enabling its spatial visualization, and therefore its understanding. The human journey illustrates the gradual expansion of *Homo Sapiens* from Africa to South America. This expansion is complex and includes multiple routes and detours over thousands of years, not represented in the object. The voyage Magalhães embarked in was linear and continuous, a circumnavigation of the globe more easily represented on a 3D model than on a planisphere. However, the projection on a polyhedron may not accurately represent the actual distances and proportions of the oceans because the surface of the globe has been distorted to fit a polyhedral shape. We propose a discussion on the limits of this projection of the terrestrial globe, which can serve as a bridge to the exploration of other resources, such as the ones described below.

2. **Explore the subjectivity of map making** using two Wikipedia pages, one on **cartographic projections** and the other presenting a **non-exhaustive list** of these projections. Exploring these pages with students will facilitate a reflection on the terrestrial globe's representations. In particular, a discussion may be promoted about which projection they are most used to seeing in books and manuals, or about the advantages and disadvantages of using the **Dymaxion map or Fuller's projection** (used in the 3D object).

- **Comparing different projections:** Have students visually research and compare the characteristics of Mercator, sinusoidal, and Gall-Peters projections. They can elaborate presentations or posters highlighting the distortions of each projection and discussing their upsides and downsides.
- **Analysing real maps and practical applications:** Distribute different maps of the same location but using different projections for students to compare and discuss what sets the representations apart. Challenge students to investigate how different projections are used in real-world applications such as maritime navigation.
- **Discussing ethics and representation:** Prompt a discussion on the ethics underlying cartographic projection choices. For instance, how choosing a particular projection might influence public perception of global issues such as development inequalities or climate change.

2. **Explore the making of a planisphere** using the following resources: the **Projection Wizard** and the **World Map Generator**, or **Mapbox**. Projection Wizard is a cartographic projection selection tool that helps you choose the most suitable projection for a map. World Map Generator is an online tool that allows you to create and customize interactive maps..

- **Projection and distortions:** Use the *Projection Wizard* to help students understand that there is no universally perfect projection. Each has its advantages and distortions. Ask students to choose a region of the world and compare how the different projections represent it. Using the *Projection Wizard*, allow students to experiment how different projections distort areas and shapes.
- **Geographical and historical studies:** Encourage students to create personalized maps with *World Map Generator* to study continents, countries, and historical events such as Fernão Magalhães's voyage. Suggest to students that they create and present geographic projects in the *World Map Generator*.
- **Critical Thinking:** Encourage students to question why certain projections are better suited for certain purposes than others.

EXPLORATION PROPOSAL: Magalhães and Elcano's voyage

Explore the voyage undertaken by Magalhães and Elcano, discussing the motivations and history behind the expedition. The implications and consequences brought on by this voyage from the perspective of the populations may also be debated. Use **Around the World in 200 messages**, a tool produced by "Expresso" newspaper detailing the circumnavigation voyage, to cue:

- **Historical Analysis:** Historical analysis: Apprise the details of Fernão Magalhães's circumnavigation voyage, including dates, routes and main events, comparing them with the simplified version presented in the 3D object. Mark on the object other points that strike the students' attention.
- **Research and discussion on global impact:** Encourage research on the impact of Magalhães and Elcano's expedition on global trade and intercontinental relations. Promote discussions about the information gathered.

EXPLORATION PROPOSAL: The journey of humanity

To explore the journey of humanity, the class can address topics such as demography and the recent history of humanity summarized in numbers, methods and key concepts in the study of human history, some historical milestones and facts about humanity, as well as perceptions on ancestry.

1. **Guided exploration of the [World Population History page](#):** World Population History is an interactive map that displays the evolution of world population over the last two millennia and allows you to explore the recent history of humanity in numbers. By navigating the timeline, you can observe how population centres have changed as a result of natural events, discoveries and geopolitical changes.
 - Have students explore and visualize the recent history of the world's population and understand how population centres have changed over time. You can focus on shorter periods, like the 50 years before and after Magalhães's voyage.
 - Explore how the world's population has increased over the centuries. Ask students to pinpoint the year when world population reached 1 million, and discuss the consequences of subsequent population growth.
2. **Explore the [Smithsonian Natural History page](#), on how "[Humans Change the World](#)":** This page explores the human capability to innovate and shape the environment, highlighting several key areas: technology and tools; agriculture and animal domestication; urbanization and infrastructure; climate change and the environment.

- Divide students into groups and assign parts of this section to each group for exploration, suggesting further research on their assigned historical era. Make sure they identify historical/ cultural/ technological milestones. Each group should present their findings and discuss ideas and perspectives.
- Perform interactive activities such as creating a **timeline or mind maps**. Create a collaborative timeline in the classroom, highlighting the historical milestones previously discussed. Ask students to outline mind maps connecting different historical milestones and their impacts
- Organize debates centred on important **methods and concepts** in anthropological studies, and how they can help clarify misperceptions about ancestry. To promote the discussion of prejudices and misperceptions about ancestry, we suggest watching the **movie “The DNA Journey”** together, produced by a travel agency on this very topic.

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