

A Place in the Salt!

Learning and Playing with Salt in Aveiro, Portugal

by Maria Clara F. Magalhães, Cristina Sampaio, and Paulo Trincão

For hundreds, perhaps thousands, of years, salt production was a key economic activity in the region around Aveiro, Portugal. In 2009, the interactive CD *A Place in the Salt!—Learn to Play with Salt from Aveiro* was released to highlight the scientific, cultural, and economic aspects of this ubiquitous substance. Produced by a multidisciplinary team, the CD contains activities and experiments that explore salt, salt water, brine, and some local plants and wildlife found in and around the salt pans at Aveiro.

The CD was conceived to appeal to the general public, which may have little scientific knowledge or laboratory skills, and also to primary and secondary school teachers. The majority of the activities can be carried out in a kitchen or a school classroom and do not require any specific equipment—only the supervision of an adult. There are also experiments that can be carried out by very young children.

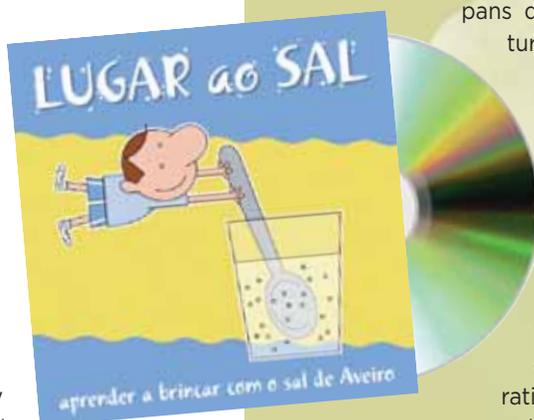
The concept for this CD began some years ago when the Museu da Cidade de Aveiro (Museum of the

City of Aveiro) suggested the creation of a booklet with some experiments related to the exploration of salt in Aveiro. The city council, which owns one of the existing salt pans (saltwater evaporation ponds), wanted to explore the economic and pedagogic aspects of salt production (Ecomuseu da Marinha da Troncalhada). The original idea was to publish a book, but this transformed into an interactive CD.

Historical/Regional Context

Salt extraction/production from seawater has existed in the Aveiro region for centuries if not millennia, even before the existence of the lagoon. The first written reference to the Aveiro (Allavarium) salt pans dates back to the 10th century, two centuries before the founding of the Portuguese Monarchy. The geological instability of the region, the continuous silting up and reopening of the lagoon to the sea, has been occurring throughout history, and, as such, has resulted in a continuous fluctuation in salt exploration in the area. The lagoon was only permanently opened to the sea at the beginning of the 19th century.

Salt exploration has been one of the most important economic activities in the Aveiro region, with more than 500 salt pans operating at its peak. Over 300 were still active at the beginning of the 20th century. From a historical and economic point of view, salt has always been a very important commercial product for Aveiro, with trading links to Brazil and other countries. Nowadays, only a few salt pans survive; one belongs to the city council, another to the University of Aveiro, and the rest are in the hands of local families that still manage to continue this ancient tradition. The loss of these salt pans means a progressive loss of the cultural and environmental richness linked to salt production. The use and even the names of the tools associated with salt production, along with the know-how, accumulated for centuries and transmitted from generation to generation, is being lost. The local wildlife and flora, well adapted to the salt pans extreme conditions, are also dying out.



One of the few remaining salt pans in Aveiro.



The Educational Project

The main aim of the interactive CD was to use salt, salt water, brine, and the flora of the Aveiro region to help children:

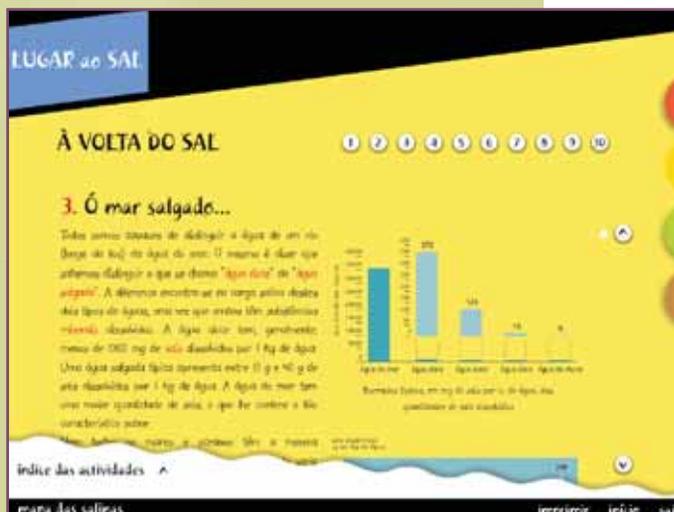
- observe the environment
- create new materials and objects
- learn some properties of materials, such as density, solubility, plasticity, etc.
- interpret the empirical knowledge, obtained from working on the salt pans, using modern scientific models
- learn the composition of particular systems such as salt or salt water
- learn which environmental factors contribute to salt crystallization in the salt pans (e.g., the tides, wind, and sunlight)

The CD is also intended to highlight some cultural and economic aspects of salt, salt water, brine, and flora. The Aveiro City Council wanted to create a method for younger generations to learn about the traditional methods of salt production, as well as the role of wildlife and plants in this particular ecosystem. The interactive science museum Fábrica Centro Ciência Viva wanted the CD to encourage children to play with science.

How is the CD Organized?

The CD/interactive book has five main sections:

1. Twenty experimental activities focus on salt water, brine, salt, and the salt pans.
2. A set of safety rules that must be followed each time the experiments are carried out: at home, at school, in the interactive science museum.
3. A section called Around the Salt, with information on 1. salt production; 2. Ria de Aveiro —the lagoon; 3. oh salty sea!; 4. biodiversity in the Ria de Aveiro salt pans; 5. tides; 6. solar radiation; 7. the sun, the wind, and the Earth; 8. the scent of salt; 9. the salt we use; and 10. handmade salt: new products, new uses. These short texts give information about the geographic and geologic characteristics of the region where the salt pans exist (Ria de Aveiro); the influence of the wind, the tide, and solar radiation on salt production; the chemical composition of sea water and of adsorbed substances in salt that impart different smells according to the region; the biodiversity in the lagoon; cultural aspects of salt production; the specific vocabulary linked to salt exploration; the economic aspects of new salt exploration; and the commercialization of new products.
4. A glossary that can be accessed directly or through keywords.
5. A technical page.



A screen shot of Oh Salty Sea! . . . , which talks about the chemical composition of sea water. There are also links to the five main sections of the CD: safety rules (red button), small texts (yellow button), glossary (green button), the technical page (brown button), and to the activities (“índice de actividades”). The links to the 10 small texts are also present (the small white buttons numbered from 1 to 10). The red highlighted words open a small window containing a description from the glossary. At the bottom there are links to the “salt pan map,” a pdf of the text for printing, and also to the start and exit of the CD.

A Place in the Salt



This screen provides links to the 20 experimental activities developed for the CD:

1. Salt crystals
2. Salt volcano
3. Salt toys
4. Bath salts
5. Dissolving salt
6. Do we need to stir?
7. Fine or coarse salt . . . which dissolves faster?
8. Can you dissolve all the salt you want in a glass of water?
9. Which solvent dissolves most salt?
10. How much salt does seawater contain?
11. Clay in river and seawater
12. Clay in the salt pans ... why?
13. *Salicornia ramosissima* and *Juncus L.*—different but similar
14. Measuring density?
15. To Float or not to float, that is the question!
16. How does sunlight effect water evaporation?
17. Sulfates in water! Yes or no?
18. How much sulfate does this water contain?
19. How much total carbonate does salt water contain?
20. What is the chloride concentration of salt water?

The experiments are presented in increasing order of complexity, ranging from those that can be done at home (from experiments 1 to 15) to those that must be carried out in a school laboratory (experiments 17 to 20) under supervision. Scientific concepts such as mass, volume, pressure, solubility, density, Archimedes principle, concentration, and chemical reactions are presented in the experiments intended for older students. Processes such as dissolution, crystallization, and vaporization can be introduced to very young children with one or more of the activities, depending on the knowledge and imagination of the supervisor.

Each experimental activity has a homepage with links to four other pages:

- **what you need**—where all the materials, equipment, and reagents needed to carry out the activity are outlined. This page is built in an interactive way where children can begin to learn, in an amusing way, about laboratory glassware and other materials, equipment, and reagents and how to handle them. When clicking on an object, the object or the reagent container moves and a sound is played.
- **what you do**—a description of the experimental procedure.

Learning and Playing with Salt in Aveiro. Portugal

- **how to explore**—a pdf document can be printed with some questions related to the activity to help children to observe and record the experiment as well as to arrive at some conclusions. These pages were created to help children increase their scientific knowledge.
- **for parents and educators**—information for adults to help in the preparation and safe execution of the activity. In some cases, some scientific information is presented.

The experimental activities are explored in a playful way. They can be carried out just for fun or to introduce some scientific concepts. For example, in activity 3. Salt toys, children can make a recipe of flour, salt, and water to make toys, create small objects, or make beautiful pictures. School teachers can use pedagogical tools to create, for example, a solar system where the notions of relative size and distance can be learned, but they also can be explored more deeply to study specific properties of solid materials.

This CD was created by a multidisciplinary team that conceived and tested the experiments and wrote the texts. Team members included secondary school and university specialists in chemistry, physics, mineralogy, biology, planning, and history; a designer who conceived and created all of the illustrations and animations; a programmer who created all the move-

ments and links; and musicians who created all the music and sounds. This project was made possible by the financial support of a number of organizations: The Fundação João Jacinto Magalhães, the Fábrica Ciencia Viva of the University of Aveiro, and the Aveiro à volta do Património project.

Sodium chloride, once an important local product in Aveiro, is the star at the center of this CD's solar system. But this is just the start, we can envisage similar projects for many other subjects. A second CD will no doubt contain the electrolysis of brine, chlorine production, health related aspects of sodium chloride, and more. 

Acknowledgements

The authors would like to express their deep appreciation to each member of the team who contributed to the CD. Special thanks go to Brian J. Goodfellow for his comments on and revision of this text and also to José Alberto Costa for help with the figures.

Maria Clara F. Magalhães <mclara@ua.pt> is a professor in the Department of Chemistry at the University of Aveiro and current chair of the Subcommittee on Solubility and Equilibrium Data of Division V. Paulo Trincão is a professor in the Department of Biology and a member of CIDTF at the University of Aveiro. Cristina Sampaio is the artist responsible for the conception, illustration, and design of the CD.

