

MUSEO NACIONAL DE CIENCIAS NATURALES, MADRID, SPAIN

Body movement: is a skeleton machine?

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Part 1 Basic information

Institutions involved

The National Natural Sciences Museum in Madrid is part of the Superior Council for Scientific research, an autonomous agency of the Ministry of Science and Technology. It was founded in 1771 and today is one of Spain's most important centres in the field of natural resources. It holds the most complete collection of natural science exhibits in the country: more than six millions of insects, molluscs, invertebrates, fish, amphibious, reptiles, birds, mammals, fossils, stones and minerals. The Department of Public Programs was created in 1990 in order to develop different programs and activities based on informal education methodology and aiming at a public understanding of science. These activities have been planned from the beginning to satisfy both scholastic and general public. Teachers and museum educators work in collaboration throughout the school year for the realisation of activities devised specifically for schools.

CAP of Retiro is a Centre for support to the Teaching staff of a central district in Madrid.

Primary schools

- *The Public School Ramiro de Maeztu.*
- *The Public School Luis de Góngora.*
- *The Intermediate Italian School.*

Aims

The main objective of the project *Is a skeleton a machine?* is to consolidate the relationship between educational centres. Other more specific objectives are:

- To offer training experience centred on the organisation of educational activities in the museum with the collaboration of the teaching staff.
- To adapt the content of the activities in the museum to the scientific curriculum with special care for multidisciplinary perspectives.
- To serve as innovative teaching resource in the development of the regular educational programs.

Materials

- 5 cuts of salamander bone, provided by a group of investigation of the Museum.
- Microscope.
- Monitor and Camcorder for television connected with the microscope.
- 1 assembled model of a natural size human skeleton, which has been familiarly, named "Casimiro".
- 1 disassembled model of a natural size human skeleton, which has been familiarly, named "Casilda".
- Sticky panel on which to assemble "Casilda". The skull and breastbone have previously been fixed to the panel.
- 4 plastic bones to keep the 4 parts in which the disassembled skeleton is divided.
- Steel Cable in which to insert the vertebrae.
- Cards.
- Kit with disassembled model of articulated arm.

Part 2. Description of the project

The work-group was created with the support of the *CAP of Retiro*, centre for permanent training of the teaching staff, and the advice of Paloma Varela, expert in experimental sciences. It was conceived in this particular way to enable a tight collaboration between the school teaching staff and the specialists of the museum Department of Public Programs. The *CAP* officially certificates the attendance of professors to the

course in which there is continuous monitoring on the planning of museum visits and activities. The museum offers the schools participating to this project the possibility of a visit to one of the exhibitions and of a free workshop.

There have been 3 primary schools and 9 professors participating to the work group:

- The Public School *Ramiro de Maeztu*, located close to the museum. The teachers who collaborated in the project are: Enrique Araúz, Montserrat Alvarez, M^a Victoria Mora and Fátima Moreno.
- The Public School *Luis de Góngora*, which has been contacted directly by the *CAP*. The teachers who collaborated in the project are: M^a Carmen Llorente and Alicia de Alberti.
- The *Intermediate Italian School* with which we have collaborated since the beginning of the SMEC European project, and which follows the Italian curriculum. The professors who collaborated in the project are: Guido Ramellini, Anna Paola Schiesaro and Germana Guerzoni.

The teachers of these centres have worked to incorporate the museum visit within their educational program, planning preparatory and follow-up activities to be carried out in class. It has been decided by the Department for Public Programs of the Museum that the visits should present the topic of movement and therefore be conducted in the exhibition "Mediterranean: nature and civilisation". In support to the visit an activity sheet and a workshop called "the machine of the body" were developed. Both activities focused on the comparison between human skeleton, animal skeleton and machine movements.

Preparation of the museum visit

In order to prepare the visit to the Museum it is of prime importance for the teacher to be confident about the spaces and resources of the museum.

A work group has been created to give the possibility to teachers of the primary school to use the *National Museum of Natural Sciences* as a teaching resource for their scholastic program. Its objectives, contents and methodology are the following.

Aims

- To reflect upon the importance of science in education and in common life.
- To design preparatory and follow-up activities.
- To deepen the relationship between museum and school through the participation of the teaching staff.

Contents

- Presentation of the work group participating to the *SMEC* project.
- Visits to the *National Museum of Natural Sciences* and to the workshop areas.
- Presentation of the workshop "the machine of the body" and proposal to work on the design of preparatory and follow-up activities.
- Individual work sessions in which the teachers create the teaching activities.
- Sharing of the work results through the presentation of sketches of the designed activities.
- Presentation of the final teaching proposals.
- Class work with preparatory activities. With the students.
- Visit to the museum and workshop "The machine of the body" with the students.
- Class work with follow up activities with the students.
- Conclusions on the activity of the work group.

Methodology

The group works with an active methodology in which the participation of the teachers is fundamental for the creation of the teaching activities.

At the same time the museum workshops have developed since 1992 a methodology based on the active participation of students. Consistently with the concept of "learning by discovery", the students are led by a museum educator to experiment different tasks. In this way they acquire directly concepts relating to the field of natural sciences, of scientific research methods and of ethical issues about attitudes towards the environment. During these experiences the students are brought as close as possible to the real work of scientists. The collections they visit are chosen on the base of their scholastic level.

Timing

The complete work of the group lasted 30 hours, divided in five modules of two and a half hours, throughout three months. After these sessions in the museum there was a period in which teachers worked in class on the designed activities together with the students. Subsequently there was a last two and a half hour meeting to elaborate conclusions.

Preparatory activities with the students:

The teachers have designed a series of preparatory activities for their students. The following selection presents works, which best suited the criteria of group work, proximity to the daily life, interdisciplinary and experimental character:

- *Throwing*. Experimenting different ways of throwing a ball to verify the functionality of the arm and the physical balance of the body.
- *X-rays*. Recognising the different parts of a human skeleton through x-rays.
- *In the laboratory*. Observing chemical reactions of the bones in an acid atmosphere to deduce data on their composition.

Visit to the museum

Organisation

Usually, to make a group visit to the Museum, it is essential book in advance. This is compulsory for groups of 12 or more people. It is necessary to have one guide for each group of 20 students, who takes responsibility of the group during the visit.

Within the framework of this project the museum organised visits for a total of 9 groups coming from the 3 participant schools. Each group stayed in the museum for 2 hours and worked in the frame of a long experimented formula which combines active visit and workshop.

The visit to the exhibition allows the "reading" of objects that can't normally be seen at school. This already justifies the use of the museum as a special teaching resource. On the other hand the workshop methodology, which is based on interaction, contributes to keeping the student's level of attention and motivation high for the entire duration of the visit.

Activities have been carried out with the following order:

1. Visit to the exhibition "Mediterranean: nature and civilisation" with the support of the booklet "Moving the skeleton". In the terrestrial fauna gallery students are asked to observe different skeletons of birds and mammals and consequently to analyse the analogies between the extremities of a hare, a flamingo and a porpoise. In marine fauna gallery, the students are asked to analyse a squid which, being an invertebrate, does not have a bony skeleton and thus has developed a different mechanism for movement. The main issue of the visit is the comparison of the anatomy of the vertebrates. Each child has his own booklet but the work is organised in groups of 5 or 6. These carry out the activities in different sequences in order not to interfere with one another when searching for information. The booklet has been created specifically for the project, with the collaboration of Carolina Rodriguez and Amaranta Martín, Masters of Museology of the Faculty of Fine Arts, Universidad Complutense of Madrid.
2. Then the pupils move to the didactic room "Aula Circular", contiguous to the exhibition, to follow the workshop "the machine of the body". This workshop is centred on the study of the human skeleton, its parts and their functions. In this activity technical resources are used in a group work in which the pupils assemble a complete human skeleton and thus understand and learn through a pleasant and playful participation.

Contents and activities

The materials that are used are listed above.

The development of the workshop responds to the following sequence:

1. Presentation of the activity. The museum educator briefly presents the skeleton of a vertebrate and its use. Students are divided in four groups of six children. Each group assembles a quarter of the human skeleton: one group has the vertebrae, another the legs and pelvis, and the other two the arms and ribs.
2. Activities from a teaching sheet. Children draw different parts of the human skeleton and recognise the displaced skeletons of 6 different vertebrate animals.
3. Assembly of the complete skeleton. Children assemble the four parts of the skeleton on the panel. In order to make this reconstruction they have a reference to a complete human skeleton.
4. Assembly of the model of an articulated arm. This activity requires precision and time. Given that not all children have the same manual skills, the teacher is provided with the assembly instructions so that they he can let pupils finish the work in class.

This workshop is part of the normal education activities in the museum. For the *SMEC* project it has been completed with the last part, the assembly of a model of articulated arm. This change has been made in order to clarify the relation between the structure of the human body and its movements. It is an innovation coming from the proposal of one of the teachers in the work group.

Follow-up work in classroom

The teachers working on the project also designed a series of follow up activities in order to continue working on the concepts, procedures and attitudes acquired in the museum visit and workshop.

The following selection presents works, which best suited the criteria of group work, proximity to the daily life, interdisciplinary and experimental character:

- The handles in daily life. Observation and analysis of some handles which children bring to the class from their own houses.
- Zoology. Reproduction, by means of mimics, of the different vertebrate and invertebrate animal movement after having seen a specialised video.
- "I know an animal..." Reinforcement, through creative activity, of the knowledge acquired in all the process by means of the creation of an imaginary animal.

Conclusions and evaluation

As a conclusion, the accompanying teacher fills in a short questionnaire in which he gives his opinion on the activity and on how the pupils responded to it. All the teachers involved in the project will present a unified form.

The teachers in general seem to have appreciated the methodology and the possibility to visit the museum following a thematic itinerary adapted to the specific interests of each group of pupils.

Facilitators/innovative aspects

The most successful part of the project was the participation of the teachers in the design of the preparatory and follow-up activities. It seems that pupils were strongly satisfied with the activities designed by their own teachers. This idea comes from some of the final considerations of the teachers involved in the project.

Appendix

- Complete project.
- Worksheets.