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STAMPING ON THE CARBON FOOTPRINT

carbon footprint, sustainability, noise pollution, air pollution, greenhouse effect, environment

chemistry, mathematics, physics, biology, geography, ecology, integrated language (age level 14–16)

10–16 years

Materials: All the additional documents can be downloaded from the Science on Stage website [1]:
Pair cards for the game (see p. 77), information cards, examples of questions and solutions, calculator

1 | SUMMARY

Football is a popular sport in most European countries. In recent years major (premier) clubs have become increasingly interested in the environmental impact of football and how to reduce its carbon footprint. The goal of this project is to educate the students about the environmental and ecological impact of football and to increase awareness of how premier football clubs could become more environmentally sustainable.

Today's world demands a global outlook in every subject and every classroom. As educators, our task is to help the students by giving them the skills, tools and perspectives they need in order to become fulfilled human beings, responsible global citizens and effective promoters of a sustainable future.

2 | CONCEPTUAL INTRODUCTION

We have created a serious game for the students that will make them think about the carbon footprint of a major sports event.

There are six sets of cards, each focusing on one aspect of sustainability. To complete the game, the players will need to cover all of them. The game is appropriate for a wide curriculum range for students aged 10–16 years. By answering the questions the students learn about the complicated effects of a big international sports event. It helps them to realise the responsibility we bear for wasting or using energy and resources such as food and water and to discover how fragile our earth is.

We picked six aspects of how a big sports event affects its natural surroundings. The six topics studied are: light, travel, green grass, waste, noise pollution and food.

What the teacher has to do

In the first lesson the teacher helps the students to review their existing skills and knowledge by:

- asking questions (What is the ecological footprint? Where can we find information about this topic? What do we know about the production, distribution and consumption of energy?) and clarifying the purpose of the activity,
- activating previous knowledge through brainstorming (using keywords),
- explaining the structure and the rules of the game.

The teacher prints out the pair cards and the information cards.

In the development lesson, the teacher explains the rules of the game, forms groups of four students each (depending on the class), identifies a group leader for each one and plays the game.

The information cards report details of the following aspects: the values of the carbon dioxide emissions of different types of transport, the combustion reaction of the various fuels, information about ways to save carbon and water, the meaning of luminous efficacy and the electrical power consumption of different kinds of bulb, a map of the efficiency of a distribution grid, the speed of sound and the level of acoustic pressure and so on. All of the data is useful for solving problems.

During the last lesson, the students should reflect on the topics of the lesson and the difficulties they encountered. All of the students should learn to overcome difficulties together and self-evaluate their group.

3 | WHAT THE STUDENTS DO

The game is played as a pair card game: 12 cards, 6 pairs, 2 cards per topic.

Topics: light, travel, green grass, waste, noise pollution, food

Working rules: Divide the class into groups named after their favourite football teams. Then spread all the cards face down on the table (option: use a Smart Board). Let the first group pick one of the cards, turn it over, look at the symbol and have a group member explain what the symbol means in a limited amount of time (e.g. use an egg timer—our suggestion is five

minutes for a higher level and two minutes for an easier one). Younger students can use keywords and terms in the information cards to help them. We suggest that older students use their personal background knowledge.

Options: Older students may check the Internet to research relevant scientific data. The group leader has to tell the rest of the class what he or she has found out about the topic.

After the given time has elapsed, the teacher can award the team between one and five points. (Our suggestion: The teacher should not tell the group the points awarded until all the other groups have made their statements.) Then the group picks a second card; if the second card matches the first symbol, the team has to answer the teacher's question about this special topic and may score additional points (up to a maximum of five points). If the team finds a pair, the cards are removed from the game.

Each pair of cards gives you a maximum of ten points.

If the team does not find the second card matching the first symbol, it is the next group's turn. The next group can either pick up a new card or the same card, but in the case of the same card the team is not allowed to give the same explanation as the first group. This team will have the same amount of time as the first one, and it will also be awarded points by the teacher.

At the end of the game, when all the cards are gone from the table, the sum of all the points will reveal who the winner is.

4 | CONCLUSION

As teachers, we should educate our students about the importance of sustainability and instil in them a sense of personal responsibility. The subjects that are covered in the game concern natural science and mathematics, and with the data they obtain the students can reflect on ecology, their carbon footprint, and the sustainability of their daily actions.

Some questions can be simplified by using the data on the information cards, because some problems (that were read only once) were difficult to solve. We might also print out the tasks in order to facilitate collaboration within the groups as they work out the solutions. When we tested the game in our classes (aged 14), all of the teams tried to solve the problems in order to be able to respond and to score two additional points if the other teams made a mistake. The game was coordinated by one student from a higher class in order to encourage peer-to-peer education.

Example of a student game session

After giving some information to the students about the topics covered by the game, the teacher puts the cards on the table.

Example of the teacher's introduction for LIGHT

"When we sit in a stadium, we rarely think about the way the energy we are using is produced and distributed, or whether the primary source is renewable or not. When we look at the results and the highlights of a match on a video screen, we do not know if the screen has been made with LED technology or whether the stadium is using an energy-saving light source. We have to change the way we think, and we must aim to make sustainable living our second nature."

The first group picks a card and discovers the light symbol. The teacher asks the team manager to explain what the team knows about the production, distribution and consumption of energy and what the difference between energy efficiency and energy conservation is. The teacher writes on the blackboard some keywords that will be useful for the class as it organises its thoughts on the subject of LIGHT. A maximum of five points is assigned.

The group picks up a new card, if it is lucky, it will get a card in the same category. Now the group has to solve one problem using the information available on the information cards. The teacher reads a question and all of the groups have to make their calculations within five minutes.

Sample task: "Check your daily electrical consumption at home (suppose your family consists of four persons)."

To answer the question, all of the teams must look at the information card to find the formula required for the solution:

Daily home electrical consumption:

$$\frac{(\text{Number of persons} \cdot 500\ \text{kWh}) + 500\ \text{kWh}}{365\ \text{days}}$$

Answer: $2{,}500 \frac{\text{kWh}}{365\ \text{days}} = 6.8\ \frac{\text{kWh}}{\text{day}}$

A correct answer adds five points to a team's score; a wrong answer adds two points to the other teams' score. The pair of cards is removed from the table and then it is another team's turn.

Some questions for the game

TRAVEL topic example:

What do you know about the carbon footprint? How many kg per km of carbon dioxide are produced by the fans (40,000 per match) over 51 matches of the 2016 UEFA European Championship if ¼ of the fans travel to the matches by train, ¼ by bike, ¼ by bus and ¼ by plane?

Answer: The one-way total is 295,800 $\frac{\text{kg}}{\text{km}}$.
(591,600 $\frac{\text{kg}}{\text{km}}$ is the two-way total)

FOOD topic example:

What is the production cycle of food? Look at the information card to find the carbon and water footprints of some foods and calculate how many litres of water are saved by eating 1 kg of potatoes per week instead of 1 kg of beef.

Answer: 15,214 L saved

NOISE topic example:

What is the range of the human acoustic threshold? The WHO (World Health Organisation) has determined that the acoustic threshold of risk is 85 dB and the acoustic threshold of pain is 120 dB. How big is the increase in sound intensity?

Answer: 3,125 times

GRASS topic example:

If we cut the grass (2.5 cm) of a stadium (120 m × 60 m), what will the volume of the cut grass be in cubic meters?

Answer: 180 m^3

WASTE topic example:

How many m^3 of garbage will be produced by the use of 7,000 paper cups if each one occupies a volume of 0.25 dm^3?

Answer: 1.75 m^3

5 | COOPERATION OPTIONS

- Share the questions and topics with other schools or classes.
- Each class that tests the game should write a new question and share it with classes in other countries.
- The game can be inserted into a multimedia platform and played in different places at the same time.
- If you involve the English teacher, you may have a win-win situation when you introduce this interdisciplinary game.

RESOURCES

[1] All additional materials (information cards and example questions) available at www.science-on-stage.de/iStage3_materials.

IMPRINT

TAKEN FROM
iStage 3 - Football in Science Teaching
available in Czech, English, French, German, Hungarian, Polish, Spanish, Swedish
www.science-on-stage.eu/istage3

PUBLISHED BY
Science on Stage Deutschland e.V.
Poststraße 4/5
10178 Berlin · Germany

REVISION AND TRANSLATION
TransForm Gesellschaft für Sprachen- und Mediendienste mbH
www.transformcologne.de

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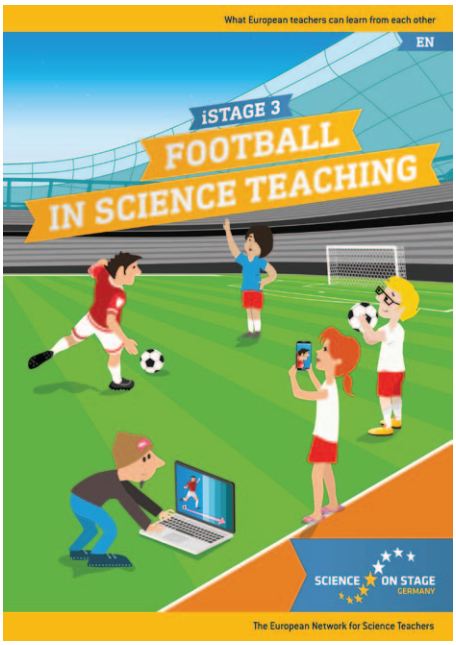
DESIGN
WEBERSUPIRAN.berlin

ILLUSTRATION
Tricom Kommunikation und Verlag GmbH
www.tricom-agentur.de

PLEASE ORDER FROM
www.science-on-stage.de
info@science-on-stage.de

First edition published in 2016



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