GOAL OF THE CENTURY

1. Overview

The Argentina v England game in the quarter-finals of the 1986 FIFA World Cup in Mexico City included two of the most famous goals in football history, both scored by the Argentinean player, Diego Maradona. The second of these was voted in 2002 as the Goal of the Century. Indeed, some claim this to be the greatest individual soccer goal of all time!

In this Case Study pupils investigate why this particular goal is so famous and admired. They create a simple mathematical model to explore the contention that it is best ever goal (so far!). At the conclusion of the three lessons, each pupil will have developed a personalized model for evaluating *any* soccer goal – either from the past or in the future. Pupils use their model to rate the Goal of the Century and compare it to some other famous goals, including some of their own choosing.

This is an engaging problem for pupils who are interested in soccer or sport in general. The opening story about the famous Maradona goal piques pupils' interest and creates a vibrant point of discussion about 'best ever' events. People often make unsupported claims about these, and so pupils should readily relate to the context.

Although ranking the 'greatness' of soccer goals is not an activity that has huge social implications *per se*, the aim of this Case is to help pupils recognise that, in everyday life, opinions are often based on what can be quite flimsy, anecdotal or subjective evidence and that it is often extremely important to try to justify claims objectively. At one level of understanding, pupils learn that goals can be compared and ranked using a mathematical model, but the Case aims to develop the deeper understanding that good decision making is based on sound reasoning supported by objective and justifiable evidence.

2. Mathematical content

To create their model, pupils identify and select parameters (variables) whose values may be either measured or counted. They devise point scales to score each variable in their chosen model. A total score for each goal is obtained by summing the scores for the selected variables. This score then allows the goal to be ranked alongside other goals.

The task is rich with mathematical possibilities and has strong links to the KS3 curriculum (see below). As they progress through the lessons, pupils discover that in order to be able to make reasoned, informed judgements about the relative greatness of soccer goals they need to think and work mathematically – although pupils may not initially recognise some of the necessary thinking as being "mathematics". Mathematics lies in the *critical understanding* that a model should be created in order to decide whether a goal is, indeed, the 'goal of the century'.

Research has shown that having pupils think qualitatively before quantitatively reduces 'cognitive overload' and allows them to focus on the core thinking without being distracted by numbers, units and formulae

Pupils learn the concept of a mathematical variable and develop an understanding of the distinctions between opinion-based, measured and counted variables. They make decisions about what variables are important and think about how they can collect the data they need from each variable. The identification, categorization, choice and use of variables with which to develop a ranking system is part of *mathematical modelling*, as is elucidating and explaining any estimates, assumptions, restrictions and constraints that they believe they need to make in ranking/rating individual goals. The discussions that ensue as pupils justify their positions add to the richness of the task, especially as it is very likely that different scoring or ranking models will produce different outcomes.

The skill-based mathematics required is appropriate for pupils in the KS3 target range, being accessible to those with lower levels of ability yet challenging for more skilled and confident pupils, particularly if they incorporate the concept of weighted variables. Number, Geometry and Measurement are involved when pupils make estimates and direct and indirect measurements of distances and angles from the video clips. Statistical skills are needed when pupils collect and tabulate the primary data.

3. Organisation and pedagogy

The lesson descriptions provide suggestions as to how the problem can be tackled, but there is flexibility for both the pupil and the teacher. Whichever approach is adopted, the nature of this problem is that it encourages pupils to explore a variety of creative solutions and then to contrast them with other models in the class.

A strong feature of this Case Study is its accessibility to pupils of differing abilities. The problem posed is an 'open' one with no 'correct' solution. This allows pupils the freedom to investigate possibilities without being concerned that they may be 'wrong.' Indeed, a motivating factor of this Case is the opportunity it allows each pupil to devise with a model of their own design.

After viewing video clips of several famous soccer goals, *every* pupil will be able to make an initial judgement about the greatness of this Maradona goal compared to other goals. Opinions are likely to differ, and this in itself makes an interesting starting point. Some pupils may disagree and want to suggest other goals as the 'best ever'. The Case allows pupils to think of different models, some of which may be quite sophisticated. For example, some pupils may come up with a weighting system.

For the teacher there is flexibility:

- in the manner in which the concepts are translated into actual classroom activities;
- in the balance achieved between control of the activity and pupil decision making;
- in deciding whether tasks should be done individually, in groups or as a whole class;
- in deciding the level of difficulty appropriate for the class in question;
- in allowing the pupils to explore ideas of interest in more detail; and,
- in determining how the pupils' work on the tasks should be assessed.

General Advice:

- Keep the Aim of the Case Study (using variables and constraints to design a model) and the final task (applying and justifying the model) in mind at all times. Remind the pupils of them frequently to ensure that individual lessons have a focus and the entire case study has a clear and meaningful purpose.
- Learn with the pupils. Work the task in preparation for the lessons. Measure the relevant parts of the video clip and form your own opinion. One approach is to create spreadsheets using Excel, and explore the variables yourself.

- Allow the pupils the amount of freedom you are comfortable with. Discussions can be guided in a directed and ordered manner or in a less structured way with pupils exploring areas of interest on their own.
- At all points where mathematical skills are required, quietly raise the pupils' awareness of the fact that this is happening, but do not introduce the skill before the need is apparent and clear.
- Extensions:
    - Pupils come up with a set of their top five all-time best ever goals using their ranking system.
    - Pupils could extend their examination to goals scored using other parts of the body. Sets of video-clips of different types of goals (such as spectacular mid-air goals or goals scored off the head) could be provided.
    - Pupils could research the voting system that was used in 2002

Assessment of pupils' work should be based on their performance in the tasks themselves. Some suggested methods of assessment are:

- Portfolio of Lessons: The worksheets can be collected and assessed at the conclusion of the Case. It is suggested that criteria be established before the task begins. For example:
    i. accuracy (of measurements, calculations, etc);
    ii. work habits (cooperation, responsibility for own tasks, etc);
    iii. effectiveness of presentation (of graphs, summary charts, etc);
    iv. selection of appropriate strategies and mathematical and ICT skills for the analysis.
- Pupils explain their model using a written justification and/or an oral presentation. They should explain the features of goals they most admire (i.e. their variables) and justify their inclusion in their model. They should also explain any restrictions/constraints/assumptions they made in the development of their model. For example, they may have decided to compare only goals kicked from within a certain distance from the goal-mouth or only goals kicked off the ground.

4. Resources

You need ICT access.

The Case Study materials include:

1. Detailed lesson plans for the teacher including goals and features of the lesson, a suggested flowchart of activities and prerequisites (preparation and prior learning).
2. Embedded video clips of goals
3. Pupil Worksheets for each lesson.
4. Homework and Assessment strategies
5. A table of Goal Data for five famous goals
6. A scaled template of a soccer field

SCALED DIAGRAM OF SOCCER FIELD

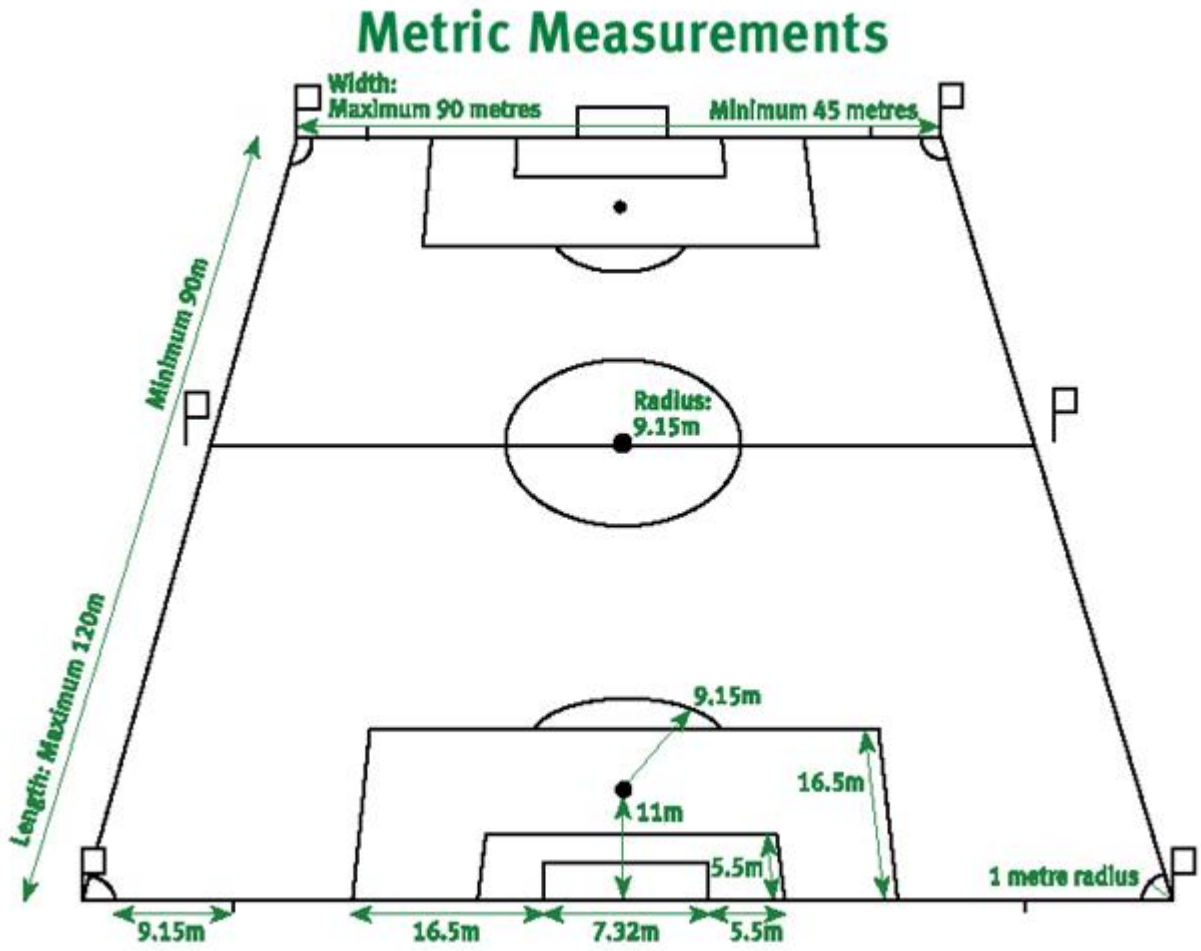

TABLE OF GOAL DATA

Player	Match Details	Suggested goal features (not a definitive list!)
Joe COLE	2006 England v Sweden World Cup See Resources Page for **Joe Cole: 2006 England v Sweden World Cup** Total running time 30s	**Opinion-based variables** • 'Wow' factor • 'Skilfulness' of the goal **Categorical variables** • Position of opposition players **Countable variables** • Number of opposition players avoided **Measurable variables** • Distance of shot • Trajectory of shot
Diego MARADONA	1986 Argentina v England World Cup Quarter Final This goal was voted "Goal of the Century" See Resources Page for **Diego Maradona: 1986 Argentina v England World Cup Quarter Final** Total running time 33s	**Opinion-based variables** • Popularity of player • 'Skilfulness' of the goal **Categorical variables** • Position of opposition players • Importance of game (World Cup quarter final. Great rivalry b/w England and Argentina) **Countable variables** • Number of opposition players avoided • Number of times player kicked ball before shot • Number of time player changed direction • Level of competition **Measurable variables** • Goal angle • Distance player carried ball • Window of goal face available to player

		• Running speed of player • Trajectory of the ball • Match time elapsed when goal scored (just after "Hand of God" goal)
Manuel NEGRETE	1986 Mexico v Bulgaria World Cup See Resources Page for **Manuel Negrete: 1986 Mexico v Bulgaria World Cup** Total running time 37s	**<u>Opinion-based variables</u>** • Wow factor • 'Skilfulness' of the goal **<u>Measurable variables</u>** • Trajectory of ball • How high the ball was when kicked • How high the players foot was when kicked
Michael OWEN	1998 England v Argentina World Cup Quarter Final See Resources Page for **Michael Owen: 1998 England v Argentina World Cup Quarter Final** Total running time 24s **Note:** No sounds on this clip.	**<u>Opinion-based variables</u>**: • Popularity of player (Owen was 18 and in his first World Cup. He had just become the youngest player to represent England. This match was his first time in the starting team for a world cup match.) • Overall skill level **<u>Categorical variables</u>** • Type of goal • Position on field from which goal was scored • Importance of game (World Cup quarter final. Great rivalry b/w England and Argentina). **<u>Countable variables</u>** • Number of opposition players avoided • Number of times player kicked ball before shot • Number of times player changed direction • Level of competition **<u>Measurable variables</u>**

		• Goal Angle • Distance player carried ball • Position of opposition players • Window of goal face available to player • Running speed of player • Match time elapsed when goal scored (Early – England's second goal in first 18mins)
Carlos ALBERTO	1970 Brazil v Italy World Cup Final See Resources Page for **Carlos Alberto: 1970 Brazil v Italy World Cup Final** Total running time 29s	**<u>Opinion-based variables</u>** • Wow factor • 'Skilfulness' of the goal **<u>Categorical variables</u>** • Importance of game • Position of opposition players **<u>Countable variables</u>** • Number of opposition players avoided • Level of competition **<u>Measurable variables</u>** • Goal Angle • Running speed of player • Distance of player from goal when ball kicked

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