PRE-GCSE INSPIRE PROGRAMME
HOW TO DESIGN A SUCCESSFUL VIDEO GAME

CLASS 5: MATHS

Welcome to our fifth class on how to design a successful video game! In this class we're building on Class 1's focus on Maths. We will look at games like the Game of Life and Tetris, and in the competitions you'll have a chance to tackle some tricky questions in Maths-based games. Keep in mind you are not expected to read every class cover to cover: we've provided lots of links to further reading and extra material, but you are welcome to focus on what is most interesting to you!

SUBJECTS COVERED: Maths

RELEASE DATE: 24 June 2020

COMPETITION DEADLINE: 8 July 2020

IN THIS CLASS:

COMPETITIONS

We encourage you to participate in as many competitions as you can, but they are not compulsory. Once all entries have been received, we will publish the top five entries for each competition on *Inspire Digital*, and students who submitted the top two entries will be awarded Amazon vouchers.

How to submit your entry:

- Complete your competition entry and make sure it follows the guidelines listed for that competition
- Fill out the *competition cover sheet*
- Email your entry and your cover sheet to us at *inspire@sjc.ox.ac.uk*

The deadline for all competition entries for Class 5 is **5pm on Wednesday 8 July 2020.**

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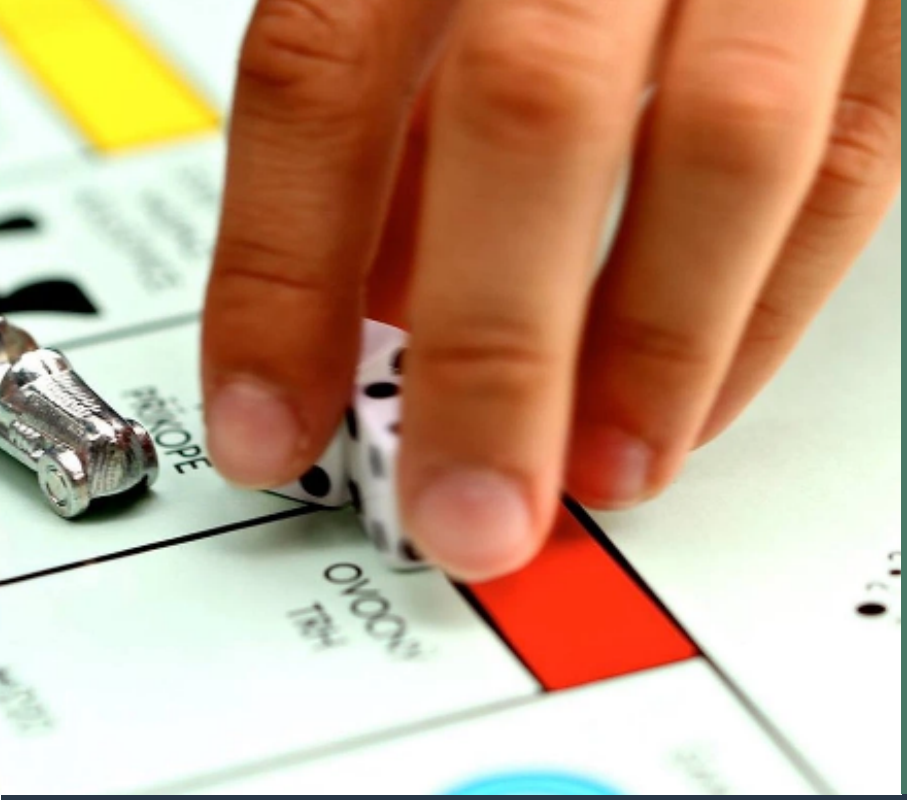
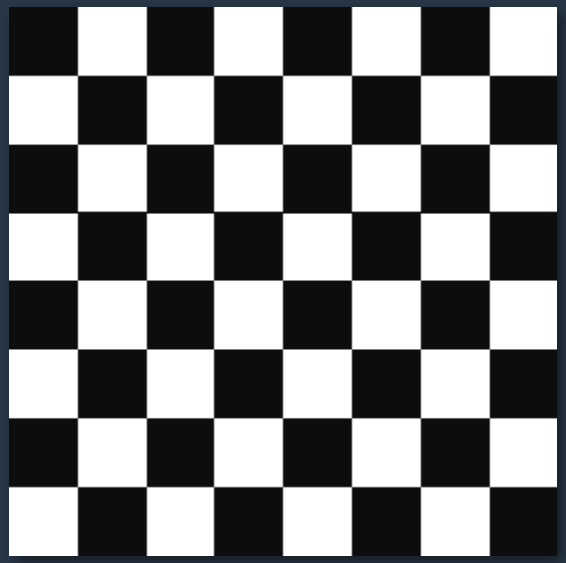


WHAT'S THE BEST WAY TO WIN AT MONOPOLY?

Monopoly may have started out as a humble board game in 1935, but it has since evolved into a multi-platform, multi-million dollar titan of the gaming world, appearing on almost every major games console over the last 30 years. The ultimate question then, is how can you improve your chances of winning? Watch the video on the right with St John's Maths Tutor Dr Tom Crawford to find out!



THE DOMINO PROBLEM

Take an 8 by 8 chess board and remove two opposite corners so that it has 62 squares. Is it possible to tile this 62 square board with 31 dominoes?

Check your work on the next page...

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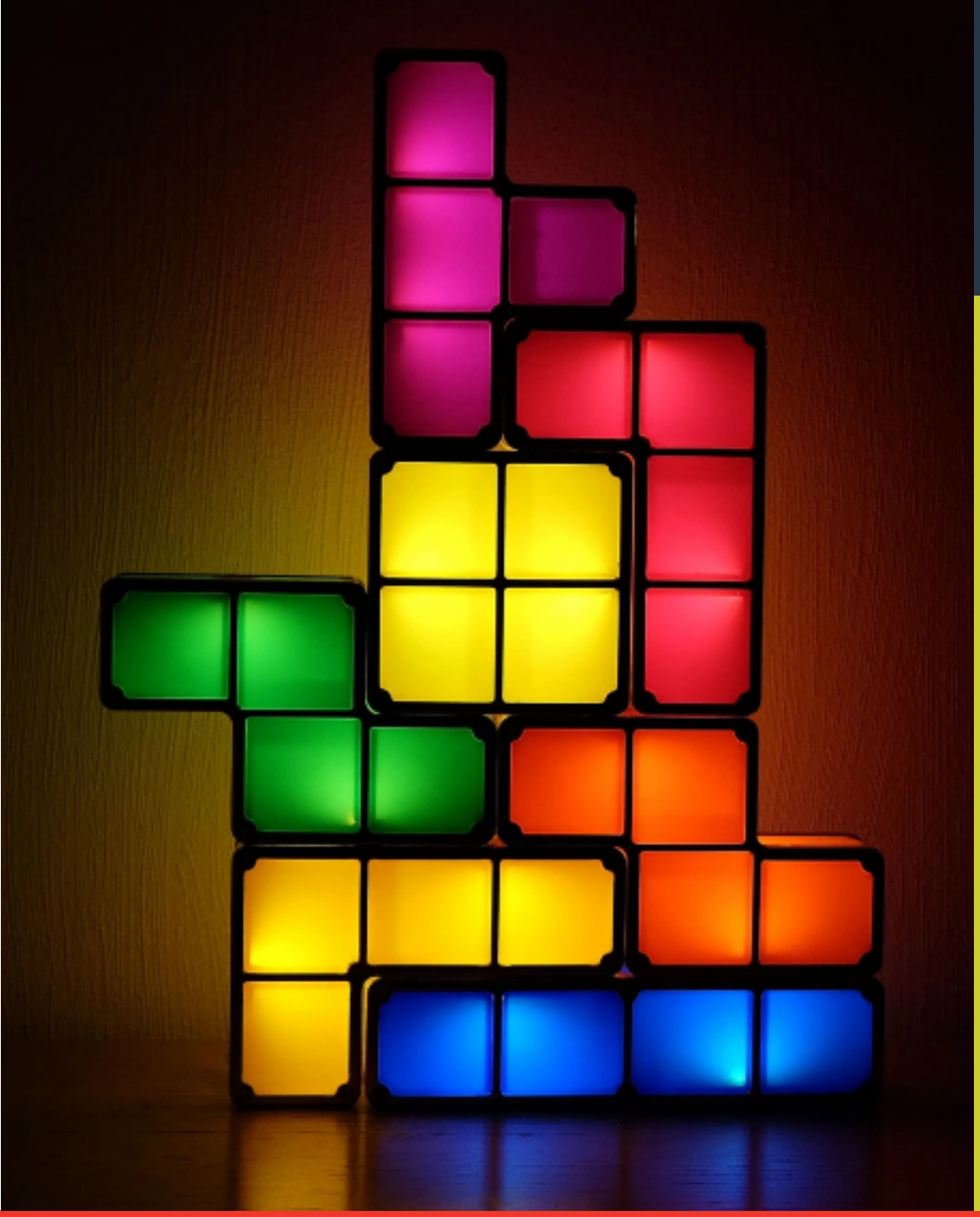

THE DOMINO PROBLEM: SOLUTION

No, this is not possible. There will be 30 squares of one colour, and 32 of the other on the altered chess board, yet each domino will cover one square of each colour. So you can't cover this board with 31 dominoes.

COMPETITION 12: A TETRIS PUZZLE

To prepare for this competition, you should complete *"The domino problem"* on Page 3 first.

One of the most successful video games of all time is Tetris. There are seven different Tetris pieces: the long piece, the square, the T-piece, two L-pieces and two Z-pieces. Each piece is made up of four square blocks, and in fact the name of the game comes from the Greek prefix *tetra* meaning 'four'.

Suppose you are given exactly one of each of the seven different Tetris pieces. Is it possible to arrange them in such a way that they form a 4×7 rectangle?

Your competition entry should explain how you reached your answer in no more than 300 words, and may involve illustrations.

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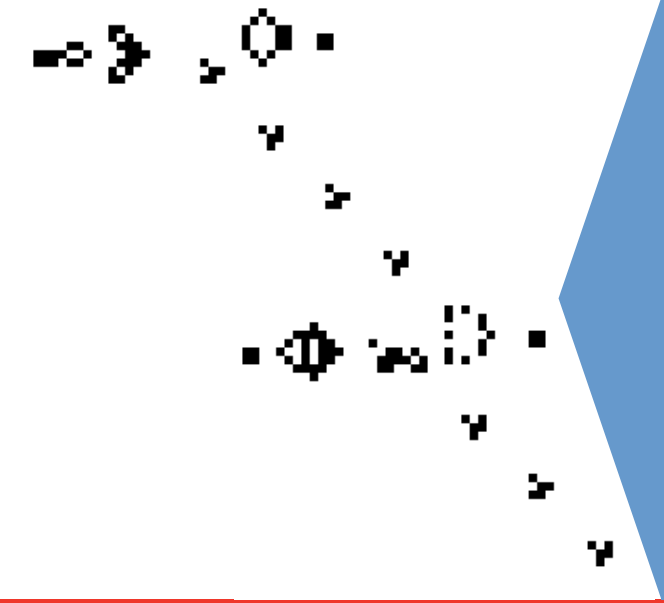
Can time travel ever be possible?

We all travel forwards through time. But can we change the rate at which we normally travel? What if we were able to go back in history? Not sure it'd be entirely straightforward...

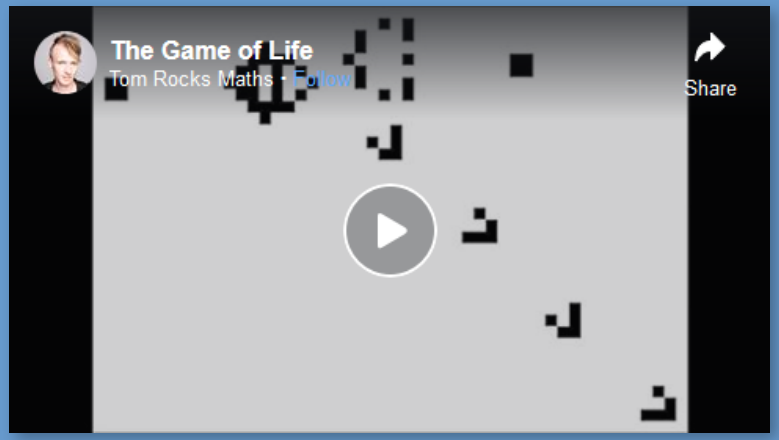
OXPLORE

Oxplore is an innovative digital outreach portal from the University of Oxford. As the 'Home of Big Questions' it aims to engage those from 11 to 18 years with debates and ideas that go beyond what is covered in the classroom. Big questions tackle complex ideas across a wide range of subjects and draw on the latest research undertaken at Oxford. Click the question on the left to start exploring some Big Questions...



THE GAME OF LIFE

The Game of Life is one of the simplest video games ever to exist, and yet is one of the most addictive! It's known as a zero player game as you simply choose your initial layout of black and white squares and then leave the game to evolve over time following a set of four simple rules. The patterns created have provided inspiration for many things and can be seen in the *design of the facade at Cambridge North train station in the UK*. Click the video to the right to listen as St John's Maths Tutor Dr Tom Crawford explains the Game of Life live on BBC Radio Cambridgeshire...



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COMPETITION 13: POISONOUS CHOCOLATE

This is a game where two players share a bar of chocolate. But there's a twist – one of the pieces of chocolate is poisoned!

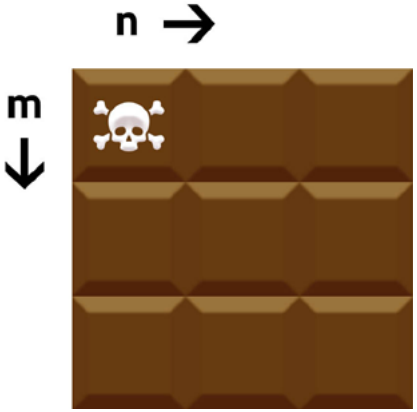
The chocolate bar is a rectangle (or a square) with *m* rows and *n* columns of chocolate squares and both players know where the poisoned piece is when the game starts.

The players take it in turns to break the chocolate either vertically or horizontally into two pieces and eat the safe side, until the only piece left is the poisoned square. The loser is the player whose turn it is to go when there's only the poisoned square left.

Consider an example of a *2 x 2* bar of chocolate with the poisoned square in the top left. Then the first player will lose, no matter whether they cut horizontally or vertically. Can you see this?

QUESTION 1:

Suppose the poisoned square is in the corner of an *m x n* bar of chocolate. Do you want to go first or second? Why?



QUESTION 2:

Now suppose you have a *3 x 5* bar of chocolate with the poisoned piece as shown (2nd from the left in the top row). Do you want to go first or second here? Why? What happens if you have a *3 x n* bar of chocolate with the poisoned piece in the same 2nd from the left position for *n > 5*?

QUESTION 3:

Suppose we have an *m x n* bar of chocolate with the poisoned piece in the 2nd from left in the top row with *m > 3* and *n = m + 2*. Who wins here, and why?

Further experimenting: How would you decide what happens in general? To explore this game you might want to record the number of possible cuts in each direction. So in question 2 when the poisoned piece is in the 2nd from the left in the top row, we would have the numbers (0, 1, 2, 3): there are 0 possible cuts above the poisoned piece, 1 cut to the left, 2 below, and 3 to the right. We can then view the game as starting with these numbers and each player takes it in turn to reduce any one of these numbers by as much as they like, and the winner is the player who leaves (0, 0, 0, 0).

You might want to try and work out what happens for the poisoned piece in the 2nd from left entry in the top row and a general *m x n* grid, using this numbers format. Do you spot a pattern if you write all the numbers in a binary expansion?

Your competition entry should attempt to answer as many of these questions as possible, and if relevant explain the reasoning behind your answers. Your competition entry can be in the form of a short essay, or you can address each question in a numbered list, and it should be between 300-500 words in length.

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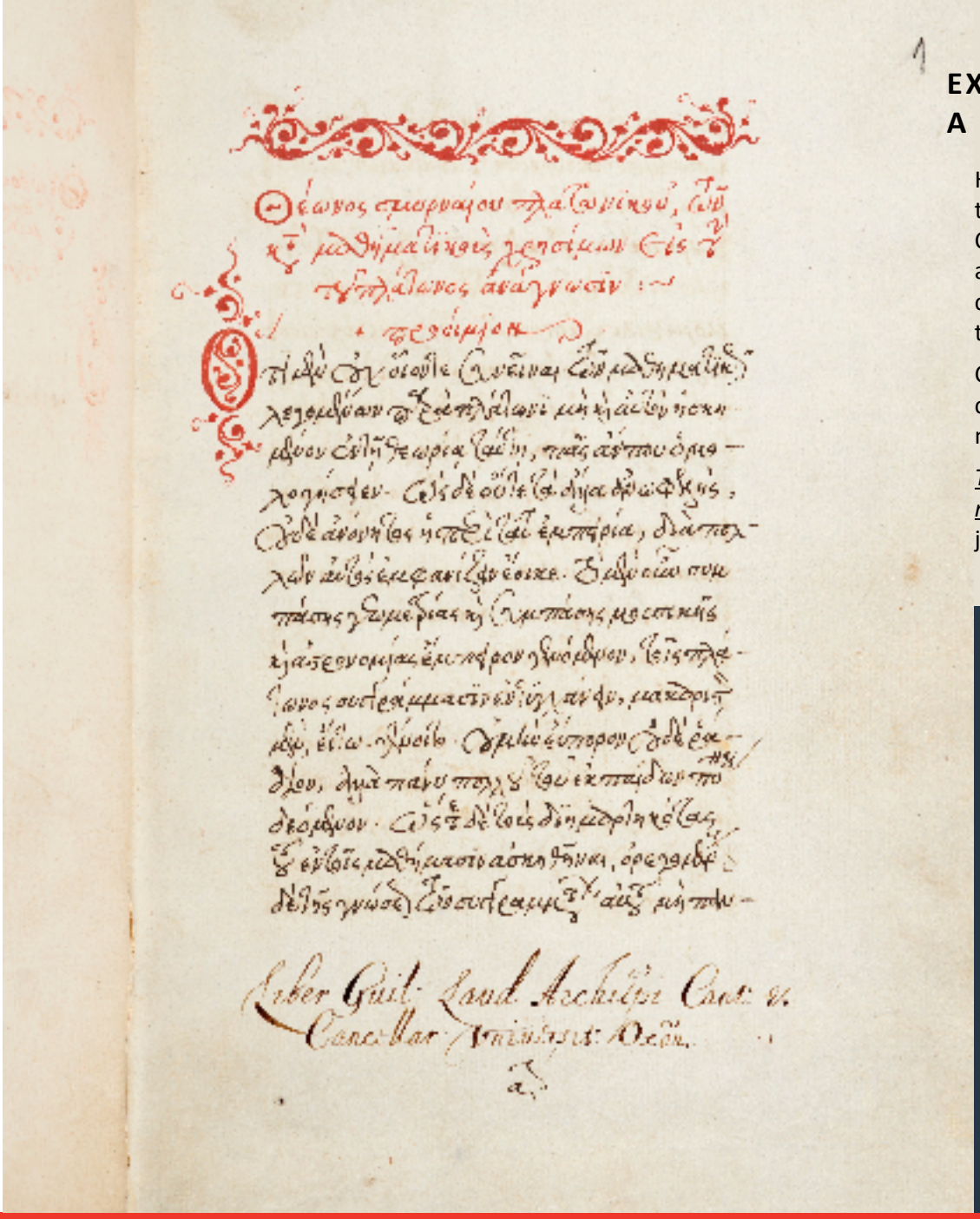

EXPLORE OUR SPECIAL COLLECTIONS: A MATHS TEXTBOOK

Have you ever seen a maths textbook quite like this one? During the lockdown, the St John's College library is making our Special Collections available via *their new website*, and they have created some quizzes around particular items in the collections.

Click on the page to the left to see how much you can figure out about this maths textbook! You'll need to scroll down the page to Quiz #5.

There are several other activities available on the new site as well, including colouring sheets and jigsaw puzzles.

CERN AND THE ATLAS DETECTOR IN MINECRAFT

The ATLAScraft project is a collaboration between the University of Oxford and the University of Birmingham, in which school students recreated parts of the ATLAS detector in Minecraft. If you own the PC or Mac version of Minecraft, you can download and explore the project for free!

Click here to get started.

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COMPETITION 14: THE GAME OF LIFE

Each class will have a photo, art or short video competition with a prompt based on the topic we are studying in that class. For this glass, the competition is based on *the Game of Life (on page 4)*: after listening to Dr Tom Crawford's explanation of the Game of Life, *you can do some of your own experimenting with the game here*. See if you can design a starting pattern and predict what the game will do with it.

Your competition entry should be a photograph or screencap of your starting pattern, or a short (<10 seconds) video of your game in action. You should also include a short written explanation (maximum 100 words) in which you explain what you expect to happen in your game.

CLICK HERE TO SUBMIT YOUR ANSWER

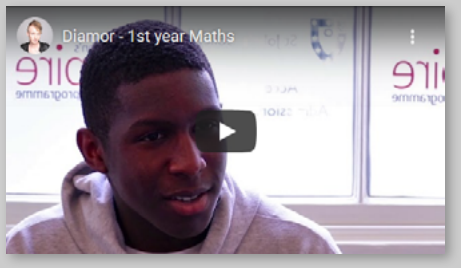
COULD A MATHEMATICIAN MANAGE A FOOTBALL TEAM?

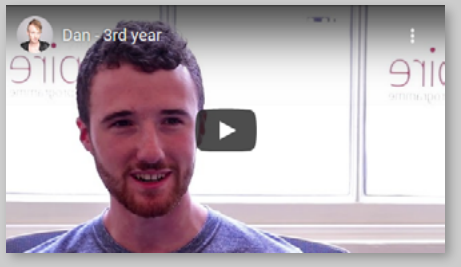
This lecture by David Sumpter from Oxford's Maths Institute is about Maths and football: What do you need to win the Premier League? Money? Sure. Good players? Yup. A great manager? It helps. Mathematics? Really? 100%. Click on the video to the left to watch.

STUDYING MATHS AT OXFORD

At St John's, you can study Maths either on its own or with other subjects like Computer Science, Statistics or Philosophy. Click the link below to learn more about these opportunities, and click the videos on the right and below to hear from current St John's students studying Maths.

Mathematics and Joint Schools





Oxford's Mathematical Institute runs a number of events, masterclasses and programmes for students of all ages interested in studying Maths. *You can find out more about these here*. Some of our favourites are:

- *Mathematics Alphabet:* The latest research from the Maths Institute presented in a fun, accessible format.
- *Public Lectures*: Freely available Maths lectures you can watch from home.

Make sure you follow the Maths Institute on social media to stay up to date!

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