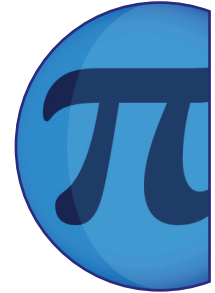




Degrees of Separation: Erdős

Key Learning Content

This film tells the strange story of the mathematician, Paul Erdős, who spent his life collaborating in mathematical research with scores of other mathematicians. So prolific and far-reaching was his work that mathematicians started to assess their own work in terms of how close they had come to collaborating with him. An Erdős number is a measure of the 'collaborative distance' of a mathematician from Erdős, with an Erdős number of one indicating that they had worked together.



The film gives an informal introduction to social networks, and to the nature of mathematical research.

Core Outcomes

Learning Points

- Be able to understand the structure of a social network.
- Be able to understand the concept of degrees of separation.
- Be able to understand the complexity and inter-relatedness of mathematical research.

Suggested Activities

- Map social networks and calculate degrees of separation.
- Calculate average degrees of separation and test the 'six degrees of separation' hypothesis.

Extension Outcomes

Learning Points

- Be able to raise numbers to integer powers.
- Be able to solve exponential equations using logarithms.

Suggested Activities

- Calculate the maximum number of contacts possible within an Erdős network where everyone has the same number of direct contacts.
- Calculate the theoretical degree of separation necessary if r people each with n friends link a population of p people.



Erdős collaborated with over 500 co-authors on 1500 papers.

Related Films

To use before the lesson plan:

Networks: Labyrinths and Mazes

This film explores the fascination of mazes and labyrinths and outlines the essential difference between the two types of puzzle.

The Seven Bridges of Königsberg

This film describes the mathematical problem studied by Leonhard Euler, which tested whether it was possible to visit the whole city of Königsberg by traversing each of its bridges only once.

To use after the lesson plan:

Chinese Development of Maths

This film maps the many parallel links between the western and Chinese development of mathematics, from the discovery of Pi, to the triangles of Pythagoras and Pascal.

Irrational Numbers: Pythagoras

This film tells the story of an early social network of mathematicians, the Pythagorean brotherhood, and their struggle with irrational numbers.

Guide Lesson Plan

Introduction

Ask the students how many people they know. Then ask: How many people do you think the people you know, know? Estimate the number of people the students can reach as friends-of-a-friend.

Show Film

Degrees of Separation: Erdős

Main Activity

Foundation

Get students to map social networks within the school. Agree a definition of what counts as really knowing somebody, then conduct a survey of how many people each student knows. Then work out which students have brothers or sisters in the school. Get siblings to interview each other to establish how many people their siblings know. Construct a detailed network diagram showing these initial links and calculate how many students in the school are included at each level. Enlist the help of other students to broaden the survey, until everyone on the school role is linked.

Main Activity cont ...

Advanced

Build a mathematical model to estimate how many other students in the school are linked to this group. If there are r students in the class and each on average knows n other students, show that at s steps removed, there is a maximum of $r \times n^s$ linked people. Then work out the minimum number of steps required for all P students in the school to be connected to the class. Show that this involves solving the equation

$$r \times n^s = P \text{ or } n^s = P/r$$

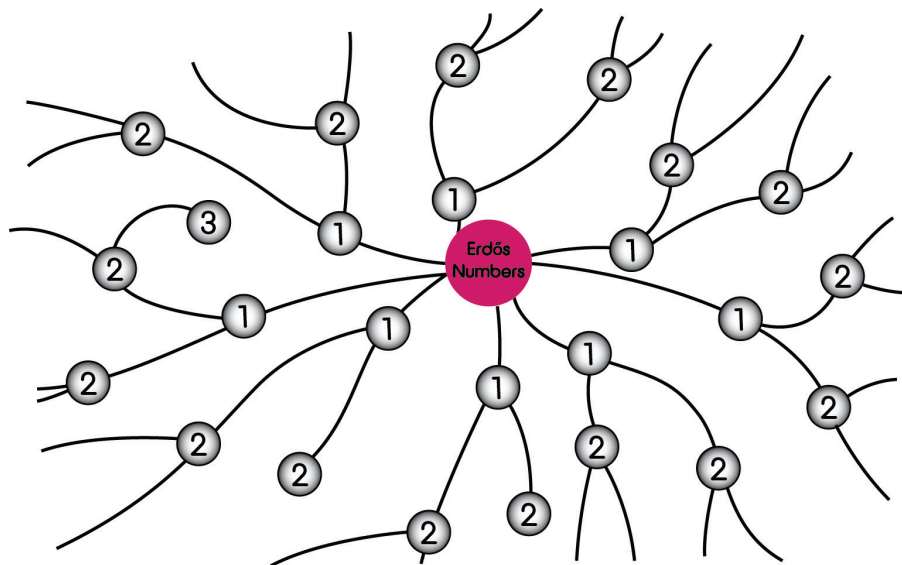
and show how this can be solved using logarithms.

Extension Activity

Extend this 'backwards' to work out how many people are linked to each individual in the group, and 'outwards' to include students in other schools, starting with students who have siblings in other schools. Work out the probable average degree of separation of the town/region/country by assuming similar levels of linkages across the entire population.

Optional Extra

Research the 'six (or sometimes seven) degrees of separation' claim and explore the many attempts that have been made to show that it is true.



Erdős numbers indicate an individual's collaborative distance from Erdős.