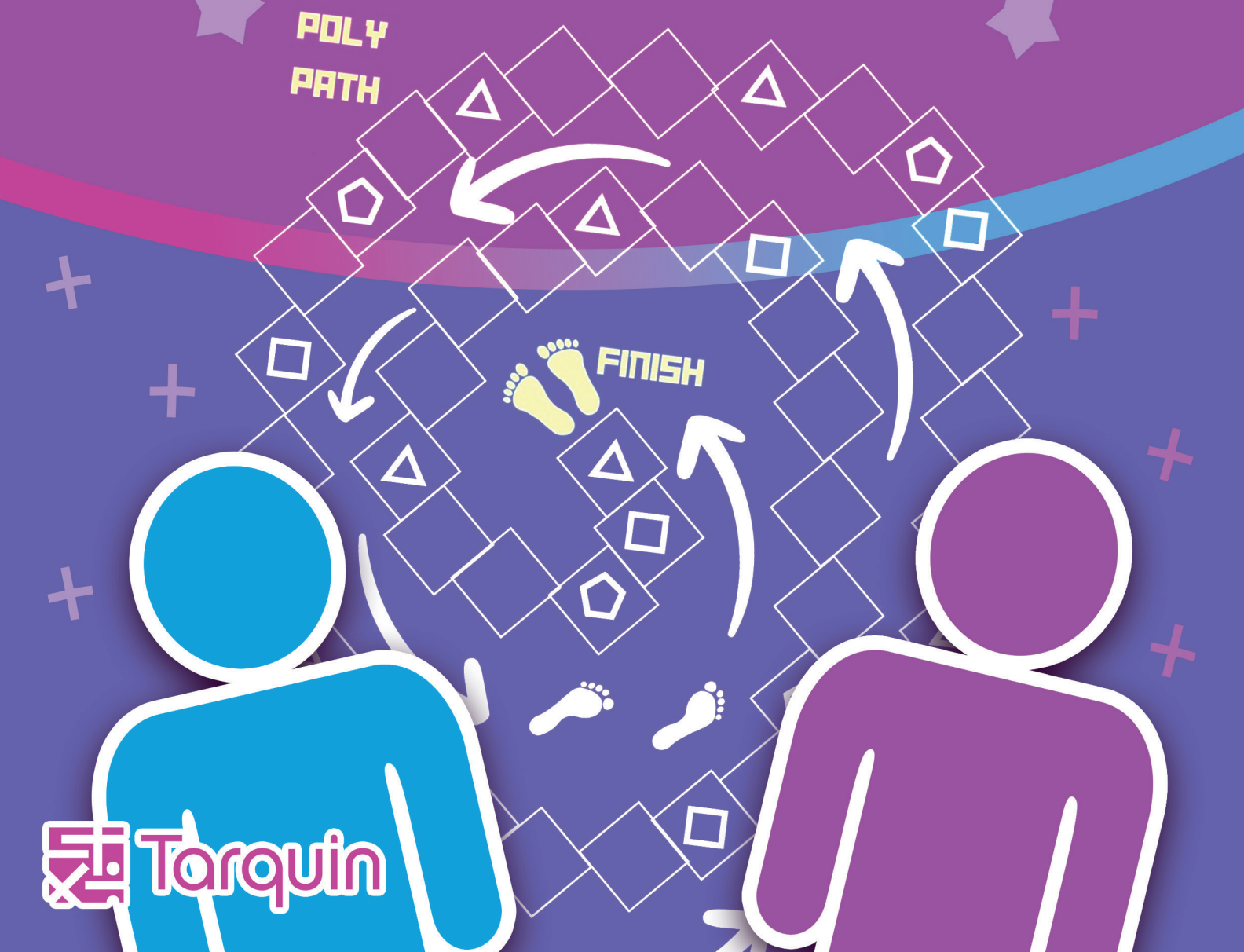
AIMING HIGH
Family Games

AIMSSEC

LET'S PLAY MATHEMATICALLY

TONI BEARDON AND CAROLINE AINSLIE



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THE AUTHORS

TONI BEARDON, founder of NRICH and AIMSSEC, has 60 years of experience of teaching in schools and universities, providing professional development for teachers and writing teaching resources. Links in this book to her AIMING HIGH website provide printable resources and more information about the mathematics underlying the games.

CAROLINE AINSLIE, founder of Bubbly Maths, has delivered talks, gameshows and other mathematical shows and workshops around the world to over 300,000 children. She is passionate about supporting AIMSSEC, a charity that gives specialist training for teachers from disadvantaged communities in Africa.





This book for families has 36 collections of games with variations for young children, for teenagers and for groups of mixed ages. Play these games at home and change attitudes to mathematics. Fear of the subject disappears, so the young people remember number and geometrical facts and understand mathematical methods and concepts better, without realising that the game was a learning process.

Games engage players in thinking how to win and lead to the development of logical thinking, systematic planning, problem solving, teamwork and communication and social skills including the ability to win or to lose gracefully, all skills that parents can help their children to develop through play.

Games develop numeracy, provide drill and practice in an enjoyable way and motivation to play repeatedly thus progressing to the next level of challenge. Drill and practice are important, whether practising to improve athletic performance in sport, or hoping to make progress and do better in mathematics tests or other schoolwork. Once players know the rules, these are short games that provide opportunities for regular and short drill and practice sessions. Many of the games comprise a game-frame and a set of rules for play, within which the mathematical content can be varied.

Human beings naturally enjoy play and thrive on it. Playful learning should be accessible to everyone, everywhere, from cradle to grave, because research shows that people of all ages learn best through focussed play.

Games for two players can often be turned into party games for two teams suitable for bigger family gatherings that allow the team members to discuss the state of play and jointly to decide on the next move. Games like Frogs, and the Squares Game, can either involve physical movement of players acting as the counters or play with counters and a gameboard. Creativity is encouraged through suggestions that groups of players might make up their own variations of the games or decide to play by slightly different rules.

Some of the games have been invented for this book and others have been played for thousands of years. Small excursions into the origins and histories of the games add to the interest and broaden understanding of past civilisations and other cultures. This cross-curricular experience is valuable in its own right.

LET'S PLAY MATHEMATICALLY

Aiming High Family Games

TONI BEARDON AND CAROLINE AINSLIE

Tarquin

AIMSSEC

Publisher's Note

Tarquin has published many books aimed at promoting mathematical thinking in its 50-plus years of existence. Rarely has there been so much fun involved as there will be in these games for families (or small groups). Playable at many levels, most of the games are perfect for mixed age groups and mixed levels of knowledge. All can be played without purchasing equipment, but we offer a Kit with the materials needed to play the games. This is available direct from us and from Amazon.

The experience of Toni Beardon and Caroline Ainslie in writing this book cannot be under-estimated and we thank them very much! This Family Games book will be followed by a version for schools and a Teachers' Guide.

Happy playing!

Let's Play Mathematically Kit

LPMK241

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INTRODUCTION AND HOW TO USE THE BOOK

People are social creatures and are returning to sociable face-to-face games with actual gameboards, dice and cards, now that computer games are not the novelty they were a generation ago. Games enable whole families to share enjoyable experiences together, both within the nuclear family and at bigger family parties.

'Let's Play Mathematically' offers ideas and free resources for playful learning that can take place in homes and in other settings. Playful learning should be accessible to everyone, everywhere, from cradle to grave. So we offer all the resources needed to play the games: in the book, through smartphone and printer and through suggestions for making their own resources from scrap material.

Some of these games have been invented especially for this book, and others have been favourites for thousands of years, with variants played in many countries around the world.

Why Play?

Playful learning includes playing organised games and much more. It involves activities that are enjoyable, finding answers to questions of interest, and most importantly, free play at home, indoors and outdoors, as well as in and out of lessons.

Curiosity and the desire to learn is a natural human trait. Babies have an inborn need to learn, they strive to make sense of their surroundings and can learn to walk and talk largely by their own efforts without being taught. Through play we practise balance, physical movement, and test our own limits. Having objects to play with, activities to choose from, and sufficient access to free play outdoors in open spaces and near trees, allows children to explore their environment, to express themselves, and to gain confidence.

Play lays the foundation for literacy and numeracy and helps the development of vocabulary, communication and creativity. Adults support learning by answering questions, by recognising their child's body language, knowing when to intervene, and when not to intervene, and giving children opportunities to play. Parents, teachers and young learners all develop emotional intelligence, patience and understanding when learners have choices to control and decide their own play.

Teaching at home, or in school, promotes playful learning when children's curiosity is stimulated and they are encouraged to ask 'what if' questions, to explore new possibilities, and to notice and talk about what they can see and do.

Play is fun. Learning to play well, both by themselves and with others, sets children up to be contented and sociable. Through play, especially in the protective environment of the home, young people learn how to be a good loser. Games engage players in thinking how to win and, in so doing, they lead to the development of valuable life-skills like logical thinking, concentration, systematic planning, problem solving, teamwork and communication and social skills.

The Games



The AIMING HIGH games are designed for enjoyment while, at the same time, school curriculum related. Each of the 36 collections of games includes variations to suit different age groups and to help beginners learn the rules and the skills involved. Some are games of skill, some games involve a mix of luck and skill, and others are games of pure chance so that the youngest players can beat their older siblings and parents. There are novel variants and extensions of old favourites like 'The Splits' variants of the 'Rock-Scissors-Paper' game that also have extensions that lead to thinking about cyclic sequences and probability.

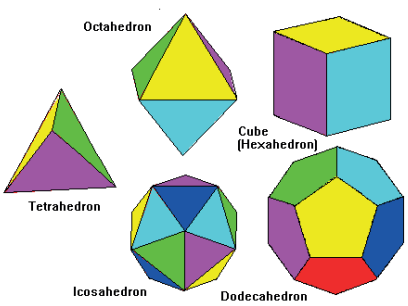


Curiosity is stimulated by questions. Anyone who has an interest in learning more than they might expect to learn at school can think about the questions and find answers on the AIMING HIGH website and elsewhere on the web. For example, cards like the one illustrated for the 'Draw and Talk' game, open doors for players to catch a glimpse of 36 different mathematical topics. One player describes the picture and the other players draw it from the instructions given. Next the players discuss how the description could be improved, and everyone develops their communication skills. To complete the process, cards have information about the picture that can be followed up by people who want to learn more.

Having already enjoyed a taste of the topic through the games in this book, young learners are set up for success when they meet that mathematical topic in school, or later in university.

Games for Teams

Games for two players can often be turned into games for two teams that allow the team members to discuss the state of play and jointly to decide on the next move. Games like 'Frogs', and 'The Squares Game', can either involve moving counters or the physical movement of players acting as the counters. Some of the games for a group of players are also suitable for larger numbers of players, all competing individually, with one person tossing dice or drawing the next card (Bingo style) rather than players taking turns to do so.



The picture on the front cover of the book shows the gameboard for the 'Polypath Game'. Players throw the die and move along the path, and must imagine that the polygons on the path are footprints of polyhedra. When they land on a square with a polygon in it, they score points for naming the solid shapes that might have made the footprint. In the 'easy' version of the game a player can refer to charts like the one illustrated. The 'expert' version involves thirteen more polyhedra and more charts. When a family plays the game, some family members can refer to the charts while others may choose not to do so.

The Games and their History

Small excursions into the origins and histories of the games add to the interest, broadening understanding of past civilisations and other cultures, and this cross-curricular experience is valuable in its own right especially for young children. Sometimes this extra knowledge of the games leads to insights that enable players to see how to win more often.

Several variants are given of each game. Players are encouraged to make up their own variations of the games, and decide to play by slightly different rules, and this gives opportunities for creativity.

Drill and practice are important, whether practising to improve athletic performance in sport, or hoping to make progress and do better in mathematics tests or other schoolwork. Many of these games develop numeracy skills, making drill and practice enjoyable and providing motivation to play repeatedly and to progress to the next level of challenge. For example, once players know the rules, the 'Target Games' collection has many variants, each one providing drill and practice in a different mathematical procedure, estimating answers to calculations, and carrying out calculations to get final answers. Each different Target variant involves thinking about probabilities, and deciding how to use the random digits that come up according to the probability that a subsequent digit might be more favourable.

Some games are presented in collections, while others are offered separately with hints that players might have seen something like this game before. Such questions lead to the identification of correspondences between apparently different mathematical structures (the property of isomorphism). This often unlocks the door to successful problem solving.

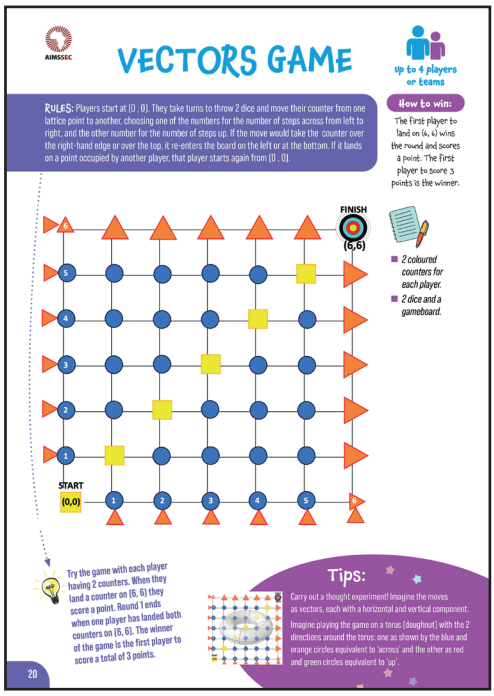
Playing for Fun

The games in this book give young people interest in the subject and motivation to learn. Winning calls for concentration and focus, and the games develop teamwork, social and communication skills, and good judgement in using probability to decide what move to make according to the most likely events that might follow that move. Players are encouraged to sustain attentive concentration, to explain what is happening and why, and to use discussion to clarify thinking, and to express feelings and ideas. Games help to build vocabulary and appreciation of the power, and the finer points and patterns, in mathematics and its applications.

Using the Book

For each game the rules, the number of players and how to win are given at the top of the first page, together with a list of resources needed at the side of the page. The gameboard, or a useful illustration, take up most of the page, with some hints and tips and brief mention of variations of the game at the bottom of the page. The next page has more details of variants of the game and questions to stimulate thinking about the underlying mathematics and ways of winning, followed by some suggestions for strategies for successful play and notes about the origins of the game.

The book can be laid open and flat so that the gameboards illustrated in the book can be used for play. Alternatively, links are given to download copies of gameboards, cards, and templates for making spinners and other resources that can be printed and laminated. This enables players to use their own resources or, if they wish, to purchase packs of playing cards and a games kit.



More in the Series

The Let's Play AIMING HIGH series will also contain a similar book of games adapted for classroom use with suggestions for incorporating the games into lessons, and a Teachers' Book with sample games, more suggestions for teaching, more information about the mathematics behind the games, connections to other mathematical topics and to applications of the mathematics. The games have been tried and tested in classrooms in Africa and the UK, and in online and face-to-face workshops with teachers from many countries around the world.

For more than twenty years, learning through play (PLAY FOR FUN - THINK TO WIN - PLAY TO LEARN) has been incorporated into the AIMSSEC pedagogy in leadership training and professional development courses for both primary and secondary teachers. It has proved invaluable as an important teaching strategy, particularly when used as short lesson starters, and for diagnostic assessment.

The Let's Play series provides ideas to help parents at home, and teachers in schools, to provide playful learning for their children. Many scholarly papers and articles give research evidence for the benefits of this pedagogy. In international comparisons of student achievement in mathematics, Finland consistently ranks near the top. Play features powerfully in Finnish education, children start school at 7, fewer hours are spent in school than in many other countries, learners are encouraged to play after school hours and homework is only for the oldest learners.

The freely downloadable book, 'A Pedagogy of Play' (Ben Mardell et al. 2023) is the culmination of eight years of research involving educators around the world. It has been written with the objective that more children worldwide will have

> **"the experience of leading their own learning, exploring the unknown, and finding joy in school. Why? Because such playful learning can help students learn fundamental concepts and skills, as well as develop their abilities to collaborate, solve problems, and navigate uncertainty. Because using play as a strategy for learning — asking 'What if?' in order to explore, adapt, and create — is vital in addressing complex local and global issues."**

Like the authors of 'The Pedagogy of Play' we want our Let's Play series to support educators and others concerned with education, including parents, and to build cultures of playful learning in classrooms and schools, and also in homes.

In the belief that educational opportunities should be equal for all, AIMSSEC works with teachers in the most disadvantaged communities to empower them to improve education in their own communities. AIMSSEC is a not-for-profit organisation dependent on volunteers who are motivated by the belief that the best hope for children to escape poverty, and have a better future, is a good education that gives them the skills that they will need to get good jobs and to thrive in every way in this rapidly changing world. All royalties for these books will go to supporting the work of AIMSSEC. Read more about AIMSSEC's work on the inside back cover of this book.