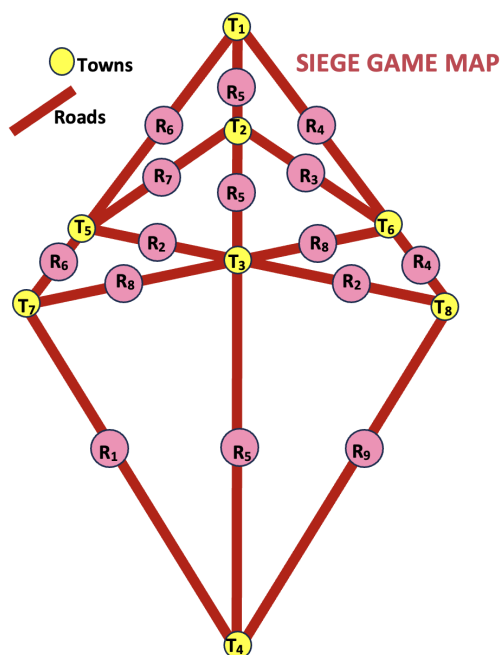


THE SIEGE GAME



Play the game using the gameboard on page 2. The winner is the first player to capture three roads going to, or through, the same town and put the town under siege.

The roadmap shows 9 straight lines representing roads $R_1, R_2, R_3, \dots, R_9$ and 8 towns $T_1, T_2, T_3, \dots, T_8$, shown in yellow. The roads go to, or through, the towns.

Some roads connect 2 towns, some connect 3 towns, and one road connects 4 towns but all towns lie on exactly 3 roads.

Players take it in turns to claim and block one of the 9 straight roads by putting a counter on the board or marking the road with a highlighter pen, closing the whole road even though it may pass through several towns.

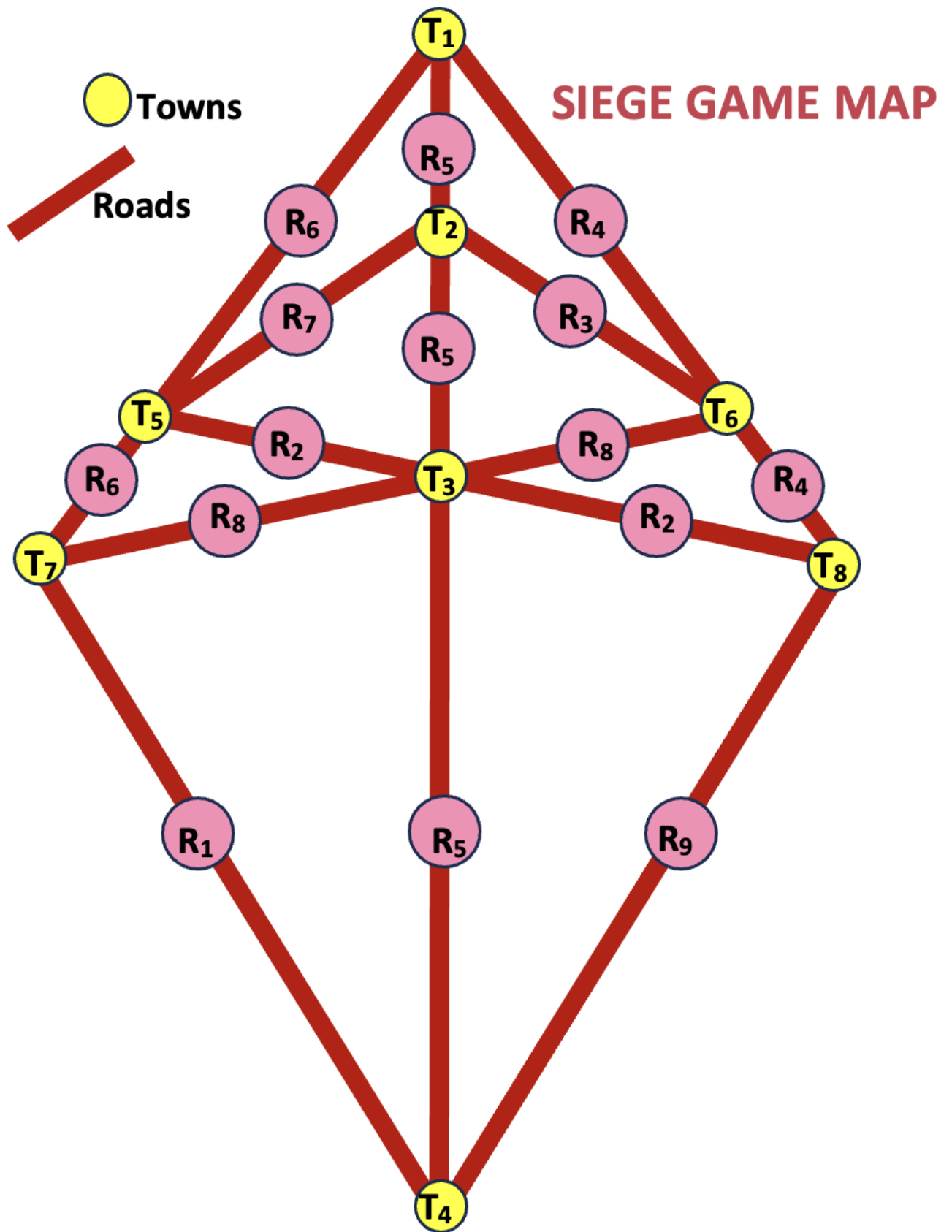
HELP

Play the game and keep a watch on what your opponent does. Make sure you claim the third road if your opponent claims two roads through the same town.

NEXT

Answer these questions:

1. Is the Siege Game like any other games you have played before?
2. For each town can you write down the combination of three roads that go through that town?
3. Which roads go through 2 towns?
4. Which roads go through 3 towns?
5. Which roads go through 4 towns?
6. Are any towns on 4 roads?
7. Have you found a winning strategy?
8. Is it possible to avoid losing this game?
9. Can you become an expert and never lose this game, although the game may sometimes end in a draw?



NOTES FOR TEACHERS

Siege is one of a set of games that includes the Fifteen Game, Pat the Pig, Magic Square Puzzle and Game and Noughts and Crosses. Essentially all are the same game in different disguises. Recognising the correspondences between the games helps students to understand isomorphism, that is the mathematical correspondences between systems that appear superficially different. The original game, which later became known as Tic Tac Toe in America, dates back over a thousand years to Persia from where it was spread to other countries along the trade routes. It was a popular game in the Middle Ages because it needed no special equipment. Pope Boniface banned it because of its association with black magic and pagan rituals, so it declined in the 10th and 11th centuries. Later it came back at universities and was very popular in Salamanca and Bologna. During the Renaissance period, 14th to 17th centuries, noughts and crosses became popular again and spread rapidly. Siege, re-named because of road closures and diversions that plague the motorist today, and the connections with wartime sieges, was part of a collection compiled by Toni Beardon for the NRICH website and adapted for AIMING HIGH.

SOLUTIONS

8 R₈	1 R₁	6 R₆
3 R₃	5 R₅	7 R₇
4 R₄	9 R₉	2 R₂

The rows, columns and diagonals in this 3 by 3 array show the sets of 3 roads that can be collected by players in order to win.

Why do this activity?

This game helps learners to develop strategic planning skills, problem solving and logical reasoning all of which are valuable life skills which need to be taught in school. It also helps them to make connections between different systems that appear different but are essentially the same. In mathematics, and in life in general, it is useful to recognise when a situation faced corresponds exactly to one that they already know how to deal with.

Learning objectives

Playing this game helps learners to develop strategic planning skills, problem solving skills and logical reasoning.

Suggestions for teaching

Make sure that the learners understand the learning objectives and that they are playing the game to help them to develop the important life skills of strategic planning, problem solving and logical reasoning.

To ensure that everyone in the class understands the rules of the game and knows how to play it, divide the class into two teams and play the game several times with the roadmap drawn or projected on the board.

Then manage the lesson so that learners play the game in pairs. Observe the play and, when you judge it to be helpful, ask a learner “Are you thinking 2 or 3 moves ahead? Can you see what is the best next move for your opponent? Will that cause you to lose and, if so, can you prevent it happening?”

After the learners have had sufficient time to play at least 2 games, have a class discussion and ask some of the key questions (see below).

Provide each learner with a copy of the gameboard map so that they can play the game at home and outside of lessons. Suggest to them that they can make their own counters from scrap card or dried beans or small stones. You might give them the homework task of playing the game.

Older learners could organise their own league, to be played outside lesson time, where every member of the class plays in the first round of the competition and half of them go on to the second round. Games are short so this is possible. Organising such a competition develops leadership and teamworking skills and involves quite a lot of systematic planning and mathematical thinking. The competition could produce a ranking, and then every member of the class can subsequently challenge another player higher up the ‘ranking ladder’ and, if the challenger wins, then they change places on the ladder

Ask all the learners to work out how many matches there will be between pairs of players. For example, if you have 64 learners in the class then there will be 63 matches (that is $32 + 16 + 8 + 4 + 2 + 1$ matches). This is the expected answer because 1 player is knocked out in each match so that, after 63 matches only one player, the champion, is left.

The competition could be organised so that, in each round, pairs of learners play 3 games and score 2 points if they win and 1 point for a draw. Then the player with the most points wins that match and the other player is knocked out. If both players have scored the same number of points then they should continue playing games until one of them wins a game.

Key questions

1. Which road is most useful in making up a set of 3 roads through the same town?
2. Which road should you choose first?

3. Which are the best roads to choose, and which are not so useful?
4. How can you stop your opponent from getting 3 roads through the same town?
5. Is the Siege Game like any other games you have played before?
6. For each town can you write down the combination of three roads that go through that town?
7. Which roads go through 2 towns?
8. Which roads go through 3 towns?
9. Which roads go through 4 towns?
10. Are any towns on 4 roads?
11. Have you found a winning strategy?
12. Is it possible to avoid losing this game?
13. Can you become an expert and never lose this game, although the game may sometimes end in a draw?

Follow up

Play the following games in class in a similar way.

Fifteen Game from <https://aiminghigh.aimssec.ac.za/fifteen-game-collection/>

Magic Square Puzzle and Game. <https://aiminghigh.aimssec.ac.za/magic-square-game/>

Pat the Pig <https://aiminghigh.aimssec.ac.za/pat-the-pig/>

Tic Tac Toe (Noughts and Crosses) and Ultimate Tic Tac Toe

<https://aiminghigh.aimssec.ac.za/ultimate-tic-tac-toe/>

See also Picture Puzzler <https://aiminghigh.aimssec.ac.za/picture-puzzler/>

Go to the **AIMSSEC AIMING HIGH** website for lesson ideas, solutions and curriculum



links: <http://aiminghigh.aimssec.ac.za>

Subscribe to the **MATHS TOYS YouTube Channel**

<https://www.youtube.com/c/MathsToys/videos>

Download the whole AIMSSEC collection of resources to use offline with the **AIMSSEC App** see <https://aimssec.app> or find it on Google Play.

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and school years up to Secondary 5 in East Africa.

New material will be added for Secondary 6.

For resources for teaching A level mathematics (Years 12 and 13) see <https://nrich.maths.org/12339>

Mathematics taught in Year 13 (UK) & Secondary 6 (East Africa) is beyond the SA CAPS curriculum for Grade 12

	Lower Primary Approx. Age 5 to 8	Upper Primary Age 8 to 11	Lower Secondary Age 11 to 15	Upper Secondary Age 15+
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
UK	Reception and Years 1 to 3	Years 4 to 6	Years 7 to 9	Years 10 to 13