



# Fire detection with the Internet of Things

**MATHEMATICS (TEACHER NOTES)**

## The Internet of Things (IoT) connects the unconnected.

The IoT is improving fire detection, helping to save lives through more intelligent, faster and efficient systems.

'Smart' fire detectors can now communicate with other detectors, alert the fire service and warn people at risk of fire.

This resource requires students to explore the optimal placing of connected fire detectors in a range of different buildings.

## Learning outcomes

- construct a series of geometrical representations
- draw and measure line segments and angles in geometric figures, including interpreting scale drawings
- calculate and solve problems involving: perimeters of 2D shapes (including circles), areas of circles, composite shapes and averages

## Resources

- PowerPoint presentation (projector or other display needed)
- access to CISCO IoT videos on YouTube
- at least one map of the grounds (A3) per group
- per group: pair of compasses, protractor, rulers, pens, pencils, paper, scissors, calculator
- squared paper (if required)
- student internet access (optional)



## How to run this project

This resource can be used in several ways:

- to support primary-secondary transition
- for team-building on a collapsed timetable day or at the beginning of an academic year
- as a focus to increase engagement in STEM
- as an opportunity for collaboration between school departments (there are Little Big Futures CREST Award guides available across the STEM subjects)
- as an activity for a holiday club or youth group.

During this project, team members will be required to fulfil a variety of roles. Team members should be encouraged to try different roles, and individuals may take on more than one role.

- problem-finding, to identify existing problems that are solvable using the IoT
- research specialisms in sensing hardware, algorithms and network technology
- a technology integrationist, able to coordinate and direct the research of specialists to come to a solution that works
- a team manager who can monitor the progress of the sub-teams
- presenters who can explain the solution to others in clear terms

Further guidance and information can be [found here](#). It includes a CREST Discovery passport that can be used to evidence a student's eligibility for the award and advice on accessing financial assistance with the CREST fee.

## Timetable

- Activity 1: Introduction/stimulus (20 mins)
- Activity 2: Placing fire detectors challenge (60 mins)
- Activity 2 extension: Placing the central node (20 mins)
- Activity 3a: Introduce presentation task (20 mins)
- Activity 3b: Prepare presentation (120 mins)
- Activity 4: Present ideas to group (30 mins)
- Activity 5: Reflection – complete passport (30 mins)

## Tips for delivery

This is a topic that can provoke extreme emotional reactions, and it is possible that some of your students may have suffered trauma as a direct result of fire. They are likely to be aware of fatal incidents which have received extensive media coverage. Whether or not your students have any actual association with victims of fire there is a need for accuracy, sensitivity and respect when discussing in the classroom.



# Discovery Day activities

(5 hour duration; may be extended if appropriate)

	Activity	Resources
<b>Activity 1</b> (20 mins)	<p>Choose one (or more) of the eight Cisco 'Internet of Everything' commercials – these cover different themes.</p> <p>Explain that previously unconnected devices are being connected to bring about huge changes in how the world works. This is the basis of the Internet of Things.</p> <p>Discuss how the Internet of Things could be used in fire prevention, detection and in alarm systems.</p>	<p><b>Streaming videos:</b></p> <p><a href="#">General introduction to the 'Internet of Everything'</a></p> <p><a href="#">Cycling accident</a></p> <p><a href="#">Basketball</a></p> <p><a href="#">Bananas</a></p> <p><a href="#">Rock concert</a></p> <p><a href="#">New year's eve power</a></p> <p><a href="#">DIY store</a></p> <p><a href="#">Cats and milk</a></p>
<b>Activity 2</b> (60 mins)	<p>Introduce the construction task using the presentation. Divide the class into groups of 3 to 5 students.</p> <p>Students are asked to play the role of employees in a company specialising in fire detection. They have been asked to protect a business' headquarters from fire. To do this they will strategically place fire detectors so as to cover as much of a business' ground as possible.</p> <p>The business' headquarters are a compound measuring 28m by 36m. There are three indoor areas within the total space (in grey).</p> <p>Students can place three different types of fire detectors- details of which are on slides 4 to 7 and on the student information sheet.</p> <p>Slides 10 to 13 introduce the constraints of the task:</p> <ul style="list-style-type: none"> <li>■ the company decide they can only spend up to £2000 on the system</li> <li>■ they have asked for at least one optical sensor installed, but no more than three, and at least one of the other types of camera</li> </ul> <p>To complete the task, students must construct accurate scale drawings to demonstrate the coverage of each camera. They can choose to work directly on the map of the grounds worksheet, or create templates of the fire detector coverage to place on the grounds before deciding where to place the detectors.</p> <p>Once complete ask students to calculate the cost of their design and an approximation for how much of the grounds they covered.</p> <p>Ask student groups to feedback on their work, including how and why they made their final decisions.</p>	<p>PowerPoint presentation</p> <p>Student booklet to complete</p> <p>Student map of the grounds worksheet (A3)</p> <p>Pair of compasses, protractor, rulers, pens, pencils, paper, scissors, calculator</p> <p>Squared paper (if required)</p>

<b>Activity 2 extension</b> (20 mins)	<p>Introduce the idea of a star network and central node (slides 8 &amp; 9).</p> <p>Challenge each group to place the central node in such a way to minimise the average distance from the fire detectors.</p> <p>Note the term 'average' is used to be deliberately vague - if the mean, median or mode is used, does that effect where the central node should be placed?</p>	<p>You may wish to watch <a href="#">this video</a> about how connected fire detection is saving lives in informal settlements:</p>
<b>Activity 3</b> (140 mins)	<p>Slides 14 onwards contain information for the main focus of the activity.</p> <p>Each group is tasked with setting up their own rival fire detection company that will use the Internet of Things as well as existing fire detectors to improve fire safety.</p> <p>Groups will present their ideas for the company in a presentation, each presentation should comprise of two main parts:</p> <ul style="list-style-type: none"> <li>■ A fire detection coverage design and a pricing strategy using the business grounds (from Activity 1) as a template</li> <li>■ Their ideas on how the IoT could be used as an early warning system for all relevant stakeholders</li> </ul> <p>Slide 16 has prompts for students to consider:</p> <ul style="list-style-type: none"> <li>■ How much area of the ground does your proposal cover?</li> <li>■ Breakdown of costs</li> <li>■ How many of each camera did you use- and why?</li> <li>■ Could you suggest multiple options for the company to choose from? A budget option or full coverage?</li> <li>■ Do you have a company name, logo and slogan?</li> <li>■ Have you included ideas for how the Internet of Things can be used to connect the system?</li> <li>■ Who is going to be told if there is a fire and how are they going to be alerted?</li> </ul> <p>To prepare for their presentation, students may require internet access to research their ideas, as well as addition copies of the student worksheets.</p>	<p>Student map of the grounds worksheet</p> <p>Pair of compasses, protractor, rulers, pens, pencils, paper, scissors, calculator</p> <p>Squared paper (if required)</p> <p>Internet access (if required)</p>
<b>Activity 4</b> (30 mins)	<p>Student groups can present their work to the whole class. You may wish to introduce a time limit of 5 minutes per group. Teacher led whole class discussion can centre on the ideas and strategies suggested during the student presentations.</p> <p>In addition, students can record their thoughts and contributions to the group presentation using the student booklet.</p>	<p>Student booklet</p> <p>Materials for student presentations.</p>
<b>Activity 5</b> (30 mins)	<p>Students to complete the CREST Discovery passport.</p>	<p>CREST Discovery passport</p>