# Producing a rule

Teacher notes

## Why use this resource?

This resource gives students a chance to develop a method for differentiating a product. By looking at factorised polynomial functions, which they can already differentiate by first expanding, students' natural desire to find a way of jumping a few steps is being harnessed here. The Chain Rule could also be developed from this resource. The motivation for doing so could come from considering how to tackle this review question.

This resource can be used to reinforce the idea of finding a generalisation by building complexity up in steps.

The final tab A certain perspective explains how this simple version of the Product Rule can be used to justify why it works for any pair of functions.

## Preparation

Students need to be able to differentiate polynomials, they do not need any other prior knowledge.

Sets of printouts of the Things you might have noticed might be useful for groups to study. Note that this section refers to the Chain Rule.

## Possible approach

This works well with students tackling the initial two functions in the Warm-up from the board and trying to spot a rule alone. These ideas can then be shared via a plenary as a large group and finally rules can be checked as a class using the toggle. Alternatively, rather than use the Warm-up examples you could ask each student to come up with their own expression with two brackets.

Students could then be asked to work in pairs or small groups as they investigate the functions in the main problem.

You might next like students to work through How does your rectangle grow? which offers a visual cue to why the Product Rule works.

## Key questions

- What in the original expression affects the coefficients in the derivative?
- What is similar and what has changed in each new function?
- How can this help us with harder functions?

## Possible support

- Encourage students struggling to find connections, to invent more of their own functions to check, or extra functions can be suggested.
- It's a good idea to follow a building process doing two or three of each type until connections are made rather than random examples.

$$y = (x+1)(ax+b)$$
$$y = (x+c)(ax+b)$$
$$y = (1-x)(ax+b)$$
$$y = (cx+d)(ax+b)$$

## Possible extension

Students could unpack ways of generalising, thinking about how they might extend to higher degree polynomials, or might start thinking about other functions (see the final tab).

If the Chain Rule has not yet been covered, students can consider functions of the form $y = (ax+b)^c$ then $y = (ax^2+bx+c)^d$ or $(x^3+2)^2$. Students can conjecture a general rule in function notation.

Students could look at some review questions such as this one.