ROBOTICS IN STEM

Here are just a few examples of how robotics can help to teach in all areas of STEM. How many more can you think of?

SCIENCE | **TECHNOLOGY** | **ENGINEERING** | **MATHEMATICS**

Electricity

How much current is required to run the motors of the robot and how does this change with the loads being moved? Does the battery have enough capacity to run the motors for long enough for the tasks to be completed?

Energy Changes and Transfers

Using simple mechanisms to give a larger force at the expense of smaller or slower movements.

Engineering

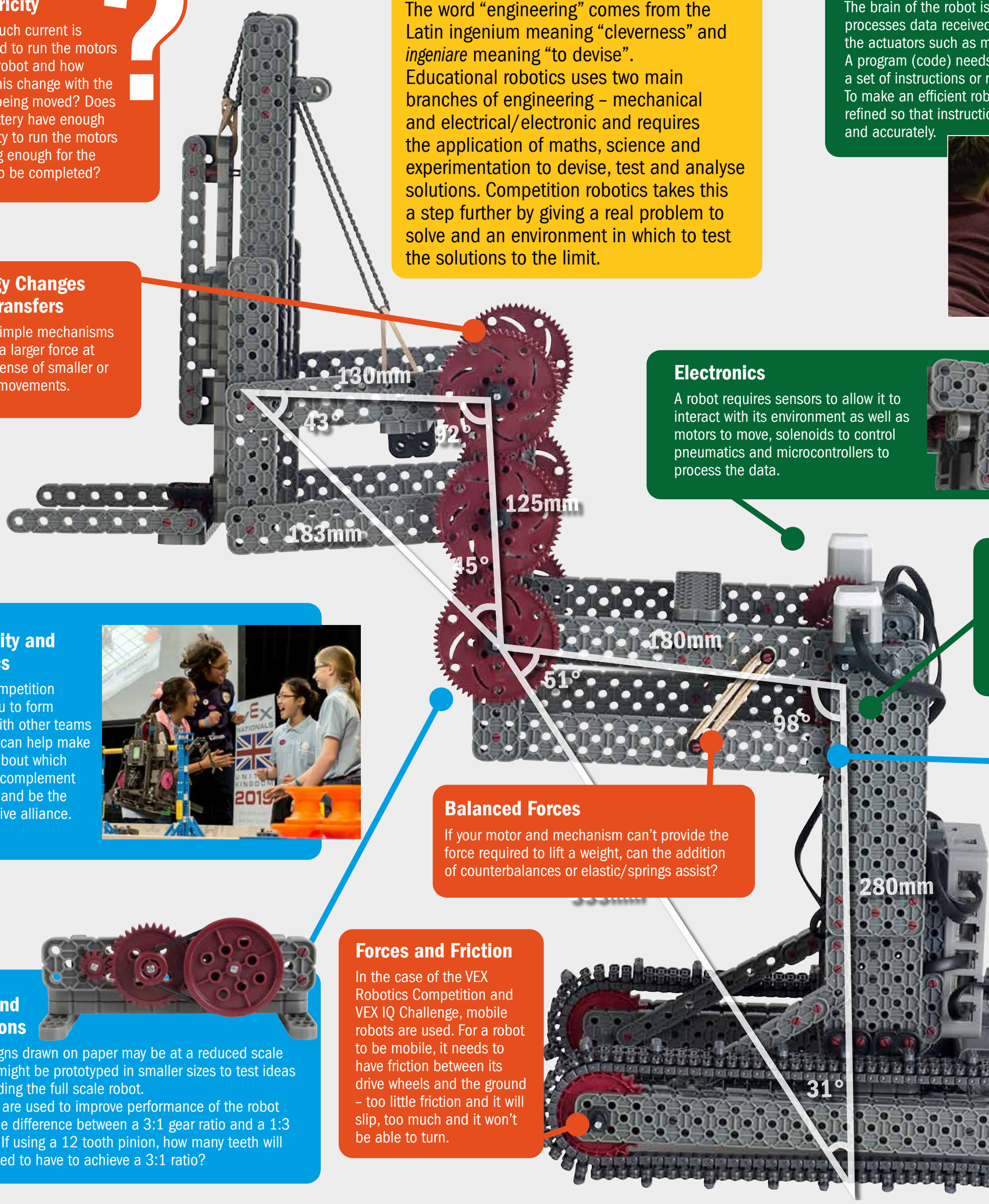
The word “engineering” comes from the Latin ingenium meaning “cleverness” and *ingeniare* meaning “to devise”.
Educational robotics uses two main branches of engineering – mechanical and electrical/electronic and requires the application of maths, science and experimentation to devise, test and analyse solutions. Competition robotics takes this a step further by giving a real problem to solve and an environment in which to test the solutions to the limit.

Programming

The brain of the robot is a microcontroller which processes data received from the sensors and controls the actuators such as motors and pneumatics.
A program (code) needs to be created which will form a set of instructions or rules for the robot to follow.
To make an efficient robot, the code needs to be refined so that instructions are executed quickly and accurately.

Electronics

A robot requires sensors to allow it to interact with its environment as well as motors to move, solenoids to control pneumatics and microcontrollers to process the data.



Materials

It is important to select the correct materials for the job – these could be selected for a combination of their strength, weight, cost and availability.

Probability and Statistics

The VEX competition requires you to form alliances with other teams – statistics can help make decisions about which teams can complement each other and be the most effective alliance.

Balanced Forces

If your motor and mechanism can’t provide the force required to lift a weight, can the addition of counterbalances or elastic/springs assist?

Geometry

Mechanisms on the robot will require an understanding of geometry to ensure that parts move correctly. It can also be used to simplify designs by using geometry to move other parts of the robot rather than by adding motors.

Ratios and Proportions

Robot designs drawn on paper may be at a reduced scale and ideas might be prototyped in smaller sizes to test ideas before building the full scale robot.
Gear ratios are used to improve performance of the robot – what is the difference between a 3:1 gear ratio and a 1:3 gear ratio? If using a 12 tooth pinion, how many teeth will the gear need to have to achieve a 3:1 ratio?

Forces and Friction

In the case of the VEX Robotics Competition and VEX IQ Challenge, mobile robots are used. For a robot to be mobile, it needs to have friction between its drive wheels and the ground – too little friction and it will slip, too much and it won’t be able to turn.