

**Unit 1: Skill Builder 3 - Turtle Drive**

**Objectives:**

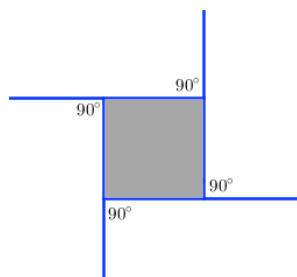
Students write two programs to accomplish challenges requiring turtle drive. First they are challenged to drive a square, and then a regular polygon with a number of sides of their choosing.

Students will:

1. Write a TI BASIC program that uses turtle drive to navigate a path.
2. Discover basic properties of regular polygons.

**Background:**

In computer science and computer graphics, **Turtle commands** are those where the present position, the “turtle”, is commanded to go to the next position by first turning to the appropriate direction and then moving forward a defined distance to reach the next point. In mathematics, this concept is known as a vector, something that has direction and size. In this activity, students will use their skills of turning and moving forward from the previous activities to accomplish two new challenges using turtle drive on the Rover. The first challenge is to drive a square with an edge length of 0.5 meters. This is accomplished by turning  $90^\circ$  and then driving forward 0.5 meters and then repeating this three more times. Notice that the angle the Rover needs to turn is the EXTERIOR angle of the polygon. It is necessary to turn a total of  $360^\circ$  in order to be facing the same direction after the Rover finishes driving. This is a general statement for all regular polygons and leads to the formula for the exterior angles of a regular polygon of  $360/n$ -sides. This formula is used in Challenge 2 where students are challenged to make a regular polygon with the number of sides of their choosing (Note – Although there is no limit on the number of sides, advise students to keep it under 30 with a side length no smaller than 1 cm to ensure best results).



Exterior Angles of a Square add up to  $360^\circ$

Rover Command	Example	Behavior
Wait <i>time</i>	Wait 2	Program waits for 2 seconds and does nothing
dispAt <i>line</i> , <i>prompt string</i> , <i>number</i>	dispAt 3,"Angle =", a	Display Angle = 60 on line 3 when the variable 'a' is set to 60
For <i>index variable</i> , <i>start</i> , <i>stop</i> EndFor	For n, 1, 10 ... EndFor	Repeats commands within structure 10 times with the loop count in variable n.
RV LEFT <i>angle units</i> SPEED <i>unit</i>	RV LEFT 60	Rover makes a right hand* $60^\circ$ spin (if the angle is omitted it will turn $90^\circ$ )
RV FORWARD <i>distance unit</i>	RV FORWARD 1.2 M	Go forward 1.2 M at default speed of .20 M/S

\* The LEFT and RIGHT turns are made with a frame of reference from Rover's driver's seat.

**TI-Innovator™ Rover Set-Up:**

Students may work in groups of two or three. Choose an area to work that has at least 2 meters of clear uniform floor space. Carpeted flooring is less desirable than tile. If needed, driving mats may be used for a driving surface.

**Materials:**

- Dry erase marker and pen holder
- Drive mat or large hard, flat surface

**Student Activity:**

**Challenge 1:** Write a program named “c1” that drives a square with an edge length of 0.5M.

**Teacher Notes:**

**Teacher Guidance during Challenge 1:**

*Review the Rover commands needed for this activity.*

- Every time a program needs to talk to the Rover, use the command: Send "CONNECT RV"
- When a program needs to run using units of meters, use the command: Send "SET RV.GRID.M/UNIT 1"
- When Rover needs to go forward some distance, use: Send "RV FORWARD DISTANCE 0.4 M"
- When Rover needs to turn a specific angle, use: Send "RV RIGHT 30"
- Review the commands DispAt, Wait and For...EndFor.
- See [U1SB1 Example Programs.tns](#) and [U1SB2 Example Programs.tns](#)
- Give students the opportunity to explore making a square. Instead of giving them the turn angle allow them to explore various angles to achieve their goal.
- Allow them to choose to use a For...EndFor loop or to explicitly list the many turtle drive commands one after the other.

*Foster a discussion with your students regarding which is the better method or which is the most understandable.*

- Ask them to observe the beginning direction and ending direction once they successfully drive a square.
- Ask them how many degrees the rover had to turn to end facing in the same direction as they started.
- For those who finish their squares quickly, challenge them to make an equilateral triangle.
- Help them to observe the exterior angles of their square and triangle. If they can use the dry erase marker to draw on a board or large paper, illustrate the exterior angle.
- Refer to c1 in [U1SB3 Example Programs.tns](#)

```
Define c1()=
Prgm
Send "CONNECT RV"
For n,1,4
Send "RV LEFT 90"
Send "RV FORWARD 0.5 M"
EndFor
EndPrgm
```

**Challenge 2:** Write a program named “**c2**” that drives a polygon with as many sides as you like, up to 30, with an edge length of 0.3M.

#### Teacher Guidance during Challenge 2:

- Help students to discover the formula for the exterior angles of a regular polygon is  $360/n$ -sides.
- Point out the efficiency, compactness and readability of using a For...EndFor loop in their programs.
- Refer to **c2** in [U1SB3 Example Programs.tns](#)

```
Define c2()=
Prgm
Send "CONNECT RV"
For n,1,8
Send "RV LEFT 45"
Send "RV FORWARD 0.3 M"
EndFor
```

- Sample code demonstrates a regular pentagon.

```
Define c2()=
Prgm
Send "CONNECT RV"
For n,1,8
Send "RV LEFT 45"
Send "RV FORWARD 0.3 M"
EndFor
```

- Refer to **c2extension** in [U1SB3 Example Programs.tns](#)
- Extension: For students that finish early, have students create a program that allows the user to enter the number of sides in the regular polygon at runtime. The program should store and use a variable to draw the polygon

```
Define c2extension()=
Send "CONNECT RV"
Request "Sides:",sides
angles:=((sides)/(360))
For n,1,sides
Send "RV LEFT eval(angles)"
Send "RV FORWARD .3 M"
EndFor
Prgm
```