Thinkfun®

//CODE
PROGRAMMING GAME SERIES

ROVER CONTROL
//

Instruction Manual

AGES 8 to Adult

//CODE ROVER CONTROL

PROGRAMMING GAME SERIES //

Coding is like a superpower. It might be the reason you can make a robot work. It might even help you do something really big for the world, like send a rocket to Mars. One thing is for sure, if you learn to code, you will never be out of things to do with your new super skill.

ROVER CONTROL is the second in a series of games designed to build the mental skills needed to fully grasp the concept of coding. All of the games are screen-free for a unique, unplugged play experience. Take them anywhere you go, and before you know it, you'll be ready to CODE!

Visit **www.ThinkFun.com/learn-coding** for video instructions, solution strategies, and more great resources from the inventor!
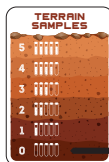
Includes

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4 Terrain Maps

40 Challenge Booklet

5 Station Tokens

Solution Booklet

2 Rovers

Sample Storage Card

3 Erasable Markers
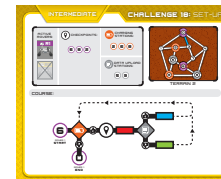
4 Start and End Tokens

Game Boards

The four Game Boards each contain a Terrain Map consisting of white pathways. Use the Erasable Markers to color the path segments.

Challenge Cards

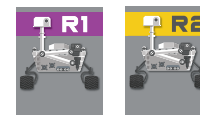Each of the 40 Challenge Cards contains a course that the Rovers are programmed to follow.

Erasable Markers

Use the red, green, and blue Markers to color in white segments on the Terrain Maps.

Rovers

The two Rovers are programmed to explore Mars along the courses mapped out on the Challenge Cards.

Charging/Data Upload Station Tokens

More treacherous courses require the Rovers to stop at Charging and/or Data Upload Stations.
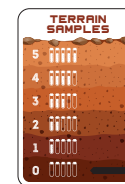
Start/End Tokens

These Tokens mark the Start and End of each of the 40 courses the Rovers are programmed to explore.

Sample Storage Card

Advanced missions require the collection of Terrain Samples. Track the number of samples collected by moving the plastic tab up as you collect samples.

How to Play

Two Rovers have been sent to Mars to explore forty courses across four types of terrain. A set of pathways made up of colored segments was found on each terrain, and the Rovers were preprogrammed with instructions for how to move along the colored segments of these pathways.

The trouble is...nature took its toll and a giant dust storm destroyed most of the colored segments that the Rovers are programmed to follow.

Your Goal

Color the white segments on the Terrain Maps to lay out the original paths the Rovers were programmed to follow.

Set-Up

Step 1: Select a Challenge Card and corresponding Terrain Map.
Note: The Terrain Map changes every 10 Challenges.

Step 2: Use the Markers to color the Terrain Map so it matches the Challenge Set-Up.
Note: Not all Challenge Set-Ups require you to color in path segments to start.

Step 3: Place the Start and End Tokens and any Charging or Data Upload Station Tokens as shown in the upper right of the Challenge Card.
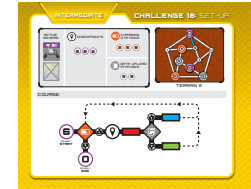Note: Charging and Data Upload Station Tokens do not appear until the Intermediate level.

**Step 4:** Place your Rover(s) near the Start Token(s).
Note: A second Rover does not appear until the Expert level. Instructions for using two Rovers are found on page 13.

Challenge Set-Up Guide

Sample Challenge Card
(Intermediate Level)

Make your Terrain Map match the Terrain Map in the upper right of a Challenge Card by coloring the path segments as indicated, then place any Tokens in the locations shown.
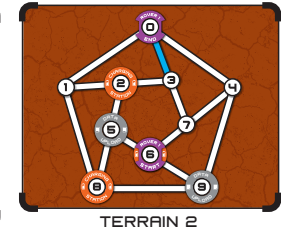

Close-Up of the Terrain Map

For clarity, Token locations are also listed elsewhere on the Challenge Cards. The location of Charging and Data Upload Station Tokens can be found in the panels to the left of the Terrain Map. The location of the Start and End Tokens can be found as part of the Course in the bottom half of the Challenge Card.

Close-Up of the list of Charging and Data Upload Station Tokens
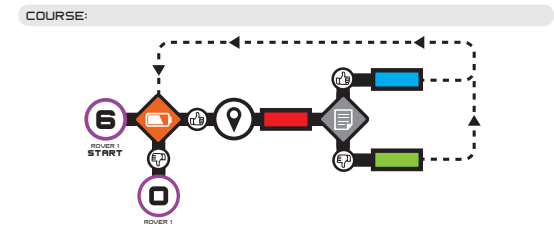
Close-Up of the Start and End Tokens within a Course

IMPORTANT: If a Charging or Data Upload Station Token is at the same location as a Start or End Token, place the Start or End Tokens over the Station Tokens so that the battery icons and data sheet icons are still visible, as shown below.
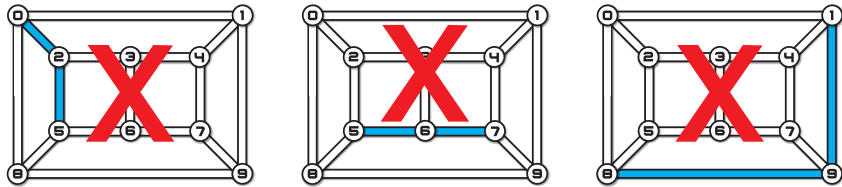
Coloring the Terrain

To correctly color the white segments on the Terrain Maps so that the Rovers can successfully navigate the courses they are programmed to explore, follow these two simple rules:

1. Only color a white segment with a single color (i.e. do not color half a segment green and the other half red).
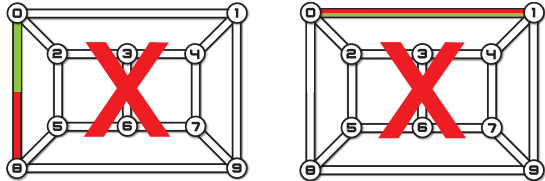
2. Two paths of the same color can never come out of the same location.

IMPORTANT: Not all white segments need to be colored; however the Rovers are only programmed to travel along the colored paths.

Rover Movement Rules

As you color the Terrain Maps, keep in mind the following two rules of Rover movement:

1. A Rover may travel across the same path more than once. This means:
   - A Rover may travel back and forth along the same path
   - A Rover may leave a path, then travel across it again later
2. A Rover may pass over the End location in the middle of a course.
   Note: To successfully complete the course, the Rover must have returned to the End Token at the end of the program.

Decoding the Courses

Each Challenge Card contains a course that one or both Rovers were programmed to follow. The course is a visual depiction of a Rover's programmed path. You must color the Terrain Maps so that a Rover can follow the course, executing the program steps in full, in the order shown. Read on to learn about each of the different elements found within a course.
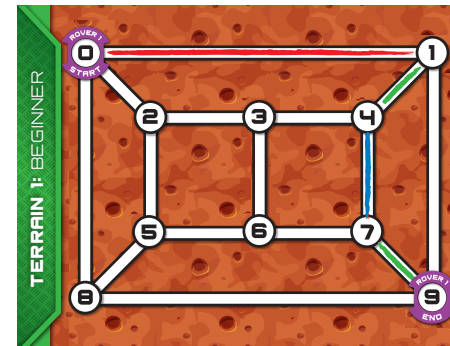
Path Instructions

The red, green, and blue colored blocks in a course equate to one of the white segments, of any length, on the Terrain Maps. It is your goal to color in the white segments so that the Rovers can travel along colored paths according to the instructions mapped out in a course.

Example:

COURSE:

Colored Terrain Map

Here is one example of a colored Terrain Map that allows the Rover to follow the instructions in a course (shown above the Terrain Map)
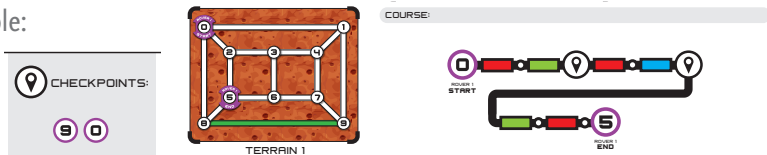
Checkpoints 📍

To ensure the Rovers don't travel off course, some programs include checkpoints. When you see the checkpoint icon in the program, look to the "CHECKPOINTS" list in the upper left of the Challenge Card to see where the Rover should be located each time you reach a checkpoint.

IMPORTANT: When multiple checkpoints are listed, the first time the Rover encounters a checkpoint, the Rover must be at the first location listed under "CHECKPOINTS"; the second time the Rover encounters a checkpoint, the Rover must be at the second location listed, and so on.

When the Rover reaches the checkpoint icon in the course, it must be at the next location from the checkpoint list; however, Rovers may freely move through checkpoint locations at any other time in their travels.

Example:

Colored Terrain Map
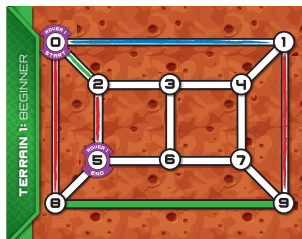
In this example with two checkpoints, the Rover must hit the "9" checkpoint first, followed by the "0" checkpoint. The Set-Up already includes a green path, so starting at "0," the Rover travels along the edges of the Terrain, traveling along the red path first.

! You are now ready to begin playing the Beginner Challenges! To begin playing, turn to page 12 for a description of how to run a course after coloring a Terrain Map. To learn about additional course elements found in the Intermediate, Advanced, and Expert levels, continue to the next page.

Station Decision Points ◆ ◆ INTERMEDIATE

Decision points are first introduced in the INTERMEDIATE CHALLENGES. A decision point has the shape of a diamond, and contains either a battery icon to correspond with the Charging Stations, or a data sheet icon to correspond with the Data Upload Stations.

Note: A third type of decision point is introduced in the Advanced Challenges, to be explained on page 11.

When a decision point appears in a course, the Rover must answer YES/NO to any one of the following questions:
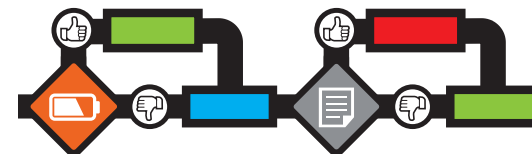
◆ Am I at a Charging Station?

◆ Am I at a Data Upload Station?

If the answer is YES, the Rover continues to the instruction after the 👍

If the answer is NO, the Rover continues to the instruction after the 👎

Example:

Snapshot of a course

Looking at the above snapshot, you can see that if the Rover is at a Charging Station, its next move would be to follow a green path. If it was anywhere but a Charging Station, it would follow a blue path next. Then, after moving across a green or blue path, the Rover would ask, "Am I at a Data Upload Station?" If the answer is YES, the Rover needs to move across a red path. If the answer is NO, the Rover needs to travel along a green path.

IMPORTANT: Decision points themselves do not advance the Rovers. They determine which of two instructions a Rover should execute next.
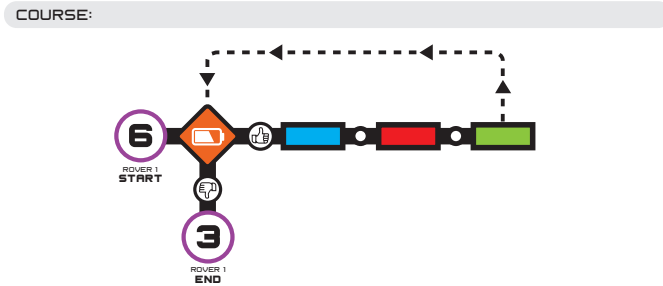
Loops

Loops are first introduced in the INTERMEDIATE CHALLENGES, in combination with decision points.

Note: Not all Challenges with a decision point include a loop, but every Challenge with a loop involves a decision point.

Loops mean that the set of instructions enclosed by the dashed lines will be repeated multiple times.

Example:

COURSE:

In the sample course above, a Rover will follow a blue path, a red path, then a green path. After traveling across the green path, the Rover will ask, "Am I at a Charging Station?" If the answer is YES, the Rover will travel across another set of blue, red, and green paths.

IMPORTANT: A loop means the Rover will be repeating instructions from the course, but that doesn't necessarily mean the Rover will travel over the exact same path segments it did before.

Note: In some Challenges you may only see one checkpoint icon in the course, but multiple checkpoints listed. This is because the Challenge contains a loop. Each time you pass the checkpoint, you must be located at the next checkpoint listed.

Sample Storage

INCREMENT INSTRUCTIONS

Increment instructions are introduced in the ADVANCED CHALLENGES through the use of a Sample Storage Card, which tracks the number of Terrain Samples the Rover collects. For Challenges that include a Sample Storage Card, always start the counter at 0.

Every time a course shows this icon move the plastic indicator on the Sample Storage Card to the next number.

SAMPLE STORAGE DECISION POINTS

Increment instructions appear in a course in combination with sample storage decision points.

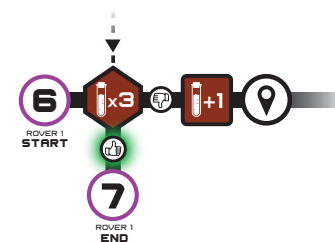When a sample storage decision point appears in the program, the Rover must ask, "Is the Sample Storage Card set to exactly this number?"

If the answer is YES, the Rover must continue to the

If the answer is NO, the Rover must continue to the

Example:

Snapshot of a course

Looking at the snapshot above, you can see the Rover will continue to follow the "thumbs down" until it has collected exactly three Terrain Samples.

Running the Course

When you have the Terrain Maps colored the way you would like them, it is time to test your design by running the course!

Before you run the course, double-check that your Terrain Map does not have two paths of the same color coming out of the same location.

Beginning at START, carry out all steps in the program, moving the Rover along the colored paths based on the sequence of instructions outlined in the course.

Note: Try running a course with a partner. One person calls out the instructions, while the other moves the Rovers across the Terrain!

If you finish running the program and the Rover is at the END – **YOU WIN!**

After you begin running a program, you may discover that a change is required. This is okay! Think about what path(s) should be erased, and about how to recolor the same path(s), or maybe color a path you left white. You'll know you need to make a correction if:

- None of the paths stemming from the current location of your Robot are the same color as the next path instruction it is supposed to follow.

- You reach a checkpoint instruction and the Rover is not at the next location listed in the checkpoints list.

Once you think you've corrected any errors in the course, place the Rover(s) back at START to run the course from the beginning.

Two Rovers

A second Rover only appears in the EXPERT CHALLENGES. Both Rovers will run the same program pictured on the course. However, they each start from different locations and will therefore take different paths to reach their respective End Tokens. Your goal is to find a way to color the path segments that will work for both Rovers.

Note: It is okay for a Rover to occupy or pass through a location occupied by the other Rover.

To win, Rover 1 must start and end at the purple Tokens after passing through the purple checkpoints. Rover 2 must start and end at the yellow Tokens after passing through the yellow checkpoints.

RUNNING A COURSE WITH TWO ROVERS: Each Rover should run the course independently, but they may do so in any order. One Rover should follow the program until it successfully reaches the END Token in its corresponding color, and then the second Rover should execute the program as well. If a Challenge contains a Sample Storage Card, be sure to reset the counter to 0 before running the program for the second Rover.

Strategy Tips and Hints

- If you can't tell how a Rover's path should start, use any checkpoints to divide the course into smaller sections that can be worked on in any order.

Note: Consider marking the checkpoints with colored dots for a better visualization of the locations the Rover will need to visit.

- If you are unsure about what color a path should be, consider coloring it differently. For example, mark the paths you are unsure of with diagonal lines only. This will help you pinpoint any changes you may need to make.

Message for Parents and Educators

The idea that all kids should acquire coding skills is one of today's fastest growing educational movements; however, the act of learning to code still feels intimidating to many. Our goal is to expose parents and kids to coding concepts in a fun, non-conventional way so that it becomes more approachable and feels like play.

The ThinkFun //Code Programming Game Series
This Programming Game Series is designed to take players on a grand tour of the big ideas in computer science. If you play all the games in our series, you will develop a love for concepts such as procedures, if/then statements, while loops, for loops, state machines, logic gates, and Boolean satisfiability, while learning how to mentally evaluate logical expressions and control structures the way computers do. Most importantly, these games will start you on a fun and thrilling journey into the realm of computational thinking. Enjoy the ride!

A Closer Look at ROVER CONTROL
Research suggests that one primary skill required to be a successful programmer is the ability to emulate the step-by-step execution of a sequence of instructions in your mind's eye and visualize how the instructions will play out. With ROVER CONTROL, players learn to do exactly that.

Much of the educational power of the game comes from the course - really a heavy-duty flowchart - and the variety of layouts which introduce fundamental programming control constructs like "while" loops and "if-then-else" conditional branching. ROVER CONTROL's rules of program execution mimic the way real computers execute programs, stepping through a procedure contained in the computer's memory, where some instructions are "actions" and others are conditional tests that determine where the instruction pointer should jump to next. Running ROVER CONTROL programs by hand, players will build a powerful mental model of how computers operate.

About the Inventor

Mark Engelberg is the inventor of ThinkFun's award-winning coding game Code Master as well as one of the challenge developers for ThinkFun's blockbuster game Rush Hour®. To create Code Master™ and the //CODE Programming Game Series he drew on his experience as a programmer of virtual reality simulations for NASA, as well as his many years of experience as a teacher of computer science and mathematical logic. Mark believes that kids of all ages can and should learn how a computer executes programs - entirely through play!

ThinkFun's Mission is to Ignite Your Mind!®

ThinkFun® is the world's leader in addictively fun games that stretch and sharpen your mind. From lighting up young minds to creating fun for the whole family, ThinkFun's innovative games and mobile apps make you think while they make you smile.

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