

A User's Guide to the Ruins of Atlantis Robot Virtual World

# Ruins of Atlantis

## Robot to the Rescue - Robot Virtual World

A follow-up activity to the **Research Tested Expedition Atlantis Robot Math Game**



*We thought Atlantis was a myth. We were wrong. With the emergence of new robotics technologies we are now able to explore areas of the world we've never seen before.*

## **2 Table of Contents**

- 3 FAQ
- 4 Checklist

## **5 Introduction & Setup**

- 5 System Requirements & Installation
- 6 What are Robot Virtual Worlds (RVW)?
- 7 What is Ruins of Atlantis?

## **8 The Ruins of Atlantis Menu Interface**

- 8 Logging in and Saving Progress
- 9 Tracking Your Performance
- 10 Optimizing for Computer Performance
- 11 Printable World Map
- 12 Virtual Robot Models

## **13 The Ruins of Atlantis In-Game Interface**

- 13 User Interface: Game Control
- 14 User Interface: Camera Control
- 15 User Interface: Measurement Toolkit Buttons
- 16 User Interface: Head-Up Display
- 17 User Interface: In-Game Map

## **17 Solving Ruins of Atlantis**

- 18 Use the Robotics Today Treasure Maps
- 19 Use Start-Points to Simplify Solving the Problem
- 20-22 Use Mathematical Programming Solutions

Research has shown that the majority of folks “guess and check” their way through robotics activities. The Ruins of Atlantis is designed to be a follow-up activity to the proven to be effective Expedition Atlantis Math Game.

*Learn more about the game on page 23.*



## Frequently Asked Questions (FAQs)

- ▶ **What are Robot Virtual Worlds?**  
(See *What are Robot Virtual Worlds*, [page 6](#))
- ▶ **What is the Ruins of Atlantis?**  
(See *What is Ruins of Atlantis*, [page 7](#))
- ▶ **Can Ruins of Atlantis Run on Older Computers?**  
(See *Optimizing my Computer's Performance*, [page 10](#))
- ▶ **Can my computer run Robot Virtual Worlds?**  
(See *System Requirements*, [page 5](#))
- ▶ **How do I install the Ruins of Atlantis?**  
(See *Installation*, [page 5](#))
- ▶ **How do I program my Ruins of Atlantis Robots?**  
You can find training materials at:  
Carnegie Mellon's Robotics Academy - [www.education.rec.ri.cmu.edu](http://www.education.rec.ri.cmu.edu)  
ROBOTC's Website - [www.robotc.net](http://www.robotc.net)  
or from the Computer Science Student Network - [www.cs2n.org](http://www.cs2n.org)
- ▶ **How do I navigate and use Ruins of Atlantis?**  
(See *Printable World Map*, [page 11](#), *Game Controls*, [page 13](#),  
*Camera Controls*, [page 14](#), *Measurement Toolkit*, [page 15](#),  
*Head Up Display*, [page 16](#), *the In-game Map*, [page 17](#))
- ▶ **How do I Solve the Challenges**  
(See *Use Robotics Today Maps*, [page 18](#), *Use Start-Points to Simplify the Programming Problem*, [page 19](#), *Use Mathematical Programming Solutions*, [pages 21- 22](#))

## Checklist

- Before you commit to using Palm Island, make sure that your computers have the capacity to run the Robot Virtual World (RVW) software by checking your computer's specifications against the system requirements, see System Requirements, [page 5](#).

*Note: If you are unsure, you can always download a trial copy and test it on your computers.*

- Adjust your computers for optimal RVW performance. RVW software allows you to adjust the graphics in the game based on your computer's performance. Slower computers can be set to lower graphics, [page 10](#).
- Learn how to login and save your progress when using the RVW software. Make sure that you know how to log in, save your progress, and log out, [page 8](#).





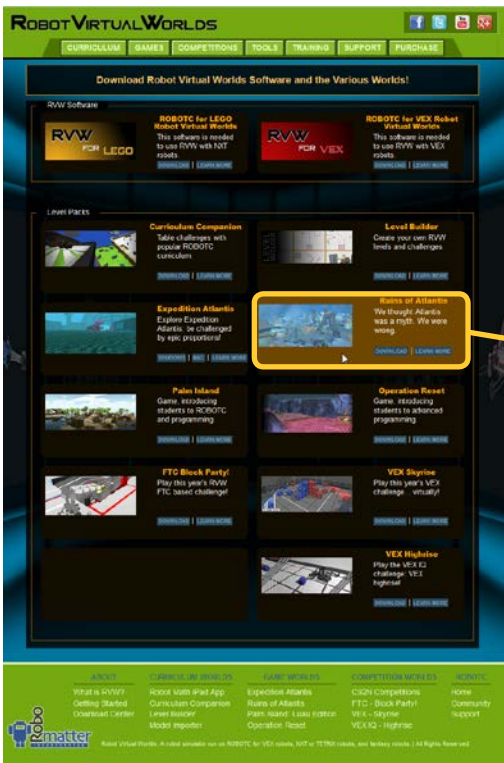
# System Requirements

- PC Compatible OS: Windows XP, Windows Vista, Windows 7, or Windows 8
- Processor: Intel Core 2 Duo processor family or better, AMD Athlon X2 processor family or better
- Memory: 2 GB RAM
- Graphics: NVIDIA® GeForce® 8800GTS or better, ATI Radeon™ HD 3850 or better
- DirectX®: DirectX® 9.0c and DirectX® 10
- Hard Drive: 250 MB free hard drive space
- Sound: Standard audio device

Robot Virtual Worlds may run on older computers, but it is highly recommended that computers have a dedicated graphics card for superior performance.

# Installation

1. You will need Administrator Level Access to the computer to install the Ruins of Atlantis Robot Virtual World.
  2. Ruins of Atlantis can be downloaded and installed as part of a **Robot Virtual World Bundle**, designed to simplify the setup process for classrooms, or as a **standalone level pack**, meant for classrooms using ROBOTC (or updating individual worlds).
- To learn more go to: [www.robotvirtualworlds.com](http://www.robotvirtualworlds.com)



You will find the Ruins of Atlantis download at:  
<http://www.robotvirtualworlds.com/download/>

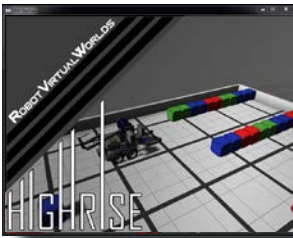


# What are Robot Virtual Worlds (RVWs)?

Robot Virtual Worlds are simulation environments designed to help you learn how to program.

The beauty of the RVW solution is that you can use the same programming language on your virtual or your physical LEGO® or VEX® robot. The RVW environment is available in:

## Competition environments



You can begin modeling your autonomous programs before your robot is complete. You can host your own virtual robotics programming competition.

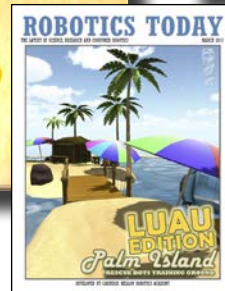
## Fantasy environments



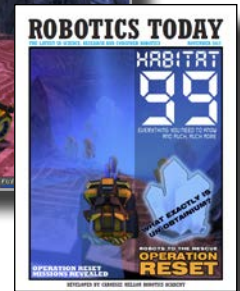
The Ruins of Atlantis



Palm Island



Operation Reset



## Classroom environments



Research has shown that learning to program in the RVW environment is more efficient than learning to program using physical robots.

Directly below are papers and articles that they've written on learning with Robot Virtual Worlds.

Liu, A., Schunn, C. D., Flot, J., & Shoop, R. (October, 2013) *The role of physicality in rich programming environments..* Computer Science Education, 23(4), 315-331.

Liu, A., Newsom, J., Schunn, C., Shoop, R. (March, 2013) *Students Learn Programming Faster through Robotic Simulation.* Tech Directions , 16-19.

Liu, A., Newsom, J., Schunn, C., Shoop, R. (May/June 2013) *Learn to program in half the time!. Robot Magazine,* 49-51.

Download copies of the articles at: <http://www.cs2n.org/teachers/research>



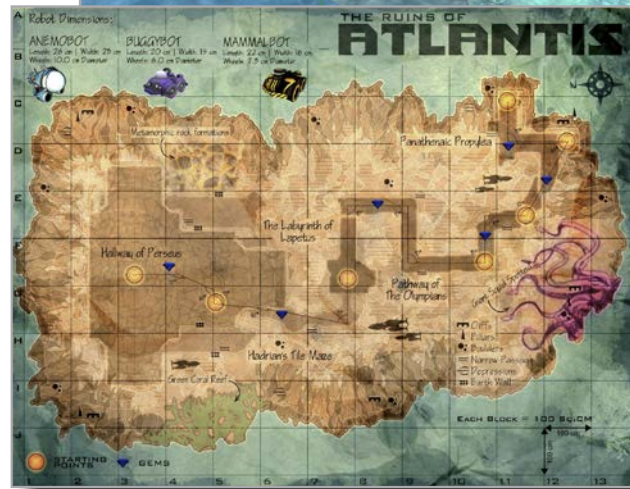


# What is Ruins of Atlantis?

Ruins of Atlantis is one of the Robot Virtual Worlds, themed in a fantasy, underwater environment. .

The level design of Ruins of Atlantis features a path that includes collectible objects and additional starting points, making it ideal for teaching introductory programming concepts such as path planning and encoder based movements.

Ruins of Atlantis is intended to be a follow-up to the standalone Expedition Atlantis math game shown directly below.



## Logging In and Saving Progress

When the Ruins of Atlantis virtual world opens, you will be presented with the user interface below. The following pages will familiarize you with many of the controls and game mechanics of Ruins of Atlantis.

How you log in determines how your progress is saved. **Make sure that you log in to save your progress.**



### 1 Log into CS2N (*Teacher Note*)

If a teacher wants to track all of her students' progress on one screen, then they will want their students to setup CS2N accounts. When students log in with their own CS2N account, their progress is tracked and stored via the CS2N network. This lets students continue their progress, even on a different computer.

Create a CS2N account at <http://www.cs2n.org/signup> (users will need an email address)

For teachers to see all of their student's progress they will need to setup a CS2N Group. Learn more at [www.cs2n.org/teachers/groups](http://www.cs2n.org/teachers/groups)

### 2 Log in locally

A local log in allows you to save your progress on a local machine. You will need to use the same computer every day to take advantage of this feature.

### 3 Log in as guest

Within the LOCAL button, there is an option to log in as guest. Logging in as a guest allows teachers to preview and demonstrate the game easily, but once the game is closed no progress will be saved. This option should not be used with students, as all progress will be lost if the application is closed, even accidentally.



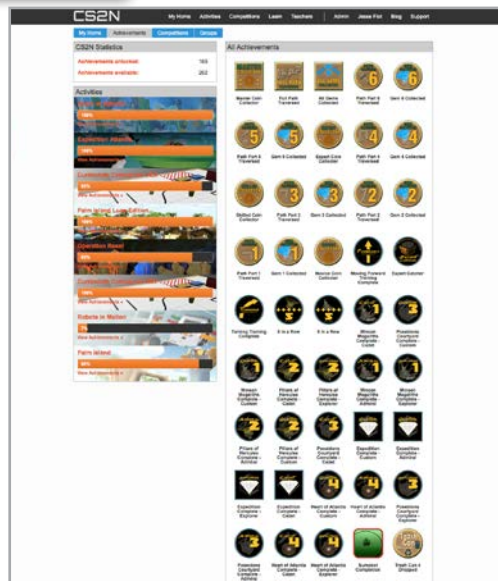
# Tracking Your Performance

## Badges and Achievements

The Computer Science Student Network (CS2N) contains free activities, courses, and resources for teachers to teach Robotics and Computer Science. Teachers can use CS2N to create a Group and keep track of their students progress.

Robot Virtual Worlds give out badges upon completing certain tasks or behaviors.

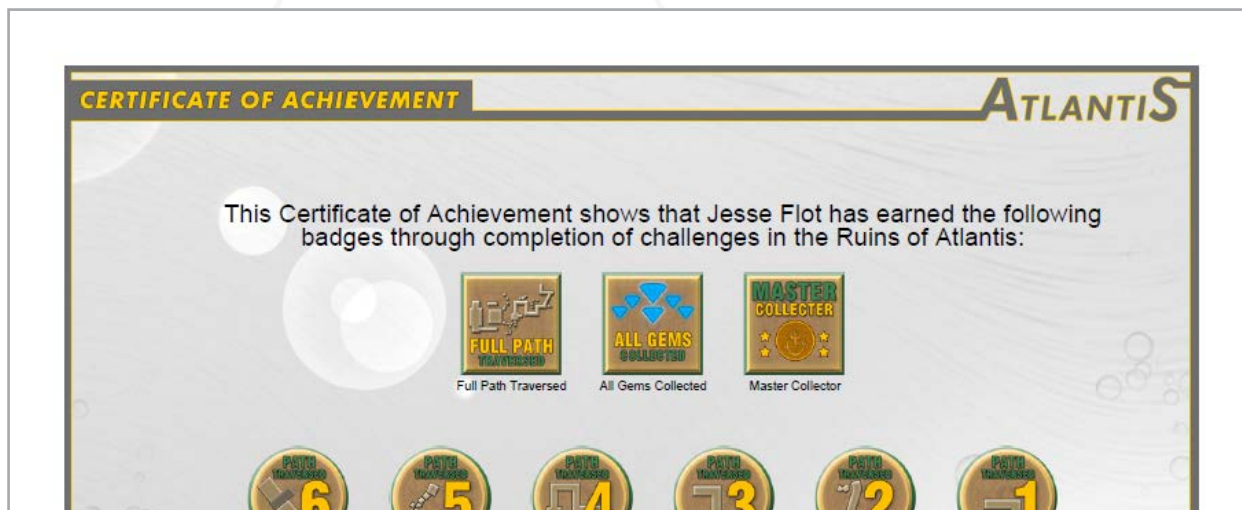
CS2N is able to keep track of your Robot Virtual Worlds Achievements (or badges) once a CS2N account is created. Go to [CS2N.org](http://CS2N.org) to create an account and begin getting achievements.



## No Internet connection? That's okay!

Achievements can also be obtained by creating a Local account. This is useful for computers that cannot connect to the internet. You can do this by simply selecting the "Create Local Account" option.

The student's achievements are stored on the local computer and viewable in the BADGES menu. From there students can also generate a PDF of their achievements which can be saved and printed.



## Optimizing for Computer Performance

The Robot Virtual Worlds are built using a real physics and gaming engine, and have similar computer processing demands as a video game. To allow the RVWs to be run on a wider variety of computer hardware, graphics quality settings are included. You'll find these controls in the OPTIONS menu.



**VISUAL EFFECTS:** This toggle controls whether the game plays certain animations, such as the bubbles and fish. Toggle it off if your computer has limited graphics processing power, or your notice inconsistency in your robots behavior.

**SOUND EFFECTS:** This toggle controls the in-game sounds. We recommend toggling this off if your computer lab does not have headphones for each station.

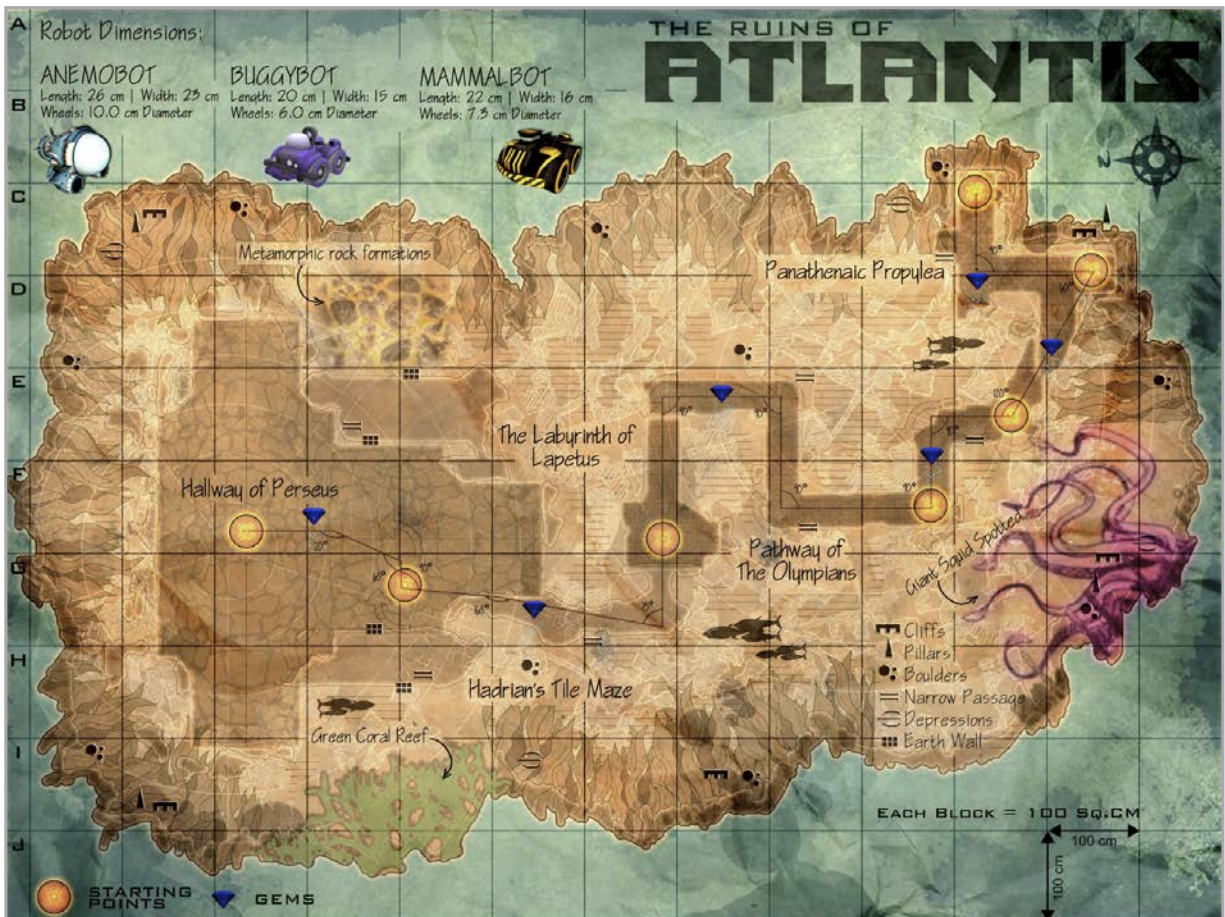
**GRAPHICS QUALITY:**

- **LOW (FASTER)** - Reduces the visual quality of the virtual world. Better for computers with limited graphics processing power
- **MEDIUM** - Default setting. Balances the visual quality of the virtual world with graphics processing demands.
- **HIGH (SLOWER)** - Improves the visual quality of the virtual world. Better for computers with sufficient graphics processing power



# Printable World Map

In the MEDIA section of the menu, you'll find a high resolution, printable map of Ruins of Atlantis. The map contains key information such as the distances and angles the robots will need to move and the physical characteristics of their robots allowing students to make informed decisions as they program.



**Teacher Note** - Consider printing a large version of the map to facilitate class discussion. Don't miss the opportunity to reinforce your student's math skills with the robot dimensions and distance key, students are able to calculate how far their robot needs to travel. The printable map is designed to be used with the in-game measurement toolkit.





## Virtual Robot Models

From the main screen, you are able to choose from three different robot models: Anemobot, Buggybot, and Mammalbot. Robot specifications, including motor ports, sensor ports, and robot dimensions appear when selecting robots from the ROBOT menu. You will need this information when writing programs for the virtual robots.

Pressing the **PLAY** button will launch the Ruins of Atlantis virtual environment with your selected virtual robot.






Note - In the Buggybot and Mammalbot pictures directly above one picture identifies encoders as Digital  $n$  and the other as Port  $n$ , this is based on the software and hardware platform that you are using.

## User Interface: Game Controls

Every Robot Virtual World includes Game Controls. The Game Controls allow you to choose when the programs you download are run by the virtual robot, to reset the virtual robot to a starting point, and to return to the main menu. In the Ruins of Atlantis, they are located in the lower-left corner of the screen.






-  Play / Pause: This button will run the program currently selected (or most recently downloaded) by your programming software. Once a program is running, it will switch to a Pause symbol; press it to halt a running program.
-  Reset: This button will stop a running program and reset the robot to its original starting point and orientation.
-  Home: This button will stop a running program and return you to the main menu of the Robot Virtual World you are using.



## User Interface: Camera Controls

Every Robot Virtual World includes Camera Controls. The Camera Controls allow you to change your view of the virtual world. In Ruins of Atlantis, they are located in the lower-right corner of the screen.



-  Camera 1: This is the default game camera. It will “follow” the robot from behind as it moves in the virtual world. You can zoom in and out using the scroll wheel on your mouse.
-  Camera 2: This provides a static, top-down view of the robot in the virtual world.
-  Camera 3: Like Camera 1, this camera will follow the robot as it moves in the virtual world. Using Camera 3, you can also click-and-drag in the virtual world to change your viewing angle of the robot.



## User Interface: Measurement Toolkit

Every Robot Virtual World includes the Measurement Toolkit. The Measurement Toolkit allows you to obtain key distances and angles from the virtual environment, crucial for robot path planning, by placing markers in the world.

In Ruins of Atlantis, they are located on the lower-right side of the screen.



**Show:** This button toggles the Measurement Toolkit on and off. You must press it to enable the Measurement Toolkit. If there are key objects in the environment, such as gems, the distance and angle to them from the robot will be displayed automatically.



**Add:** Press this button to put your cursor in “marker adding mode”. Click anywhere in the virtual world to add a marker, which will display its distance and delta angle from the robot. A series of up to 3 markers can be added at a time.



**Clear:** Pressing this button will remove the markers you have placed in the virtual world. Right-clicking while in “marker adding mode” will also remove the most recently created point.

## User Interface: Head-Up Display

As you explore the Ruins of Atlantis, you will encounter treasure in the form of gems and coins. There are a total of 6 gems and 60 coins in the world. For every gem collected, one of the gem-shaped slots in the Head-up Display will fill in. For every coin collected, the value next to the counter will go up by one. The robot collects the coins and gems by driving into them.



If the player/programmer is logged in locally or via CS2N, they will be awarded an achievement for every gem collected. Achievements for coins collected are also awarded, when the player/programmer has collected 5, 15, 30, and 60 coins.

Also, if the player/programmer logs in locally or via CS2N, their progress will be saved across sessions. Gems that have been collected will remain collected. Coins, on the other hand, will re-spawn every time the game is closed and reopened, so the 5, 15, 30, and 60 increments must be collected in a given session to earn the corresponding achievement.



## User Interface: In-game Map

As you explore the Ruins of Atlantis, your robot will unlock additional start points along the path. Locked start points appear as orange circular tiles, and switch to green once they are unlocked. The robot unlocks the start points simply by driving over them.



Locked starting point in-game

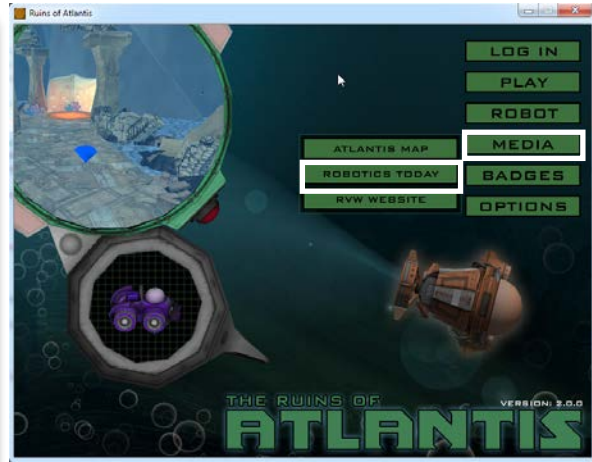


Once a start point has been unlocked, it can be selected from the in-game map, which can be toggled on and off with the MAP button at the bottom of the screen. Clicking one of the green, start point-shaped buttons will transport the robot to the corresponding location in the world. This is very useful as programming the robot to move through the world can be an incremental process.

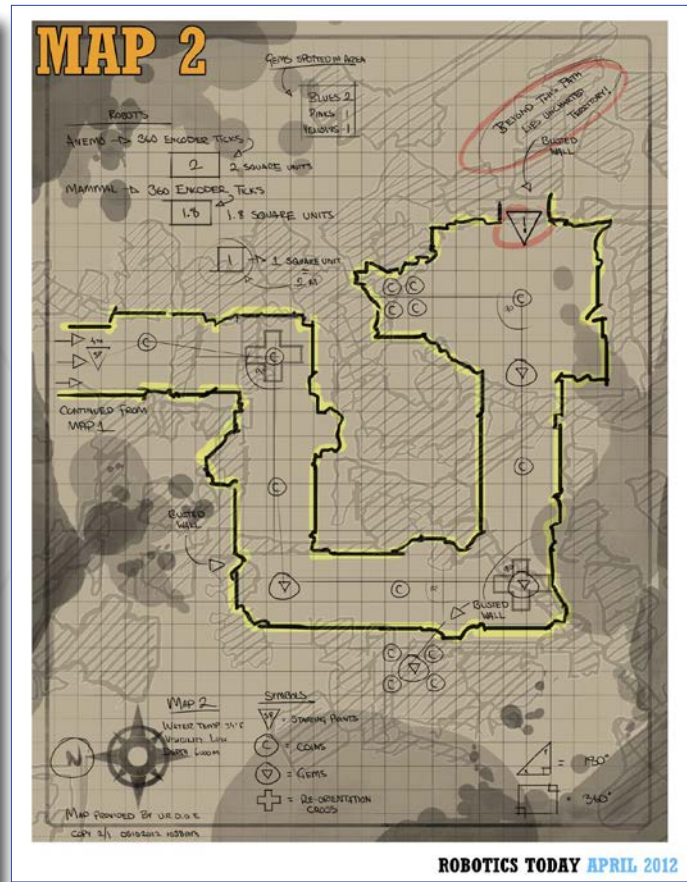
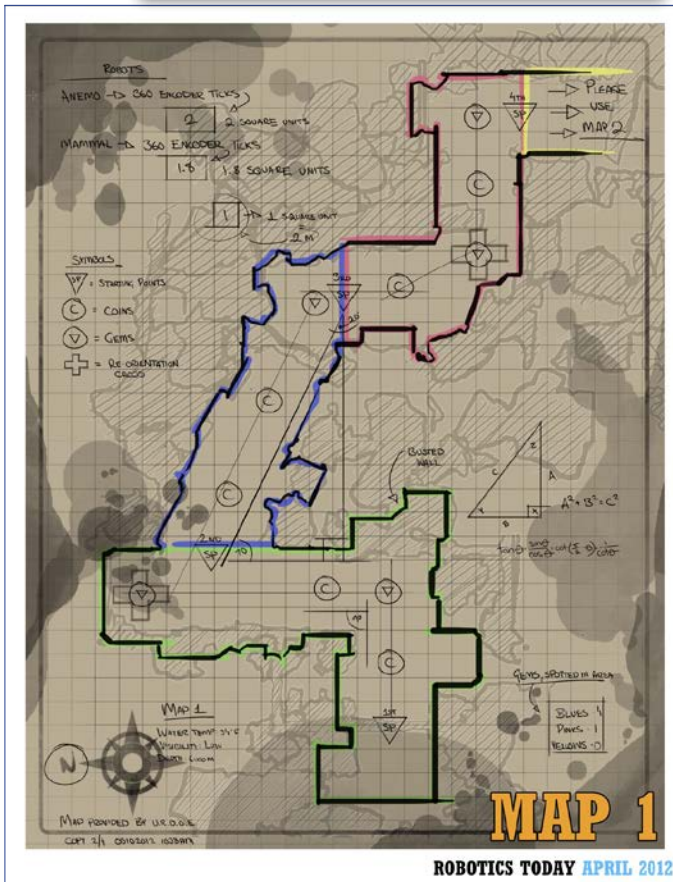
If the player/programmer is logged in locally or via CS2N, they will be awarded an achievement for every start point unlocked. Unlocked start points are saved across sessions.



# Use Robotics Today Maps!



Select Media on the Ruins of Atlantis splash page, then select Robotics Today to find the story behind this expedition as well as the treasure maps below.



Find detailed maps for the first five Start-Points on Page 4 and 5 of the Atlantis version of Robotics Today. Use Camera 3 and the Measurement Toolkit to find 6 and 7.

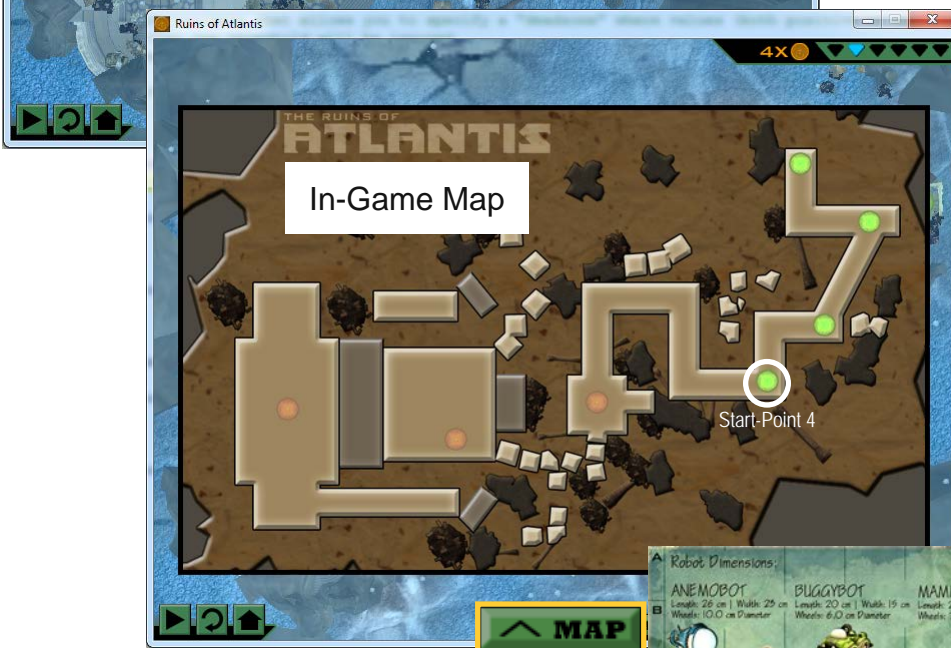


## Use Start-Points to Simplify the Programming Problem

There are seven different Start-Points that can be unlocked in the game. The challenge will be easier to solve in small increments, unlocking on Start-Point at a time, than if you try to solve it all at once.



Pictured left is the Camera 2 view of the Ruins of Atlantis. The Start-Points that have been unlocked are green and the Start-Points still to be unlocked are orange.

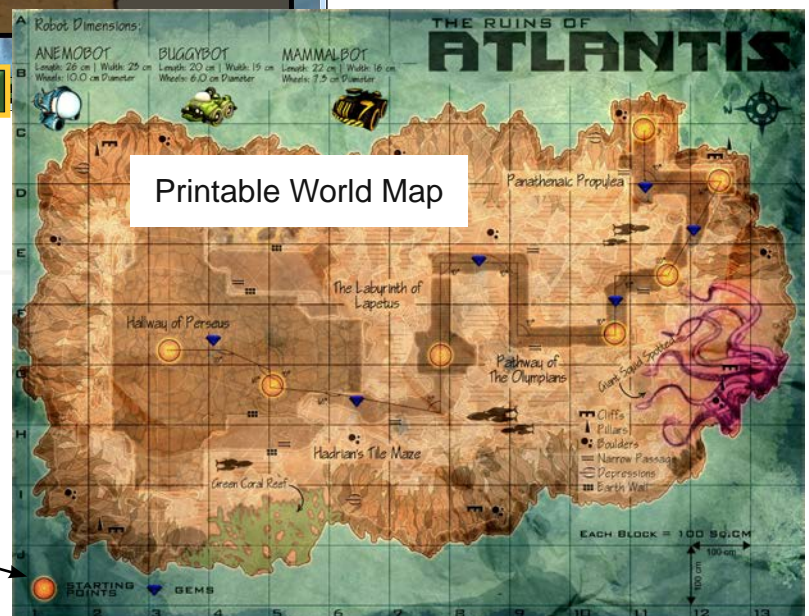


Pictured right is the In-Game map. You are able to restart your robot on any of the green Start-Points. If you've logged in correctly, your progress will be saved and you no longer will need to start at the beginning. In the example at the right you now can start programming at Start-Point four.



Select the Map Button on the center of the game interface to see your available Start Points.

Start-Points on the Printable World Map pictured at the right are yellow-orange in color.

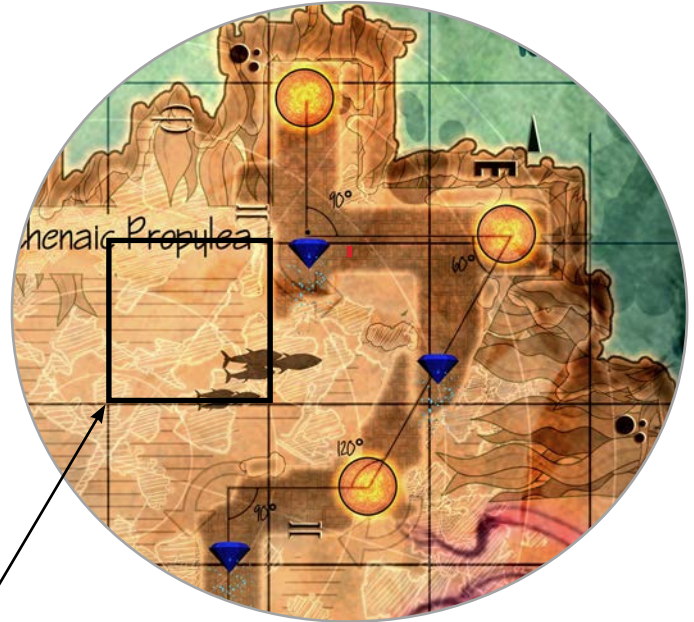


Printable World Map

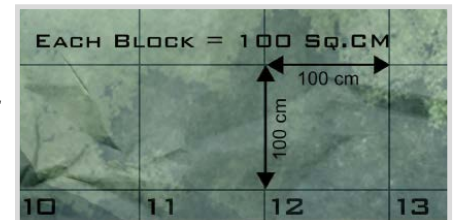


# Use Mathematical Programming Solutions

Picture below is segment of the Ruins of Atlantis printable map.



Each grid is 100cm by 100cm.



The correct way to program a robot is to determine the distance that you need to travel and then calculate how many rotations your robot's wheels need to turn. The maps and the Measurement Tool kit will help with the distance. On the next page you will see how to calculate rotations.

A Robot Dimensions:		
<b>ANEMOBOT</b>	<b>BUGGYBOT</b>	<b>MAMMALBOT</b>
Length: 26 cm   Width: 23 cm	Length: 20 cm   Width: 15 cm	Length: 22 cm   Width: 16 cm
Wheels: 10.0 cm Diameter	Wheels: 6.0 cm Diameter	Wheels: 7.3 cm Diameter
		

Robot sizes are located at the top of the map. You can also find them on the game interface.

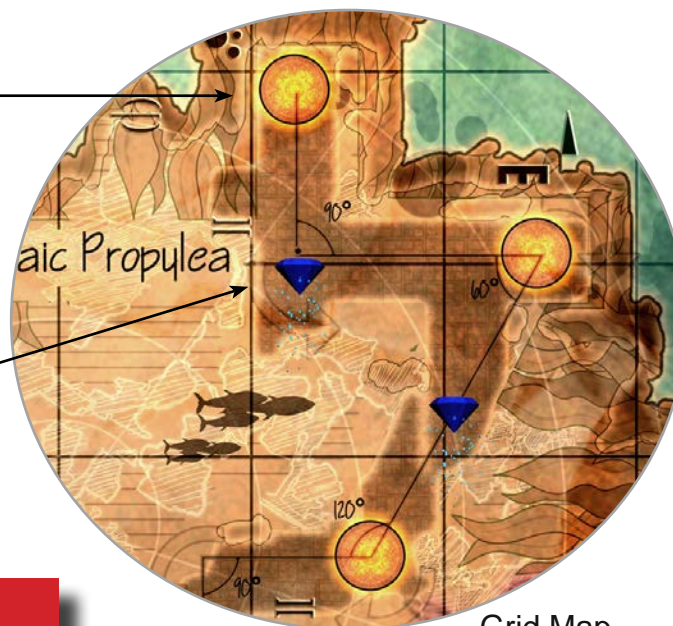


# Use Mathematical Programming Solutions



Anemobot robot starts here

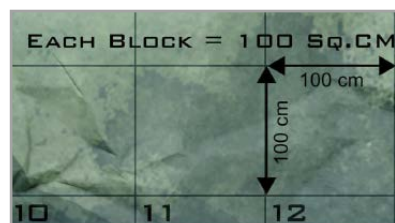
The blue gem



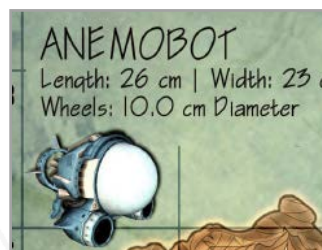
Grid Map

The picture above left is a zoomed-out in-game top view of the first challenge, Collect the Blue Gem.

Look at the grid map (upper right) and compare it to the distance key. The distance key says that a grid square is 100 cm wide and 100 cm high. From the robot to the blue gem is conveniently one grid or 100 cm.



Distance Key



Robot Specifications

The example robot is Anemobot (the submarine model). Its specifications tell us that it has a 10 centimeter wheel diameter. With this information we can find the circumference of the wheel and then how many rotations it will take to move the 100 centimeter distance. See the calculations below:

$$\begin{aligned} \text{Circumference} &= \pi * \text{Diameter} \\ \text{Circumference} &= 3.14 * 10 \text{ cm} \\ \text{Circumference} &= \mathbf{31.4 \text{ cm}} \end{aligned}$$

$$\frac{100 \text{ cm distance}}{31.4 \text{ cm circumference}} = \mathbf{3.18 \text{ wheel rotations}}$$

Anemobot will have to travel **3.18 wheel rotations** to move from the start point to the blue gem!

## Use Mathematical Programming Solutions

In-game, remember that the Measurement Toolkit, can be used to collect actual values, since the distances derived from the map grid are approximations.

The blue gem is an important object in view, so it's distance is displayed by default - 0.99 meters, or 99 centimeters. That's very close to our 100 centimeter measurement!



Run the program you wrote to move the robot to the blue gem. Keep in mind that the Robot Virtual Worlds are developed with a physics engine, and real world factors such as robot drift will be present.

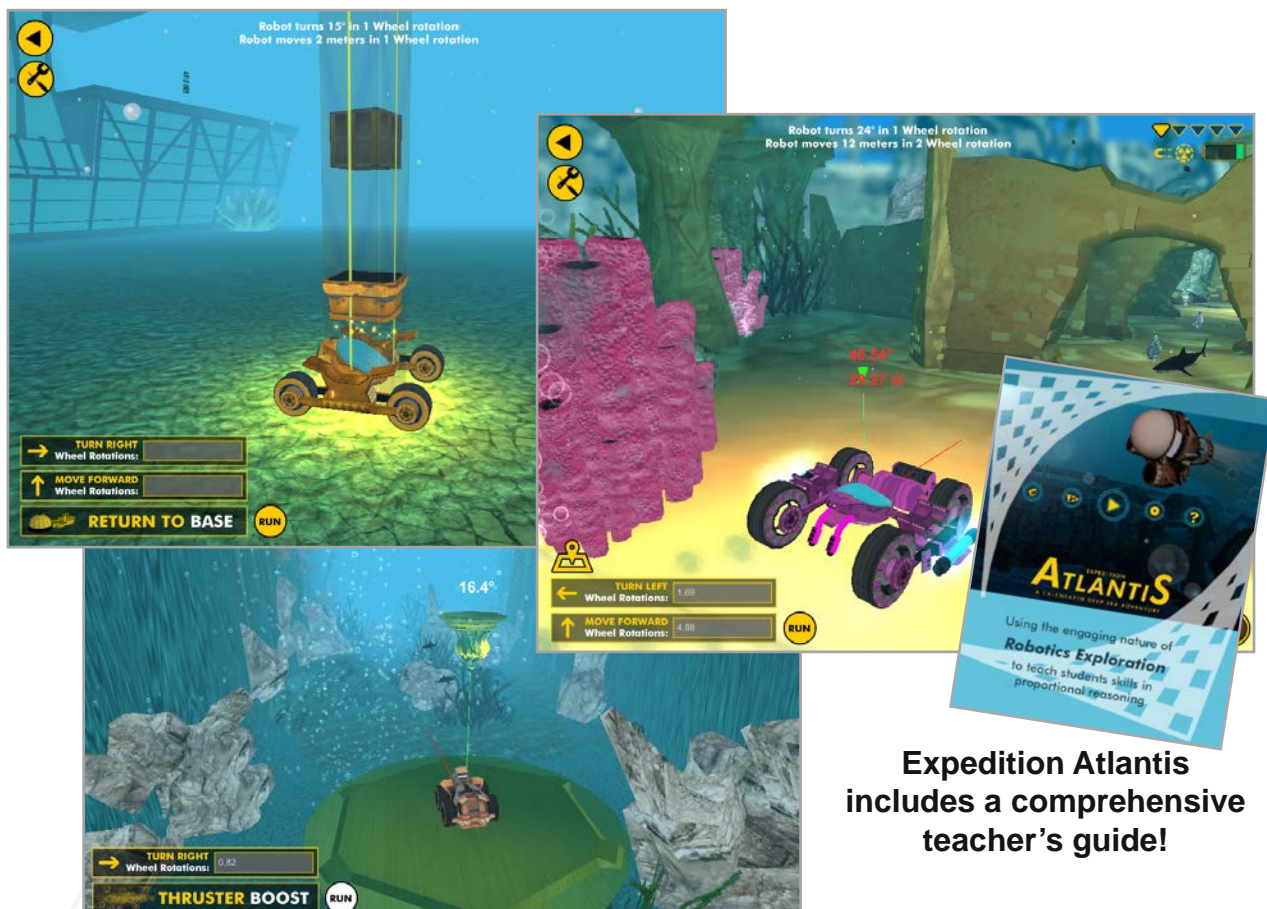
This sequence of can be used to solve for all movements in the Ruins of Atlantis. For additional math practice, have the students solve the Ruins of Atlantis with multiple robot models; each have different wheel diameters and robot sizes which will change the values used in the proportional problems.



## Expedition Atlantis a Math Game

It's the year 2023 and Atlantis has been discovered deep in the ocean, off of the coast of Africa. A team of elite scientists and engineers have been sent to investigate the underwater ruins, and you're one of them! Use your skills to maneuver the teams underwater vehicles in this expedition to Atlantis!

Expedition Atlantis presents mobile robot math problems in a highly scaffolded and contextualized manner. The game uses a mythical legend, underwater robotics exploration, and a game-like quest to motivate students to use math rather than “guess and check” their way through robot programming. The game is designed so that students learn to play the game in the game and includes ingame tutorials.



Expedition Atlantis intentionally removes the notion of programming allowing kids to focus on learning mathematical strategies without having to worry about the nuances of programming. Expedition Atlantis' rewards students for mathematical solutions, and if the teacher uses the tools provided in its teacher guide, is designed to generalize students' proportional reasoning skills by the end of the game.

Additional details and resources for Expedition Atlantis can be found at:  
<http://robotvirtualworlds.com/atlantis/>