About Virtual Labs

To understand science process, students need practice with science investigation. Virtual labs are designed to give students the opportunity to practice designing and conducting virtual investigations in preparation for designing and conducting their own hands-on investigations. Virtual labs take between 2 and 4 class sessions to complete.

The advantage of a virtual investigation is that conditions are more controlled than during hands-on, allowing students to focus their attention on the logic of the design and the results of the investigation. Virtual investigations can be repeated quickly, and can provide investigative experiences that are not available through hands-on due to constraints of time, resources, or safety.

Virtual Labs are not intended as totally independent student activities. A critical point in the lab sequence is the student-developed plan to conduct the investigation. Investigative plans are approved by the teacher prior to students entering the Investigate section on their own. Because students will test one variable at a time, it can be preferable to have each student group collect data on just one variable, then collect all the data from the class and analyze all the variables as a large group. This is typical of science research.

Discovery Education Science virtual labs support inquiry learning by providing students practice with the following National Science Education Scientific Inquiry Standards:

- Developing testable questions
- Evaluating and designing a fair test
- Gathering and interpreting data
- Developing explanations from data
- Evaluating evidence
- Communicating science
- Using mathematics in inquiry

It is important to note that the elementary virtual labs do not provide a “control,” that is, a second investigation running alongside the first in which none of the variables are changed. The concept of using a control is complex and is introduced once students understand how to set up a fair test and conduct a simple investigation.

Virtual labs contain three parts:

**Introduction:** This part sets the stage for the investigation by presenting a real world problem around which the investigation is based. It also describes the two levels of difficulty students will find in the Investigate section.

**Investigate:** This tab allows students to select the lab level, sign in and begin conducting the investigation, one trial at a time. The first level offers a simple choice of choosing one variable to control. The second level complicates the investigation with multiple options or multiple test subjects to observe.

**Results:** This tab provides students with a record of the results of each trial in chart form. Students are also provided with a paper copy on which to record the data.
Overview
Racing RC Cars asks students to find the best combination of battery and motor to build an RC car for a race. In level 1 students test the variables of battery size and motor type in order to compete for one of two prizes: a car that will travel the farthest on one battery charge or a car that will go the fastest over 5 laps. In level 2 students have the added variable of wheel size to test. Additionally, they are asked to consider the cost of the components of the car (body, battery and motor) and are limited to a total cost of $100.

The typical sequence for instruction is to:
- Use the Introduction tab to set up the problem with the class.
- Demonstrate how to get into the lab through the Investigate tab.
- Show students how to manipulate the variable selector controls, run a trial, and review data in the Results tab.
- Stop the lab and model for students how you would use the student planning sheet to design an investigation on paper.
- Finally, assign students to groups to develop their plans to investigate just one variable.
- As each plan is approved by you, students can be assigned to work on a computer.
- Once students have collected their data, analyzed it, and drawn a conclusion, they prepare a report and share it with their fellow scientists.
- Bring the class together to discuss what each group found out about how their variable affected car speed or distance, and have the class conclude what the best combination of components for the car should be, based on the data.
Introduction Tab

This section introduces students to the problem question. In this lab, students get to choose which problem question they want to answer: “Which combination of battery size and type of motor will make the RC car go the farthest before the battery dies.” OR “Which combination of battery size and type of motor will make the RC car go the fastest?” The Introduction describes the two levels of difficulty for this lab.

Investigate Tab

This section offers students a choice between the two lab levels. Only one lab should be conducted by students at a time. Students also log in so that their data table shows the name(s) of the investigator(s).

- Level 1, students race an RC car for distance or speed. This level allows students to change the variables of battery size and motor type to determine which combination produces a car that will travel the farthest around a track before the battery dies (called distance) or which combination will go the fastest around the track during five laps. It is recommended that students work with Level 1 first since the variables and results are simpler than Level 2.

- In Level 2, students again race an RC car, changing the battery size and motor type. But this time they can also change the wheel size. In addition, they have to consider the cost of the components of the car (body, battery and motor) and are limited to a total cost of $100. Students will discover that the combination of battery, motor and wheel size that goes the farthest or fastest costs more than the amount they are allowed. Note that wheel size is not a cost factor in this level.

Results Tab

In Results, data is provided as it is collected by the computer during the Investigate phase. Depending on the level selected, the computer provides the appropriate data chart with the results of each trial the students conducted. Students may move back and forth between the investigation and the results. However, this data must be printed out or recorded before exiting the lab or it will be lost. Students are provided with a record sheet to record the data for themselves for further study.

Suggestions for Timing and Organization

On average, each level of the lab requires between two and four class sessions to complete.

First Time Users: If this is the first virtual lab your students conduct, you may need to take one whole session to go through the lab once with the students, demonstrating how it functions and modeling the planning, data collection and evaluation you want them to do.
Because you will only be choosing one variable to test, students will still be able to run the lab on their own using the variable they choose.

**Experienced Users:** If students have already designed and conducted a Discovery Education Science virtual lab before, it will usually only take part of one class session to introduce the lab and show how it functions. Students will then need time to develop their investigative design and present it for your approval. Once it is approved, students will need a class period to run the trials, collect the data and write up their explanations.

**Grouping:** It is best for students to work on the labs in small groups of 2 – 4. Mixed ability grouping works very well in this science exercise.

**Presentation of student’s findings** to their peers takes time. One way to reduce presentation time is to employ a method used by scientists called a poster presentation. Students formally write up their data and results and post it around the classroom for others to review and comment on. All students carry comment sheets as they take a “wisdom walk” in which they read their peers’ results. Comment sheets can be placed next to each report or you can have students take notes as they go.

**Explaining a “fair test”**
If this is the first lab they’ve done, this is a good time to discuss a fair test (the introduction to variable control). In experiments, scientists must change only one variable at a time for it to be a fair test. Demonstrate this by running two trials. Use Level 1 to keep the variables and results simple. You can also use this demonstration to show students how the variable selectors in the virtual lab work. Rather than jump back and forth to the Results tab, it may be better to record the outcomes on a board so they can see the results and the lab at the same time.

**Level 1**
- Trial 1: choose – small battery and motor A
- Trial 2: choose – medium battery and motor C

Explain to students that you got different results, but don’t know which variable caused the difference because all the variables were changed. If we want to know what affects the car the most, we have to keep two variables the same and only change one variable. This is called a fair test.

**Modeling the Plan to Investigate (for first time users)**
Talk about how scientists come up with their experiments. Scientists always use background knowledge to develop their ideas. Model this thinking. What do students know about what will make a model car run the best? Use their answers to choose one of the variables (battery size or motor type) and develop a hypothesis. Example: “I think the car with the biggest battery will go the farthest because bigger things usually last longer.”
Model for students how you would plan the investigation. Develop a testable question that involves one variable. Example: “How does changing the battery size affect how far the car will go before the battery dies?” Ask out loud: “What will I be changing in each trial?” “What will I have to keep the same in each trial?” Record this. Then invite students to describe what you should put down on the chart. What will each trial involve? Complete the plan so they can see how it’s done.

Guiding Students as They Develop and Conduct Their Investigations
Organize students into their lab groups (2 – 4 per group). They will now develop their own questions and plan their investigations. Keep the virtual lab visible on the projection screen as well as your plan so they will be able to relate what they are planning to what they can see. Go around and guide students through the planning process. They should be able to show you how many trials they will conduct and which variables will change and which stay the same for each trial. Once you have approved their plans, you can assign groups to the computers to begin the investigation.

If students are in a computer lab, you can go around and monitor their activity. Try to use guiding questions, rather than correcting them or suggesting what to do next. Be sure they are following their plan and recording their results. It is not uncommon for students (or scientists) to wish to change their plan, once they get into the actual lab. If so, they must give you good reasoning and explain the logic of changing their plan. The plan must be revised and approved before they can continue or before they start the lab over.