Programming with Raspberry Pi Microcomputers

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| **Program Title** | Programming with Raspberry Pi Microcomputers (One-Day) | | |
| **Brief Description** | During this 90 minute program, participants put computer parts together using Kano Computer Kits. Kids then experiment with programming through pre-installed games. | | |
| **Age Range** | 9-12 |  | |
| **Registration Required** | **Yes** | |  |
| **Maximum Number of Participants** | 10 (1 participant per kit) | | |
| **Literacy Connection** | The handout list books that help kids continue coding on their own. See supplementary documents. | | |
| **Estimated Costs** | 10 kits already owned by the library | | |
| **Staffing / Training Requirements** | Recommended 2 librarians. Possible with 1 librarian, 1 support staff (for set-up and take-down).  Familiarity with basic computer coding concepts an asset, but you do not need to know how to write specific coding languages! | | |
| **Equipment** | **10 Kano Kits**  Includes Kano SD Card, Motherboard (green circuit board), plastic case in two pieces, lid with speaker, extra lid without speaker, red power cable, yellow HDMI cable (we do not use this), green wifi dongle, 10 DVI Adapters  10 DVI Cables  10 monitors (with power cables)  3 extension cords  3 power bars  *Optional: Laptop and Projector if using Powerpoint presentation* | | |
| **Space and Furniture** | Set up tables around the room. Two monitors and two Kano Kits per table. Every two kits needs 1 power bar and 1 wall plug. | | |

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| **Step-by-Step Instructions** |
| 1 Hour Prior to Program Start:  Set up each station with:   * Monitor with a power cord (connected to a power bar) as well as a DVI cable (these will eventually be connected to the Raspberry Pi using the DVI adapter found in the kit) * Kano Kit   + Oct 22, 2016 - Kit #4 requires external speakers (included) and appears to have a different version of the operating system running that causes confusion. Recommend not using if possible. JL/MPL * Reset Handout and pencil   Program Outline:   * Introduction (5 min) * Build Kano Kit (20 min) * Reset Raspberry Pi (15 min) * Pong (15 min) * Snake (15 min) * Free Time, Closing Remarks (20 min)   + Depending on how much time participants have had to experiment with coding and how much time you have left, you can have them shut down and put away their Kano Kits at the end of the session.   Whether you are using the PowerPoint presentation or not, the script below will give you more information about speaking points.  **PowerPoint Script**  **Slide 1** - Welcome! Go around and share names. Can anybody tell me what’s missing from these computers? (take answers) Yes! the hard drives because we are going to build those today!  Today you will be building computers and learning a bit of code using two classic games – Snake and Pong. You are master of the games and can change the look and even the rules of the games with code.  Hands up has anyone done coding before? (look for experts that may be able to assist others)  This is a beginner’s class, so if you are more advanced you may be asked to help others. Define code? Computer code is a language that a computer understands. It tends to be very short.  **Slide 2** – Point out the various parts of the Kano kit. (Detailed description of all parts in the glossary.) Point out where they are in the Kano Kit.  **Slide 3** - Time to build your computers! Hand out a Kano Kit to everyone – give them an option of DIY with the manual or following along with the group on the PPT. They are welcome to open up the boxes and look. **Assembly should take about 20 min.**  **Slide 4** - Building the Kanos – Insert the motherboards (green circuits) into the plastic case. Show them an example up front first. Remind them that the green circuit is fragile. TELL THEM NOT FORCE THE COMPUTER IF IT DOES NOT FIT. ASK FOR HELP.  **Slide 5** - Look on the bottom of the computer. There is a slot that the SD card fits in. The boy’s face should face the floor when you put it in.  **Slide 6** - Take the speaker out. Put the blue cord through the hole in the plastic lid.  **Slide 7** - Point out the pins on the board. They give the computer parts power.  **Slide 8** - These two specific pins shown are the only ones that work. Demo connecting the cords. Remind them to be gentle and ask for help.  **Slide9** – Clip the speaker in place. Using the blue cord, plug your speaker into the side of the Raspberry Pi.  **Slide 10** – Plug the DVI cable from the monitor into the adapter (should have the cables affixed to monitors beforehand). Plug the adapter into the side of the Raspberry Pi. Turn the monitor on.If the monitor is doesn’t turn on, press Source. If that doesn’t work, double check all connections.  **Slide 11** - The red cord plugs into a USB slot on the R Pi. The white antenna gets taken out of its pocket on the side of the keyboard.  **Slide 12** - The white wifi antennae gets plugged into the other USB slot on the R Pi.  **Slide 13** - CAREFULLY slide the prongs into the power adapter. Plug the USB side of red cord into the bottom power adapter. Then plug the smaller end into the R Pi.  **Slide 14** - Plug it into the Power Bar. Turn on your keyboard by pushing the white power button on the right side. There should be a green light on the keyboard and a blue light on the Raspberry Pi. If nothing appears on the screen, try pressing the 'Source' button on the monitor itself.  **Slide 15** - Use the grey track pad to move the mouse. Use the grey button on the left of the keyboard to select things with the pointer. Demo for the group.  **If the Rasp. Pi computers ask for an update, tell participants to click ‘Update Later ’.**  **Slide 16-17** – Walk participants through resetting the Pi’s. This is necessary because otherwise the apps will start on a harder/different level. Make sure participants type the terminal command exactly as they see it, hit enter, and see the reset confirmation message before restarting the second time; this is usually the step that they miss.  **Slide 18-21** - They’ll be using command lines in Snake. Ask anyone if they know what a command line is and if they have ever used it. Try and get them to guess what the 3rd line means.  Answer in English: I want you to make the [-b]oard a [m]edium size.  Give roughly 15 minutes for people to play Snake.  **Slide 22** – Pong uses GUI a Graphical User Interface (G.U.I. or 'gooey' for short), a picture based way of telling the computer shat you want it to do. Pong used a GUI called Kano Blocks. Moving the blocks around does the same thing as typing code in a command line. Smartphones and computers usually use this mode. Like Lego, you can click these blocks together in a variety of combinations  Then get everyone to play Pong for the remainder of the session (about 30 min). Make sure to leave 5 min at the end to shutdown and clean up. Ask participants to avoid playing the other games unless they are very far ahead to the group.  The games will let you play them endlessly, so encourage kids to hit escape and move on to the next tutorial if they get distracted.  **Hints for tutorials:** The games have built in tutorials that make participants go through a series of challenges **IF YOU WANT TO SKIP THE CHALLENGES, USE PLAYGROUND MODE** and the kids can play at will. They do not need to finish all the challenges and some will not be able to do so in the time provided. Your job is to help kids as they struggle through each lesson and steer them away from only playing the game not doing the lessons. The Kano mascot (a boy in a judo suit) lets you know how you are doing during the tutorials. When you make a mistake, the kid’s face is sad and he gives you hints on what you did wrong. His arm will point to where you should click to fix your mistake.  **Last 15 minutes of program (if time permits):**  Have kids unplug from Power Bar and Monitor. Have them pack their keyboard and any cords back in the box, Have kids count the number of items in the box to make sure everything is back in the kit.  **Glossary**  **Bluetooth:** A piece of hardware that sends a different kind of signal through the air. This is very short range and a lot of phones use it to connect devices that are close together.  **Command Lines:** A text based way of interacting with a computer software through only the keyboard. This is the first way people every communicated with keyboards. You need to know the special code words to use a command line properly.  **Graphical User Interface, G.U.I. (sometimes pronounced 'gooey'):** A picture based way of interacting with computer software through the mouse and keyboard. This involves manipulating pictures on the screen (like clicking an icon) to give the computer a command.  **Hardware:** The physical parts of the computer: chips, memory, etc. We are playing with hardware when we are building the computer.  **Kano Computer:** A special software put on a Raspberry Pi computer that includes games and instructions to teach you code. This costs about $100.  **Keyboard/Mouse:** A piece of hardware that help a person interact with the computer to give the software commands get the computer to do we what we want.  **Memory:** The part of the computer that stores what you have already told it. This stores things like the operating system, programs like Minecraft, works of art, music, and many other things.  **Operating System:** Kano is the operating system on our Raspberry Pi computers. An operating system is the big program that helps run all the smaller programs like Minecraft. On your home computer Windows and Macintosh are other brands of operating system.  **Power Supply:** A piece of hardware that manages the power for the whole computer. This is both the plug as well as a small box in the computer itself.  **Processor:** The part of the computer that handles the work when you tell a computer to run a program. This is the part of the computer that processes the binary code, the simplest kind of code that all computers use.  **Programmatic Thinking:** This is what you do when you think like a computer. Programmatic thinking teaches you to try and give commands in the simplest and most efficient way possible. It also means using shortened words and pictures to represent whole ideas. This is what coding is.  **Raspberry Pi:** A super cheap computer that has the power of standard computers of about 5-6 years ago. They are incredibly small, cost roughly $40 on their own, and are meant to be customized.  **Screen:** A piece of hardware that displays the command line or G.U.I. and lets us know what is going on in the software.  **Software:** The programs on the computer that only exist in its memory and on the screen. These are the programs we are playing with on the screen.  **Speakers:** A piece of hardware that takes code and makes it into sound or music.  **Wifi adapter:** A piece of hardware that sends signals through the air that connect with the internet. We do not use our wifi adapter in this program. |

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| **Raspberry Pi Microcomputer Program - Troubleshooting**  **Common problems and solutions:**   * I’m having trouble getting 2 computers and monitors to fit into 1 power bar because the Rasp Pi adapter is so bulky.   + Plugging in 2 adapters into the power bars can be tricky, but the adapters can rest gently on the power button without turning it off. See orientation below: Red boxes are Rasp Pi plugs, purple boxes are screens, and orange box is the power button that the R Pi adapter rests on. Note, you do need 5 or 6 free plugs per powerbar to get everything to fit.      * The Rasp Pi computer won’t turn on!   + There are two ways to turn on these computers. You can push the power button attached to the side of the keyboard. Or just unplug the power chord and then plug it back in to automatically turn it on.   + Make sure the monitor is connected correctly and the SD card is fit snuggly in Rasp Pi. * The keyboard won’t turn on.   + Plug the keyboards in to a Rasp Pi computer that is powered on. Unless the keyboard has 0% power, it should start charging and be able to turn on.   + If the keyboard still won’t turn on, it has to charge and won’t be able to be used. Get the child to pair up with a neighbour for activities. * A participant got stuck during one of the games. I don’t know how to help!   + Each lesson in the games is a unique challenge, so there is no one-size fits all solution. When you do something wrong during a challenge, the Kano boy’s face makes a frown. This is your sign that something is not right, *even if it looks like you completed the task*. There must be some detail that does not match the instructions. Start over and try again. Ask around the room to see if someone else had success. * The wireless is not working and the Kano kits and it is trying to connect to the internet.   + This is actually what is supposed to happen. There is no internet connectivity in this VPL program. There is no reason to plug the wifi adapters (green) into the Kanos. Any time something asks for internet connectivity, get participants to click ‘Skip’ or ‘Later’. * The computer has stopped working and will not respond to any clicking or pushing of keys.   + Give it one minute to finish what it is doing.   + Some programs cause it to freeze – a program called Scratch is one of them. It is hidden, but if the kids find it and open it, it will freeze.   + If NOTHING else works, unplug the white wifi dongle on the side and then plug it back in. This will cause the computer to reboot. Do this as a last resort. |
| **RESET THE COMPUTER (read carefully and check off each step as you complete it!)**   * Click the **K** in the bottom left corner of the screen * Select **Code**, then click **Terminal** * In the terminal, type **sudo kano-init reset** and the Enter key   + The message “kano-init RESET scheduled for next system reboot” should appear. If it doesn’t, enter the command again carefully. * After the confirmation message, click **K** again, then **Shutdown** and **Reboot**.   **Once the computer has rebooted...**   * What’s your name? Type **VPL** and the Enter key * Follow the commands until it asks you if you want to connect to the Internet * Select **No Internet**, then **Connect Later**, then **Play Offline** * Select **Test Sound**, then **Play Sound** * When asked to create a profile, click **Skip** * When the Kano starts talking to you, hit the Esc key to exit and begin coding!   http://rack.2.mshcdn.com/media/ZgkyMDE0LzEwLzI4L2E5L2tubzA4N2FkLjY5YzU0LmpwZwpwCXRodW1iCTg1MHg4NTA-CmUJanBn/a7c832f4/c97/kno087ad.jpg  **BEFORE YOU GO:**  Take apart your Raspberry Pi carefully. It should look like this when you are done! |