**Software Defined Radio Camp**

**By Spencer Grady and Hunter Litke**

**Notes:**

* These are lesson plans for the proposed Software Defined Radio Camp. The target audience for these lessons is High School students, grades 9-12. The lessons could be adapted to encourage participation of Middle School students as well.
* The time for this proposed Software Defined Radio (SDR) Camp was agreed to be from 8:30-11:30 during the summer or during a week's holiday from school. Reasoning to support this decision for the timing of the SDR CAMP was based on multiple factors including facility availability, support from administration at facility, student schedules involving school calendar, and ability to support camp without interfering with students' lunch (taken off CAMP site)/ work schedules/ additional activities/ etc.
* Resources required for the SDR Camp would include:
* Additional assistance for this SDR Camp could be provided through the following:
  + AmeriCorps participants needing hours for their AmeriCorps Program and would earn through these hours with their support of an event such as this SDR CAMP.
  + BETA Club students needing hours for their BETA Club Program and would earn through these hours with their support of an event such as this SDR CAMP.
  + Science Clubs already established at the facility to help with the SDR CAMP.
  + Interested STEM Teachers within the organization willing to donate their time for supporting an SDR CAMP for student enrichment.

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| SDR CAMP LESSON PLANS  Day #1 Spencer Grady and Hunter Litke |

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| **Title**: SDR CAMP DAY#1- Introduction to SDR | **Grade**: High School 9th-12th | **Subject**: Science |
| **Standards**:  **PS4.C:  Information Technologies and Instrumentation**  [Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=13&detailid=113)  **PS4.B:  Electromagnetic Radiation**  [Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=12&detailid=111)  **PS4.A:  Wave Properties**  [The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=110)  [Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2), (HS-PS4-5)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=333)  [[From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=334) | | |
| **Duration**: 8:30am - 11:30am | **Materials**:   * Signage for directions to CAMP classroom * Day #1 sign in sheet * Personal Information Sheet completed by each participant. * Lanyards for students * Clear Touch Boards with internet * Light Spectrum Activity Materials including | |

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| **Objectives:**   * The students will be introduced to Software Defined Radio (SDR). * The students will identify ways for individuals to send messages/ information through the light spectrum. |

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| **Actions**:   * Students enter and sign in.   + Make sure students sign in at a table where their names, addresses, and emergency contacts are completed on a personal data sheet for each participant.   + Plus, inquire about any additional concerns or special needs for the CAMP's duration, such as medical or physical needs.   + Do use lanyards for the students to wear during the day, then leave the lanyards for each remaining day of the CAMP. Students may have lanyards at the conclusion of Day #3. * WELCOME! Meet and Greet * SDR Camp directors and leaders introduce themselves to become acquainted with participants. * Introduce the facilities, rules, and areas of interest- labs/ restrooms/ drink machine/ water fountains/ office/ etc. * SDR Camp participants introduce themselves and share their present understanding of SDR. * Power point #1 / Day #1– Introduction to Software Defined Radio SDR * Group Discussions with CAMP leaders concerning information presented. Specific questions and comments will be shared and addressed concerning the power point. (This can be broken into smaller groups or whole group depending on size and needs of group participants.) * Short Break (10-15 minutes) * Power point #2 / Day #1- * Group Discussions with CAMP leaders concerning information presented. Specific questions and comments will be shared and addressed concerning the power point. (This can be broken into smaller groups or whole group depending on size and needs of group participants.) * Workshop Day #1 Activity- Morse Code with Lights * CAMP leaders will explain the objectives for the Morse Code with Lights assignment and then demonstrate the Morse Code with Lights Assignment. * Participants will be divided into groups/ teams to be active participants of assignment. Be sure to rotate communicators sending and communicators receiving the data. |

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| **Closing and Check for Understanding**:   * Watch the time and be sure to allow for Team Clean Up before CAMP dismissal time for the day. * Closing discussions and reflection of learning for the day. (Whole group or small group depending on group needs.) * Review and discuss activities for the day and for the camp. * Collect lanyards as students depart for the day. |

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| **Extension Activities/ Homework**:   * Suggested links to add knowledge on SDR information. * Suggested links to add knowledge on Morse Code uses. |
| **Day #1 Reflection for CAMP Leaders:**   * Make sure room and items/ materials are secured for the day. * File participant personal sheets with the administration in the office for safe keeping for the camp. * Prepare for Day #2 with set up. |

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| SDR CAMP LESSON PLANS  Day #2 Spencer Grady and Hunter Litke |

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| **Title**: SDR CAMP DAY#2- Careers/ Ethics/ and GNURadio | **Grade**: High School 9th-12th | **Subject**: Science |
| **Standard**:  **PS4.C:  Information Technologies and Instrumentation**  [Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=13&detailid=113)  **PS4.B:  Electromagnetic Radiation**  [Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=12&detailid=111)  **PS4.A:  Wave Properties**  [The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=110)  [Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2), (HS-PS4-5)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=333)  [[From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=334) | | |
| **Duration**: 8:30am - 11:30am | **Materials**:   * Signage for directions to CAMP classroom * Day #2 sign in sheet * Distribute Lanyards. * Personal Information Sheet completed by each participant on file and a copy in the office * Lanyards for students * Clear Touch Boards with internet * GNURadio activity materials | |

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| **Previous Knowledge**:  Day #1 experience from SDR Camp / introduction to SDR |

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| **Objectives**:   * Students will identify and discuss various career opportunities with Software Defined Radio. * Students will participate in ethics training involving SDR. * Students will utilize GNURadio learning to decode a radio signal. |
| **Actions**:   * Welcome and Greet Students * Participants sign in and collect lanyards. * Make sure all participants have a personal information sheet with emergency contacts on file. * CAMP leaders and assistants provide a quick recap of Day #1 objectives and activities. * Answer any questions that have arisen since Day #1 or comments. * Power point #3 - Day #2 Careers in SDR * Introduce career opportunities involving Software Defined Radio and how to best prepare for these careers. * Group Discussion- small group or whole group depending on participants needs. * Power point #4 / Day #2 - Ethics involving SDR * Group Discussion- small group or whole group depending on participants needs. * Break (10-15 minutes) * Workshop Day #2 GNURadio |

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| **Closing and Check for Understanding**:   * Watch the time and be sure to allow for Team Clean Up before CAMP dismissal time for the day. * Closing discussions and reflection of learning for the day. (Whole group or small group depending on group needs.) * Review and discuss activities for the day and for the camp. * Collect lanyards as students depart for the day. |

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| **Extension Activities/ Homework**:   * Look for SDR careers locally, in the news, globally, and seek to share this information tomorrow. |
| **Day #2 Reflection for CAMP Leaders:**   * Make sure room and items/ materials are secured for the day. * Prepare for Day #3 with set up. |

SDR CAMP LESSON PLANS

Day #3 Spencer Grady and Hunter Litke

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| **Title**: SDR CAMP Day#3- SDR and YOU! | **Grade**: High School 9th-12th | **Subject**: Science |
| **Standard**:  **PS4.C:  Information Technologies and Instrumentation**  [Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=13&detailid=113)  **PS4.B:  Electromagnetic Radiation**  [Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=12&detailid=111)  **PS4.A:  Wave Properties**  [The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=110)  [Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2), (HS-PS4-5)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=333)  [[From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)](https://my.nsta.org/ngss/DisciplinaryCoreIdeas.aspx?id=11&detailid=334) | | |
| **Duration**: 8:30am - 11:30am | **Materials**:   * Signage for directions to CAMP classroom * Day #3 sign in sheet * Distribute Lanyards and T-shirts * Lanyards for students * Clear Touch Boards with internet * Advanced SDR Materials | |

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| **Previous Knowledge**:   * Participation and Attendance from Day #1 & Day #2 |

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| **Objective**:   * The students will actively participate in Advanced SDR configurations |
| **Actions:**   * Welcome and Greet Students * Participants sign in and collect lanyards. * Distribute t-shirts to participants * CAMP leaders and assistants provide a quick recap of Day #2 objectives and activities. * Answer any questions that have arisen since Day #2 or comments. * Power point #5 - Day #3 * Workshop #3 /Day #3 |

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| **Closing and Check for Understanding**:   * Watch the time and be sure to allow for Team Clean Up before CAMP dismissal time for the day. * Closing discussions and reflection of learning for the day. (Whole group or small group depending on group needs.) * Review and discuss activities for the day and for the week. * Provide a survey for students to complete concerning the camp. * Have survey completed as part of camp conclusion. * Either paper copies or a link may be used for this depending on the coordination of the location and time. |
| **Extension Activities/ Homework**:   * Encourage students to stay in touch with SDR related organizations and events. * Provide some helpful links for students to accomplish this endeavor. |

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| **Day #3 Reflection for CAMP Leaders:**   * Make sure room and items/ materials are secured for the day. * Discuss and review survey results for planning again. * Visit with school/ building staff and thank them for their support. |