

Hazardous Chemicals, Activities or Devices Rules

Includes DEA-controlled substances, prescription drugs, alcohol & tobacco, firearms and explosives, radiation, lasers, etc.

The following rules apply to research using hazardous chemicals, devices and activities. These include substances and devices that are regulated by local, state, country, or international law, most often with restrictions of their use by minors such as DEA-controlled substances, prescription drugs, alcohol, tobacco, firearms and explosives. Hazardous activities are those that involve a level of risk above and beyond that encountered in the student's everyday life.

These rules are intended to protect the student researcher by ensuring proper supervision and the consideration of all potential risks so that the appropriate safety precautions are taken. Students are required to meet all standards imposed by Intel ISEF, school, local, and/or regional fair(s).

Rules for ALL Projects Involving Hazardous Chemicals, Activities and Devices

1. The use of hazardous chemicals and devices and involvement in hazardous activities require direct supervision by a Designated Supervisor, except those involving DEA-controlled substances, which require supervision by a Qualified Scientist.
2. The student researcher must conduct a risk assessment in collaboration with a Designated Supervisor or Qualified Scientist prior to experimentation. This risk assessment is documented on the Risk Assessment Form 3.
3. Student researchers must acquire and use regulated substances in accordance with all local, state, U.S. federal and country laws. For further information or classification for these laws and regulations, contact the appropriate regulatory agencies.
4. For all chemicals, devices or activities requiring a Federal and/or State Permit, the student/supervisor must obtain the permit prior to the onset of experimentation. A copy of the permit must be available for review by adults supervising the project and the local, affiliated, and Intel ISEF SRCs in their review prior to competition.
5. The student researcher must minimize the impact of an experiment on the environment. Examples include using minimal quantities of chemicals that will require subsequent disposal; ensuring that all disposal is done in an environmentally safe manner and in accordance with good laboratory practices.
6. The following forms are required:
 - a. Checklist for Adult Sponsor (1), Student Checklist (1A), Research Plan/Project Summary and Approval Form (1B)
 - b. Regulated Research Institution Form (1C), when applicable
 - c. Qualified Scientist Form (2), when applicable
 - d. Risk Assessment Form (3)

Additional Rules for Specific Regulated Substances

There are additional rules for the following regulated substances:

- DEA-controlled Substances
- Prescription Drugs
- Alcohol & Tobacco
- Firearms and Explosives
- Drones

1. DEA-Controlled Substances

The U.S. Drug Enforcement Administration (DEA) regulates chemicals that can be diverted from their intended use to make illegal drugs. Other countries may have similar regulatory bodies; students outside of the U.S. must adhere to their own country's drug regulatory agency requirements in addition to U.S. DEA regulations. DEA-controlled substances and their schedule number are at the DEA website under Sources of Information. It is the responsibility of the student to consult this list if there is a possibility that substances used in experimentation could be regulated.

- a. All studies using DEA-controlled substances must be supervised by a Qualified Scientist who is licensed by the DEA (or other international regulatory body) for use of the controlled substance.
- b. All studies using DEA Schedule 1 substances (including marijuana) must have the research protocol approved by DEA before research begins. Schedule 2, 3 and 4 substances do not require protocol approval by DEA.

2. Prescription Drugs

Prescription drugs are drugs regulated by federal or country laws to protect against inappropriate or unsafe use. Special precautions must be taken in their use for a science project as follows:

- a. Students are prohibited from administering prescription drugs to human participants.
- b. A veterinarian must supervise student administration of any prescription drugs to vertebrate animals.

3. Alcohol and Tobacco

The U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB) regulates the production of alcohol and distribution of alcohol and tobacco products. Many such products are restricted by age for purchase, possession and consumption.

- a. Fermentation studies in which minute quantities of ethyl alcohol are produced are permitted.
- b. The Designated Supervisor is responsible for the acquisition, usage and appropriate disposal of the alcohol or tobacco used in the study.
- c. Production of wine or beer by adults is allowable in the home and must meet TTB home production regulations. Students are allowed to design and conduct a research project, under direct parental supervision, involving the legal production of the wine or beer.
- d. Students are prohibited from conducting experiments where consumable ethyl alcohol is produced by distillation. However, students are allowed to distill alcohol for fuel or other non-consumable products. To do so, the work must be conducted at school or a Regulated Research Institution and follow all local and country laws. See Alcohol and Tobacco Tax and Trade Bureau (TTB) website for details.

4. Firearms and Explosives

The U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), along with state agencies, regulates the purchase and use of firearms and explosives. A firearm is defined as a small arms weapon from which a projectile is fired by gunpowder. An explosive is any chemical compound, mixture or device, the primary purpose of which is to function by explosion. Explosives include, but are not limited to, dynamite, black powder, pellet powder, detonators, and igniters.

The purchase of a firearm by a minor is generally unlawful. The use of a firearm, without proper state certification, is illegal. Students should check the training and certification requirements of individual states and countries.

- a. Projects involving firearms and explosives are allowable when conducted with the direct supervision of a Designated Supervisor and when in compliance with all federal, state and local laws.
- b. A fully assembled rocket motor, reload kit or propellant modules containing more than 62.5 grams of propellant are subject to the permitting, storage and other requirements of federal explosive laws and regulations.
- c. Potato guns and paintball guns are not considered firearms unless they are intended to be used as weapons. However, they must be treated as hazardous devices.

5. Drones

Projects involving unmanned aircraft systems (UAS)/drones must follow all state, Federal and country laws. See the Federal Aviation Administration (FAA) for more details (www.faa.gov/uas/registration).

Guidance for Risk Assessment

Please find below guidance on conducting risk assessment when using the following:

- Hazardous Chemicals
- Hazardous Devices
- Radiation

1. Hazardous Chemicals

A proper risk assessment of chemicals must include review of the following factors:

- a. Toxicity – the tendency of a chemical to be hazardous to health when inhaled, swallowed, injected or in contact with the skin.
- b. Reactivity - the tendency of a chemical to undergo chemical change.
- c. Flammability - the tendency of a chemical to give off vapors which readily ignite when used under normal working conditions.
- d. Corrosiveness - the tendency of a chemical, upon physical contact, to harm or destroy living tissues or physical equipment.

When assessing risk, the type and amount of exposure to a chemical must be considered. For example, an individual's allergic and genetic disposition may have an influence on the overall effect of the chemical. The student researcher must refer to Safety Data Sheets provided by the vendor (SDS) to ensure that proper safety precautions are taken. Some SDS sheets (e.g., Flinn) rank the degree of hazard associated with a chemical. This rating may assist students and adult sponsors in determining risk associated with the use of a chemical.

A risk assessment must include proper disposal methods for the chemicals used in an experiment. The Flinn Catalog (referenced in the Sources of Information section) provides information for the proper disposal of chemicals. If applicable, the student researcher must incorporate in the research plan disposal procedure required by federal and state guidelines.

Environmentally Responsible Chemistry

The mission of environmentally responsible (green) chemistry is to avoid the use or production of hazardous substances during chemical process. The principles of green chemistry are described on the EPA website in the Sources of Information section. Whenever possible the following principles should be incorporated into the research plan.

- Waste prevention
- Use of the safest possible chemicals and products
- Design of the least possible hazardous chemical syntheses
- Use renewable materials
- Use catalysts in order to minimize chemical usage
- Use of solvents and reaction conditions that are safe as possible
- Maximization of energy efficiency
- Minimization of accident potential

2. Hazardous Devices

The documentation of risk assessment (Form 3) is required when a student researcher works with potentially hazardous/dangerous equipment and/or other devices, in or outside a laboratory setting that require a moderate to high level of expertise to ensure their safe usage. Some commonly used devices (Bunsen burners, hot plates, saws, drills, etc.) may not require a documented risk assessment, assuming that the student researcher has experience working with the device. Use of other potentially dangerous devices such as high vacuum equipment, heated oil baths, NMR equipment, and high temperature ovens must have documentation of a risk assessment. It is recommended that all student designed inventions also have documentation of a risk assessment.

3. Radiation

A risk assessment must be conducted when a student's project involves radiation beyond that normally encountered in everyday life. Non-ionizing radiation includes the spectrum of ultraviolet (UV), visible light, infrared (IR), microwave (MW), radiofrequency (RF) and extremely low frequency (ELF). Ionizing radiation has enough energy to remove tightly bound electrons from atoms, thus creating ions. Examples include high frequency UV, X-Rays, and gamma rays.

Lasers usually emit visible, ultraviolet or infrared radiation. Lasers are classified into four classes based upon their safety. Manufacturers are required to label Classes II – IV lasers

Projects involving radionuclides (radioisotopes) and X-rays must involve a careful examination of the risks associated with the study and appropriate safety precautions must be taken. Depending upon the level of exposure, radiation released from these sources can be a health hazard.

A risk assessment must take into account the time of exposure, distance and shielding involved in the study.

- a. A study of natural radiation that is no more than encountered in everyday life is exempt from the following requirements.
- b. All studies may not exceed the dose limits set by the Nuclear Regulatory Commission of 0.5 mrem/hr or 100 mrem/year of exposure.
- c. If the voltage needed in the study is <10 kvolts, a risk assessment must be conducted. The study may be done at home or school, and SRC preapproval is not required.

- d. A study using 10-25 kvolts must have a risk assessment conducted and must be preapproved by the SRC to assess safety. Such a study must be conducted in a metal chamber using a camera only, not direct view through glass. A dosimeter or radiation survey meter is required to measure radiation exposure.
 - e. All studies using > 25 kvolts must be conducted at an institution with a Licensed Radiation Program and must be preapproved by the Institutions' Radiation Safety Officer or the Committee which oversees the use of ionizing radiation to ensure compliance with state and federal regulations.
2. Dunn, C. M. and Chadwick, G. L., *Protecting Study Volunteers in Research*, 3rd Edition (2004). Boston, MA: Thomson Centerwatch. ISBN 1-930624-44-1.
Can be purchased from:
www.amazon.com
 3. NIH tutorial, "Protecting Human Research Participants"
<http://phrp.nihtraining.com/users/PHRP.pdf>
 4. Belmont Report, April 18, 1979
www.hhs.gov/ohrp/humansubjects/guidance/belmont.html
 5. *Standards for Educational and Psychological Testing*. (1999). Washington, DC: AERA, APA, NCME.
www.apa.org/science/programs/testing/standards.aspx
 6. American Psychological Association
750 First Street, NE Washington, DC 20002-4242
phone: 202-336-5500; 800-374-2721
www.apa.org

Sources of Information for All Projects

1. United States Patent and Trade Office
Customer Service: 1-800-786-9199 (toll-free);
571-272-1000 (local); 571-272-9950 (TTY)
www.uspto.gov
www.uspto.gov/patents/process/index.jsp
 2. European Patent Office
www.epo.org
www.epo.org/applying/basics.html
 3. The Mad Scientist Network at Washington University School of Medicine:
www.madsci.org
 4. ANS Task Force
www.anstaskforce.gov

Aquatic Nuisance Species (ANS) Task Force
www.anstaskforce.gov
www.anstaskforce.gov/Documents/ISEF.pdf
 5. APHIS
www.aphis.usda.gov/
Animal and Plant Health Inspection Service
Invasive Species List
 6. Invasive Species Specialist Group
www.issg.org
The Global Invasive Species database contains invasive species information supplied by experts from around the world.
 7. Invasive Species Information
www.invasivespeciesinfo.gov/resources/lists.shtml
Provides information for species declared invasive, noxious, prohibited, or harmful or potentially harmful.
 8. *Success with Science: The Winner's Guide to High School Research*
<http://www.successwithscience.org>
Gaglani, S. and DeObaldia, G. (2011). Research Corporation for Science Advancement.
ISBN 0-9633504-8-X
7. Educational and Psychological Testing
Testing Office for the APA Science Directorate
phone: 202-336-6000
email: testing@apa.org
www.apa.org/science/programs/testing/index.aspx
 8. The Children's Online Privacy Protection Act of 1998 (COPPA)
(15 U.S.C. §§ 6501–6506)
www.ftc.gov/privacy/coppafaqs.shtml

Information for students:
www.apa.org/science/leadership/students/information.aspx
Information regarding publications:
www.apa.org/pubs/index.aspx

Vertebrate Animals Animal Care and Use

1. *Laboratory Animals*, Institute of Laboratory Animal Research (ILAR), Commission on Life Sciences, National Research
<http://dels.nas.edu/ilar>
 2. *Guide for the Care and Use of Laboratory Animals, 8th Edition (2011)*
<http://grants.nih.gov/grants/olaw/Guide-for-the-Care-and-Use-of-Laboratory-Animals.pdf>
www.nap.edu/catalog.php?record_id=12910
 3. *Guidelines for the Care and Use of Mammals in Neuroscience and Behavioral Research (2003)*, Institute for Laboratory Animal Research (ILAR).
<https://www.nap.edu/catalog/10732/guidelines-for-the-care-and-use-of-mammals-in-neuroscience-and-behavioral-research>
- To order these ILAR publications contact:
National Academies Press
500 Fifth Street, NW
Washington, DC 20055
phone: 888-624-8373 or 202-334-3313; fax: 202-334-2451
www.nap.edu
4. Federal Animal Welfare Act (AWA)
7 U.S.C. 2131-2157
Subchapter A - Animal Welfare (Parts I, II, III)
<https://www.nal.usda.gov/awic/animal-welfare-act>

Human Participants

1. Code of Federal Regulation (CFR), Title 45 (Public Welfare), Part 46-Protection of Human Subjects (45CFR46)
<https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46>

Document is available from:
USDA/APHIS/AC
4700 River Road, Unit 84
Riverdale, MD 20737-1234
email: ace@aphis.usda.gov
phone: 301-734-7833; fax: 301-734-4978
<http://awic.nal.usda.gov>

5. *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (Agri-Guide)*
Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC International)
<https://www.aaalac.org/>
https://www.aaalac.org/about/Ag_Guide_3rd_ed.pdf
6. *Guidelines for the Use of Fish in Research* (2014), American Fisheries Society.
www.fisheries.org
www.fisheries.org/afs/docs/policy_16.pdf
7. *Euthanasia Guidelines*
AVMA Guidelines on Euthanasia (2013)
American Veterinary Medical Association
www.avma.org/KB/Policies/Documents/euthanasia.pdf

Alternative Research and Animal Welfare

1. *The National Library of Medicine* provides computer searches through MEDLINE:
Reference & Customer Services
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
888-FIND-NLM or 888-346-3656; 301-594-5983;
email: info@ncbi.nlm.nih.gov
www.nlm.nih.gov
www.ncbi.nlm.nih.gov/sites/entrez
2. *National Agriculture Library* (NAL) provides reference service for materials that document a) Alternative Procedures to Animal Use and b) Animal Welfare.
Animal Welfare Information Center
National Agriculture Library
10301 Baltimore Avenue, Room 410
Beltsville, MD 20705-2351
phone: 301-504-6212, fax: 301-504-7125
email: awic@ars.usda.gov
www.nal.usda.gov/awic
3. *Institute of Laboratory Animal Resources* (ILAR) provides a variety of information on animal sources, housing and handling standards, and alternatives to animal use through annotated bibliographies published quarterly in *ILAR Journal*.
ILAR - The Keck Center of the National Academies
500 Fifth Street, NW, Keck 687
Washington, DC 20001
phone: 202-334-2590, fax: 202-334-1687
email: ILAR@nas.edu
<http://dels.nas.edu/ilar>
4. Quarterly bibliographies of Alternatives to the Use of Live Vertebrates in Biomedical Research and Testing may be obtained from:
Specialized Information Services
NLM/NIH
2 Democracy Plaza, Suite 510
6707 Democracy Blvd., MSC 5467
Bethesda, MD 20892-5467
phone: 301-496-1131; Fax: 301-480-3537

email: tehip@tehl.nlm.nih.gov
<https://www.sis.nlm.nih.gov>
<http://toxnet.nlm.nih.gov/altbib.html>

5. *Johns Hopkins Center for Alternatives to Animal Testing* (CAAT) has worked with scientists since 1981 to find new methods to replace the use of laboratory animals in experiments, reduce the number of animals tested, and refine necessary tests to eliminate pain and distress.
email: caat@jhsp.edu
<http://caat.jhsp.edu/>
6. Quality Assurance Manuals (for appropriate species)
Such as:
Poultry: <https://www.ams.usda.gov/?dDocName=STELDEV3002393>
Beef: <http://www.bqa.org/manuals.aspx>
Pork: <http://old.pork.org/filelibrary/youthpqa/youthpqamanual.pdf>

Potentially Hazardous Biological Agents

1. American Biological Safety Association: ABSA Risk Group Classification – list of organisms
www.absa.org
2. American Type Culture Collection (ATCC)
www.atcc.org
3. Bergey's Manual of Systematic Bacteriology website – follow the links for resources and microbial databases for a collection of international websites of microorganisms and cell cultures.
www.bergeys.org/resources.html
4. Biosafety in Microbiological and Biomedical Laboratories (BMBL) – 4th Edition. Published by CDC-NIH
www.cdc.gov/biosafety/publications/bmb15/BMBL.pdf
5. World Health Organization Laboratory Safety Manual
www.who.int/diagnostics_laboratory/guidance/en
6. Canada – Agency of Public Health – list of non-pathogenic organisms
<http://www.phac-aspc.gc.ca/lab-bio/index-eng.php>
7. American Society for Microbiology
<https://www.asm.org/division/w/web-sites.htm>
8. Microbiology Society
Charles Darwin House
12 Roger Street
London
WC1N 2JU
UK
education@microbiologysociety.org
<http://microbiologyonline.org>
9. *NIH Guidelines for Research Involving Recombinant DNA Molecules*. Published by National Institutes of Health.
<http://osp.od.nih.gov/office-biotechnology-activities/oba/index.html>
10. OSHA – Occupational Health and Safety Administration
www.osha.gov

Hazardous Chemicals, Activities or Devices General Lab/Chemical Safety

1. *Safety in Academic Chemistry Laboratories, Volumes 1 and 2*, 2003. Washington, DC: American Chemical Society.
Order from (first copy free of charge):

American Chemical Society
Publications Support Services
1155 16th Street, NW
Washington, DC 20036
phone: 202-872-4000 or 800-227-5558
email: help@acs.org
www.acs.org/education

11. U.S. Nuclear Regulatory Commission
Material Safety and Inspection Branch
One White Flint North
11555 Rockville Pike
Rockville, MD 20852
phone: 301-415-8200; 800-368-5642
www.nrc.gov

2. General
Howard Hughes Medical Institute has resources for working with cell cultures, radioactive materials and other laboratory materials.
www.hhmi.org/resources
3. Environmental Protection Agency (EPA) website for green chemistry
www.epa.gov/greenchemistry
4. Safety and Data Sheets (SDS)
www.flinnsci.com/msds-search.aspx
A directory of SDS sheets from Flinn Scientific Inc. that includes a ranking of hazard level and disposal methods.

www.ilpi.com/msds/index.html - A listing of numerous sites that have free downloads of MSDS sheets.
5. Pesticides
National Pesticide Information Center
<http://npic.orst.edu/ingred/products.html>
Describes the various types of pesticides and the legal requirements for labelling. Provides links and phone numbers to get additional information.

Environmental Protection Agency
<http://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1>
A database of product labels. Enter the product name or company name to view the approved label information of pesticides which are registered with the agency.
6. DEA Controlled Substances
Drug Enforcement Agency website:
www.justice.gov/dea/index.htm
Controlled Substance Schedules—a list of controlled substances:
www.deadiversion.usdoj.gov/schedules/
7. Alcohol, Tobacco, Firearms, and Explosives
Alcohol and Tobacco Tax and Trade Bureau
www.ttb.gov
Bureau of Alcohol, Tobacco, Firearms and Explosives
www.atf.gov
8. Radiation
Radiation Studies Information (CDC)
www.cdc.gov/nceh/radiation/default.htm
9. CDC Laboratory Safety Manuals
www.cdc.gov/biosafety/publications/index.htm
10. Occupational Safety and Health Administration
www.osha.gov
Safety and Health Topics:
www.osha.gov/SLTC
www.osha.gov/SLTC/reactivechemicals/index.html
www.osha.gov/SLTC/laserhazards/index.html
www.osha.gov/SLTC/radiationionizing/index.html