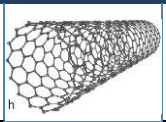
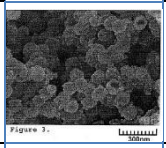
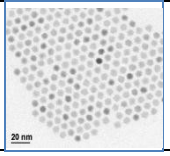
GENERAL WRITTEN SOP-Nanomaterials

The OSHA Laboratory Standard explicitly requires "standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals." Although the Laboratory Standard does not specifically cover work using nanomaterials, if the general SOP in this section do not fulfill this requirement, you must amend and append in some manner as to comply.

The increasing use of nanomaterials in research labs warrants consideration of the hazards they may pose. As is the case with many new technologies, the health effects of nanomaterials have not been thoroughly investigated. Consequently, the uncertainty surrounding the toxicity of nanomaterials merits a cautious approach when working with them.

Nanomaterials include any materials or particles that have an external dimension in the nanoscale (~1 – 100 nm). Nanomaterials are both naturally occurring in the environment and intentionally produced. Intentionally produced nanomaterials are referred to as Engineered Nanomaterials (ENMs). Materials whose properties do not differ significantly between their nanoscale and larger forms are generally excluded from ENMs. The most common types of ENMs are carbon based materials such as nanotubes, metals and metal oxides such as silver and zinc oxide, and quantum dots made of compounds such as zinc selenide.

	Type	Examples
	**Carbon Based**	**Buckyballs or Fullerenes, Carbon Nanotubes*, Dendrimers** *Often includes functional groups like* PEG (polyethylene glycol), Pyrrolidine, N, N-dimethylethylenediamine, imidazole*
	**Metals and Metal Oxides**	**Titanium Dioxide (Titania)**, Zinc Oxide, Cerium Oxide (Ceria), Aluminum oxide, Iron Oxide, Silver, Gold, and Zero Valent Iron (ZVI) nanoparticles**
	**Quantum Dots**	**ZnSe, ZnS, ZnTe, CdS, CdTe, CdSe, GaAs, AlGaAs, PbSe, PbS, InP** *Includes crystalline nanoparticle that exhibits size-dependent properties due to quantum confinement effects on the electronic states (ISO/TS 27687:2008).*

* Carbon Nanotubes are subject to a proposed Recommended Exposure Limit[10] of TWA 7 µg/m^3 due to the risk of developing respiratory health effects.

**Nano-Titanium Dioxide is subject to a proposed Permissible Exposure Limit[11] of TWA 0.3 mg/m^3 due to the risk of developing lung cancer. There are mixed studies regarding TiO2 skin penetration. Some studies indicate TiO2 and ZnO does not pass through the stratum corneum[6,7], while others indicate significant penetration through the skin[8].

Table from Nanotoolkit (https://www.ehs.uci.edu/programs/sop_library/Nanotoolkit.pdf)

Nanomaterials can be categorized by the potential risk of exposure they pose to personnel based on the physical state of the materials and the conditions in which they are used.

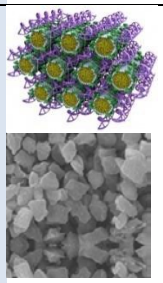
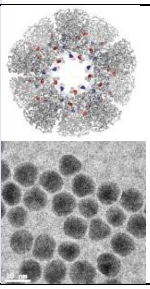
Risk Level	Material State or Type of Use *Material State or Type of Use*	Examples	
Category 1 Lower Exposure Potential	**Material State** *No potential for airborne release (when handling)* **Solid**: Bound in a substrate or matrix **Liquid**: Water-based liquid suspensions or gels **Gas**: No potential for release into air (when handling) **Type of Use** • No thermal or mechanical stress	• Non- destructive handling of solid engineered nanoparticle composites or nanoparticles permanently bonded to a substrate	
Category 2 Moderate Exposure Potential	**Material State** *Moderate potential for airborne release (when handling)* **Solid:** Powders or Pellets **Liquid:** Solvent-based liquid suspensions or gels **Air:** Potential for release into air (when handling) **Type of Use** • Thermal or mechanical stress induced	• Pouring, heating, or mixing liquid suspensions (*e.g.,* stirring or pipetting), or operations with high degree of agitation involved (*e.g.,* sonication) • Weighing or transferring powders or pellets • Changing bedding out of laboratory animal cages	
Category 3 Higher Exposure Potential	**Material State** *High potential for airborne release (when handling)* **Solid:** Powders or Pellets with extreme potential for release into air **Gas:** Suspended in gas	• Generating or manipulating nanomaterials in gas phase or in aerosol form • Furnace operations • Cleaning reactors • Changing filter elements • Cleaning dust collection systems used to capture nanomaterials • High speed abrading / grinding nanocomposite materials	

Table from Nanotoolkit (https://www.ehs.uci.edu/programs/sop_library/Nanotoolkit.pdf)

In general, the risk of exposure is lowest when nanomaterials are bound in a solid matrix with little potential to create airborne dust or when in a non-volatile liquid suspension. The risk of exposure increases when nanomaterials are used as fine powders or are suspended in volatile solvents or gases. The parent compound of the nanomaterial should also be taken into consideration when evaluating the potential hazards associated with exposure (e.g., a highly toxic compound such as cadmium should be anticipated to be at least as toxic and possibly more toxic when used as a nanomaterial).

See https://www.ehs.uci.edu/programs/sop_library/Nanotoolkit.pdf for more details.

A detailed Standard Operating Procedure (SOP) template for working with nanomaterials that provides guidance on appropriate work practices, engineering controls, Personal Protective Equipment (PPE), and waste disposal practices depending on the risk level of a particular nanomaterial or process involving a nanomaterial follows.

Standard Operating Procedures (SOP)

For the Laboratory Use of Engineered Nanomaterials

Instructions: Review the ***Quick Guide: Risk Levels and Control Measures for Nanomaterials***. Use this template to develop a Standard Operating Procedure for your experiment / process. *The Quick Guide is found in the Nanotoolkit https://www.ehs.uci.edu/programs/sop_library/Nanotoolkit.pdf*

OVERVIEW

PROCEDURE TITLE:		
DATE OF CREATION / REVISION:		
LOCATION: *(Building, Room #)*		
PRINCIPAL INVESTIGATOR (PI) OR LABORATORY SUPERVISOR NAME:	PHONE:	EMAIL:
DESCRIPTION. PROVIDE A 1-2 SENTENCE BRIEF DESCRIPTION OF THE PROCESS. INDICATE IF AEROSOLS ARE LIKELY TO BE CREATED.		

MATERIAL STATE AND CONDITIONS OF USE	FREQUENCY (check one):	DURATION PER EXPERIMENT:
Nanomaterials are handled in/as: ☐ **DRY PARTICLES** (POWDERS / PELLETS) ☐ **SUSPENSION / GELS** ☐ **GASEOUS PHASE**	☐ **ONE TIME** ☐ **DAILY** ☐ **WEEKLY** ☐ **MONTHLY** ☐ **OTHER:**	_____ MINUTES; OR _____ HOURS

HAZARDS

RISK LEVEL:

☐ **CATEGORY 1**: LOW POTENTIAL FOR EXPOSURE
☐ **CATEGORY 2**: MODERATE POTENTIAL FOR EXPOSURE
☐ **CATEGORY 3**: HIGH POTENTIAL FOR EXPOSURE

POTENTIAL HAZARDS. IDENTIFY POTENTIAL CHEMICAL AND SAFETY HAZARDS USING THE MATERIAL SAFETY DATA SHEET (MSDS) FOR THE NANOMATERIAL OR PARENT COMPOUND. THE TOXICITY OF THE NANOMATERIALS MAY BE GREATER THAN THE PARENT COMPOUND. SPECIAL CONSIDERATION SHOULD BE GIVEN TO THE HIGH REACTIVITY OF SOME NANOPOWDERS WITH REGARD TO POTENTIAL FIRE AND EXPLOSION, PARTICULARLY IF SCALING UP THE PROCESS. CONSIDER THE HAZARDS OF ANY PRECURSOR MATERIALS IN EVALUATING THE PROCESS. FOR MORE INFORMATION, REFER TO THE SECTION ON "PLANNING YOUR RESEARCH".

INSTRUCTIONS: INDICATE THE ENGINEERING, WORK PRACTICE, AND PERSONAL PROTECTIVE EQUIPMENT (PPE) CONTROLS YOU WILL BE IMPLEMENTING TO REDUCE THE HAZARDOUS EFFECTS OF WORKING WITH YOUR NANOMATERIALS. BASE YOUR SELECTION ACCORDING TO THE "QUICK GUIDE" SECTION.

CONTROLS

ENGINEERING CONTROLS. INDICATE ENGINEERING DEVICE(S) TO BE UTILIZED. NOTE: IF WORK CANNOT BE CONDUCTED WITH APPROPRIATE ENGINEERING CONTROLS, CONSULT WITH AN EH&S PROFESSIONAL.

- ☐ **FUME HOOD** *(laboratory-type)*
- ☐ **BIOSAFETY CABINET** *(must be ducted if used in conjunction with volatile compounds)*
- ☐ **ENCLOSED SYSTEM** *(i.e., glove box, glove bag, or sealed chamber)*
- ☐ **POWDER HANDLING ENCLOSURE**
- ☐ **OTHER:**

WORK PRACTICE CONTROLS. THE FOLLOWING CONTROLS WILL BE IMPLEMENTED *(check all that apply)*:

☐ Category 1 work practices

- **STORE** in sealed container with secondary containment with other compatible chemicals
- **LABEL** chemical container with the identity of contents and include term "nano" as descriptor
- **TRANSFER** in sealed container with secondary containment
- **PREPARE** work space by lining with absorbent materials
- **CLEAN** all surfaces potentially contaminated with nanoparticles (e.g., benches, glassware, apparatus) at the end of each operation using a HEPA vacuum and/or wet wiping methods.
- **WASH** hands frequently. Upon leaving the nanomaterial work area, remove any PPE worn and wash hands, forearms, face, and neck.
- **NOTIFY** in advance of animal facility and cage labeling / management requirements if dosing animals with nanomaterial

☐ Category 2 work practices

- **FOLLOW** all work practices listed for Category 1.
- **RESTRICT ACCESS.**
- **POST** signs in area
- **USE** antistatic paper and/or sticky mats with powders.

☐ Category 3 work practices

- **FOLLOW** all work practices listed for Category 2.

☐ **Approvals Required.** IDENTIFY TASKS THAT REQUIRE PRIOR APPROVAL BY THE PRINCIPAL INVESTIGATOR / LABORATORY SUPERVISOR BEFORE PERFORMING:

☐ **Other** DESCRIBE ANY ADDITIONAL WORK PRACTICES SPECIFIC TO THE EXPERIMENT / PROCESS:

PERSONAL PROTECTIVE EQUIPMENT (PPE). INDICATE THE PPE TO BE UTILIZED *(check all that apply)*:

Body Protection:	☐ Long pants (no cuffs) ☐ Laboratory coat *made of standard materials* ☐ Laboratory coat *made of non-woven fabrics with elastics at wrists (i.e., Tyvek®)* ☐ Coveralls (disposable) with head coverage *(i.e., Tyvek®)*
Eye / Face Protection:	☐ Safety glasses with side shields ☐ Chemical splash goggles ☐ Face shield
Hand Protection:	☐ Latex ☐ Nitrile ☐ Neoprene ☐ Vinyl ☐ Other:
Foot Protection:	☐ Closed toe shoes ☐ Over-the-shoe booties
Other:	☐ Respiratory Protection* ☐ Other:

* Consult with your institution on respiratory program requirements

ACCIDENT AND SPILL PROCEDURES

LOCATION OF NEAREST EMERGENCY EQUIPMENT:

Item:	Location
Eyewash / Safety Shower	
First Aid Kit	
Chemical Spill Kit	
Fire Extinguisher	
Telephone	
Fire Alarm Manual Pull Station	

DESCRIBE INSTITUTION'S EMERGENCY PROCEDURES:

Personnel Exposure procedures

1. Flush contamination from eyes/skin using the nearest emergency eyewash /shower for a minimum of 15 minutes. Remove any contaminated clothing.
2. Take copy of MSDS(s) of chemical(s) when seeking medical treatment.
3. Report potential exposures to your Principal Investigator/Laboratory Supervisor.
4. File an incident report with your institution.

Spill Response procedures

1. **Notify.** Alert workers near spill to avoid entering the area. Post signs in area or on door of lab. Eliminate sources of ignition. Report spill to your Principal Investigator/Lab Supervisor.
2. **Assess.** Are you able to cleanup spill yourself?
   - ☐ YES
     *Proceed with **Spill Cleanup** if it is a small spill (i.e., 30 mL), you are knowledgeable about the hazards of the spill, it can be cleaned up within 15 minutes, and an appropriate spill kit is available.*
   - ☐ NO
     Obtain spill assistance. Contact your institution's hazardous materials unit.
3. **Cleanup Spill.** Wear existing PPE (NOTE: Respiratory protection may be required if spill / release is outside the engineering control device).
   For powders:
   - *Use a dedicated, approved HEPA vacuum whose filtration effectiveness has been verified.*
   - *Do not sweep dry nanoparticles or use compressed air.*
   - *Consider possible pyrophoric hazards associated with vacuuming up nanoparticles.*
   - *Wet wipe using damp cloths with soaps or cleaning oils, or commercially available wet or electrostatic microfiber cleaning cloths. Consider possible reactivity of nanoparticles with the wipe solvent..*

   For liquid dispersions:
   - *Apply absorbent material (appropriate for the solvent in the dispersion) to liquid spill.*
4. **Dispose.** Dispose of used cleaning materials and wastes as hazardous waste.
5. **Report.** File incident report with your institution.

TRAINING

GENERAL SAFETY TRAINING. DESCRIBE YOUR INSTITUTION'S GENERAL LABORATORY SAFETY TRAINING.

LABORATORY-SPECIFIC TRAINING. (CHECK ALL THE APPLY)

☐ REVIEW THIS NANOTOOL

☐ REVIEW THE MSDS FOR THE NANOMATERIAL(S), *if available*

☐ REVIEW THE MSDS FOR OTHER CHEMICALS INVOLVED IN THE EXPERIMENT / PROCESS

☐ REVIEW THIS SOP

☐ OTHER:

DISPOSAL

INDICATE THE NANOMATERIAL WASTE MANAGEMENT PROCEDURES TO BE UTILIZED.

	Waste Stream	Management Method
☐	**Solid** • Dry ENM product • Filter media containing ENMs • Debris / dust from ENMs bound in matrix	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Collect waste in rigid container with tight fitting lid.
☐	**Liquid** • Suspensions containing ENMs	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Indicate both the chemical constituents of the solution and their hazard characteristics, and the identity and approximate percentage of ENMs on container labels. 6. Use leak proof containers that are compatible with all contents. 7. Place liquid waste containers in secondary containment and segregate from incompatible chemicals during storage.
☐	**Laboratory trash with trace nanomaterials** • PPE • Sticky mats • Spill clean-up materials	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Dispose of in double clear plastic bags, folded over and taped at the neck. 6. Avoid rupturing the bags during storage and transport.
☐	**Solid Matrix** embedded with nanomaterials (intact and in good condition)	1. Consult with your EH&S department, as these materials may be non-hazardous.

DESCRIBE INSTITUTION'S WASTE MANAGEMENT PROCEDURES HERE (IF APPLICABLE):

Acknowledgement. *By signing this form the individual certifies that the information provided is true and correct to the best of their knowledge.*	PRINT NAME / SIGNATURE	DATE:

Appendix B

Standard Operating Procedures (SOP) sample

For the Laboratory Use of Engineered Nanomaterials

Instructions: Review the ***Quick Guide: Risk Levels and Control Measures for Nanomaterials***. Use this template to develop a Standard Operating Procedure for your experiment / process.

OVERVIEW

PROCEDURE TITLE:
Use of fluorescent nanocrystals as biological markers

DATE OF CREATION / REVISION:
09/24/2011

LOCATION:
(Building, Room #) *Sproul Hall 4127*

PRINCIPAL INVESTIGATOR (PI) OR LABORATORY SUPERVISOR NAME:	PHONE:	EMAIL:
Jane Doe	*(951) 827-6303*	*jane.doe@university.edu*

DESCRIPTION. PROVIDE A 1-2 SENTENCE BRIEF DESCRIPTION OF THE PROCESS. INDICATE IF AEROSOLS ARE LIKELY TO BE CREATED.

To achieve high optical density, maintain thinness, and prevent photodegredation, fluorescent nanocrystals will be used (over organic dyes) as biological markers. This study will also investigate fabrication of nanocomposites (polymer spheres) to avoid slow recognition kinetics and high non-specific bonding.

MATERIAL STATE AND CONDITIONS OF USE	FREQUENCY (check one):	DURATION PER EXPERIMENT:
Nanomaterials are handled in/as: ☐ DRY PARTICLES (POWDERS / PELLETS) ☑ SUSPENSION / GELS ☐ GASEOUS PHASE	☐ ONE TIME ☐ DAILY ☑ WEEKLY ☐ MONTHLY ☐ OTHER:	*30* _____ MINUTES; OR _____ HOURS

HAZARDS

RISK LEVEL:

☐ **CATEGORY 1**: LOW POTENTIAL FOR EXPOSURE
☑ **CATEGORY 2**: MODERATE POTENTIAL FOR EXPOSURE
☐ **CATEGORY 3**: HIGH POTENTIAL FOR EXPOSURE

POTENTIAL HAZARDS. IDENTIFY POTENTIAL CHEMICAL AND SAFETY HAZARDS USING THE MATERIAL SAFETY DATA SHEET (MSDS) FOR THE NANOMATERIAL OR PARENT COMPOUND. THE TOXICITY OF THE NANOMATERIALS MAY BE GREATER THAN THE PARENT COMPOUND. SPECIAL CONSIDERATION SHOULD BE GIVEN TO THE HIGH REACTIVITY OF SOME NANOPOWDERS WITH REGARD TO POTENTIAL FIRE AND EXPLOSION, PARTICULARLY IF SCALING UP THE PROCESS. CONSIDER THE HAZARDS OF ANY PRECURSOR MATERIALS IN EVALUATING THE PROCESS. FOR MORE INFORMATION, REFER TO THE SECTION ON "PLANNING YOUR RESEARCH".

Chalcogen oxide is harmful if inhaled or ingested. Chemical is incompatible with strong bases.
Cadmium Selenide (CdSe) is harmful if inhaled or ingested or when in contact with skin. Chemical is incompatible with acids.

INSTRUCTIONS: INDICATE THE ENGINEERING, WORK PRACTICE, AND PERSONAL PROTECTIVE EQUIPMENT (PPE) CONTROLS YOU WILL BE IMPLEMENTING TO REDUCE THE HAZARDOUS EFFECTS OF WORKING WITH YOUR NANOMATERIALS. BASE YOUR SELECTION ACCORDING TO THE "QUICK GUIDE" SECTION.

CONTROLS

ENGINEERING CONTROLS. INDICATE ENGINEERING DEVICE(S) TO BE UTILIZED. NOTE: IF WORK CANNOT BE CONDUCTED WITH APPROPRIATE ENGINEERING CONTROLS, CONSULT WITH AN EH&S PROFESSIONAL.

- ☐ FUME HOOD *(laboratory-type)*
- ☑ BIOSAFETY CABINET *(must be ducted if used in conjunction with volatile compounds)*
- ☐ ENCLOSED SYSTEM *(i.e., glove box, glove bag, or sealed chamber)*
- ☐ POWDER HANDLING ENCLOSURE
- ☐ OTHER:

WORK PRACTICE CONTROLS. THE FOLLOWING CONTROLS WILL BE IMPLEMENTED *(check all that apply)*:

☑ Category 1 work practices

- **STORE** in sealed container with secondary containment with other compatible chemicals
- **LABEL** chemical container with the identity of contents and include term "nano" as descriptor
- **TRANSFER** in sealed container with secondary containment
- **PREPARE** work space by lining with absorbent materials
- **CLEAN** all surfaces potentially contaminated with nanoparticles (e.g., benches, glassware, apparatus) at the end of each operation using a HEPA vacuum and/or wet wiping methods.
- **WASH** hands frequently. Upon leaving the nanomaterial work area, remove any PPE worn and wash hands, forearms, face, and neck.
- **NOTIFY** in advance of animal facility and cage labeling / management requirements if dosing animals with nanomaterial

☑ Category 2 work practices

- **FOLLOW** all work practices listed for Category 1.
- **RESTRICT ACCESS.**
- **POST** signs in area
- **USE** antistatic paper and/or sticky mats with powders.

☐ Category 3 work practices

- **FOLLOW** all work practices listed for Category 2.

☐ **Approvals Required.** IDENTIFY TASKS THAT REQUIRE PRIOR APPROVAL BY THE PRINCIPAL INVESTIGATOR / LABORATORY SUPERVISOR BEFORE PERFORMING:

Obtain PI approval prior to procuring (purchasing) nanomaterials.

☐ **Other** DESCRIBE ANY ADDITIONAL WORK PRACTICES SPECIFIC TO THE EXPERIMENT / PROCESS:

PERSONAL PROTECTIVE EQUIPMENT (PPE). INDICATE THE PPE TO BE UTILIZED *(check all that apply)*:

Body Protection:	☑ Long pants (no cuffs) ☐ Laboratory coat *made of standard materials* ☑ Laboratory coat *made of non-woven fabrics with elastics at wrists (i.e., Tyvek®)* ☐ Coveralls (disposable) with head coverage *(i.e., Tyvek®)*
Eye / Face Protection:	☐ Safety glasses with side shields ☑ Chemical splash goggles ☐ Face shield
Hand Protection:	☐ Latex ☑ Nitrile ***(2 layers)*** ☐ Neoprene ☐ Vinyl ☐ Other:
Foot Protection:	☑ Closed toe shoes ☐ Over-the-shoe booties
Other:	☐ Respiratory Protection* ☐ Other:

* Consult with your institution on respiratory program requirements

Accident and Spill Procedures

Location of Nearest Emergency Equipment:

Item:	Location
Eyewash / Safety Shower	*Outside main door of in Sproul Hall 4127*
First Aid Kit	*Under sink in Sproul Hall 4127*
Chemical Spill Kit	*Under sink in Sproul Hall 4127*
Fire Extinguisher	*On the fourth floor of Sproul Hall, near restrooms*
Telephone	*On desk in corner of Sproul Hall 4127*
Fire Alarm Manual Pull Station	*On the fourth floor of Sproul Hall, near restrooms*

Describe institution's emergency procedures:

Follow "In Case of an Accident" poster affixed to laboratory door

Personnel Exposure procedures

1. Flush contamination from eyes/skin using the nearest emergency eyewash /shower for a minimum of 15 minutes. Remove any contaminated clothing.
2. Take copy of MSDS(s) of chemical(s) when seeking medical treatment.
3. Report potential exposures to your Principal Investigator/Laboratory Supervisor.
4. File an incident report with your institution.

Spill Response procedures

1. **Notify.** Alert workers near spill to avoid entering the area. Post signs in area or on door of lab. Eliminate sources of ignition. Report spill to your Principal Investigator/Lab Supervisor.
2. **Assess.** Are you able to cleanup spill yourself?
   IF YES
   *Proceed with **Spill Cleanup** if it is a small spill (i.e., 30 mL), you are knowledgeable about the hazards of the spill, it can be cleaned up within 15 minutes, and an appropriate spill kit is available.*

   IF NO
   Obtain spill assistance. Contact your institution's hazardous materials unit.
3. **Cleanup Spill.** Wear existing PPE (NOTE: Respiratory protection may be required if spill / release is outside the engineering control device).
   For powders:
   - *Use a dedicated, approved HEPA vacuum whose filtration effectiveness has been verified.*
   - *Do not sweep dry nanoparticles or use compressed air.*
   - *Consider possible pyrophoric hazards associated with vacuuming up nanoparticles.*
   - *Wet wipe using damp cloths with soaps or cleaning oils, or commercially available wet or electrostatic microfiber cleaning cloths. Consider possible reactivity of nanoparticles with the wipe solvent..*

   For liquid dispersions:
   - *Apply absorbent material (appropriate for the solvent in the dispersion) to liquid spill.*
4. **Dispose.** Dispose of used cleaning materials and wastes as hazardous waste.
5. **Report.** File incident report with your institution.

Training

General Safety Training. Describe your institution's general laboratory safety training.

Laboratory Safety Orientation, Hazardous Waste Management, and Chemical Hygiene are required of all users prior to working in the laboratory. All courses are available online at http://www.university.edu

Laboratory-Specific Training. (Check all the apply)

- ☑ Review this nanotool
- ☑ Review the MSDS for the nanomaterial(s), *if available*
- ☑ Review the MSDS for other chemicals involved in the experiment / process
- ☑ Review this SOP
- ☐ Other:

DISPOSAL

INDICATE THE NANOMATERIAL WASTE MANAGEMENT PROCEDURES TO BE UTILIZED.

	Waste Stream	Management Method
☐	**Solid** • Dry ENM product • Filter media containing ENMs • Debris / dust from ENMs bound in matrix	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Collect waste in rigid container with tight fitting lid.
☑	**Liquid** • Suspensions containing ENMs	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Indicate both the chemical constituents of the solution and their hazard characteristics, and the identity and approximate percentage of ENMs on container labels. 6. Use leak proof containers that are compatible with all contents. 7. Place liquid waste containers in secondary containment and segregate from incompatible chemicals during storage.
☑	**Laboratory trash with trace nanomaterials** • PPE • Sticky mats • Spill clean-up materials	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Dispose of in double clear plastic bags, folded over and taped at the neck. 6. Avoid rupturing the bags during storage and transport.
☐	**Solid Matrix** embedded with nanomaterials (intact and in good condition)	1. Consult with your EH&S department, as these materials may be non-hazardous.

DESCRIBE INSTITUTION'S WASTE MANAGEMENT PROCEDURES HERE (IF APPLICABLE):

Use the University Online Tag Program (OTP) to schedule pickup of hazardous waste with EH&S.

Acknowledgement. *By signing this form the individual certifies that the information provided is true and correct to the best of their knowledge.*

PRINT NAME / SIGNATURE: Jane Doe

DATE: *09/24/2011*

References:

"Nanotoolkit: Working Safely with Engineered Nanomaterials in Academic Research Settings" http://www.ehs.ucr.edu/laboratory/nanotoolkit.pdf

National Institute of Occupational Safety & Health's (NIOSH) "Safe Practices for Working with Engineered Nanomaterials in Research Laboratories" http://www.cdc.gov/niosh/docs/2012-147/pdfs/2012-147.pdf

National Institute of Occupational Safety & Health's (NIOSH) "Current Strategies for Engineering Controls in Nanomaterial Production and Downstream Handling Processes" http://www.cdc.gov/niosh/docs/2014-102/pdfs/2014-102.pdf