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1 OVERVIEW

1.1 SAFETY CAPTAIN MESSAGE

As Charles M. Hayes once said, *“Safety first is safety always.”* At Arctos we wholeheartedly believe in this quote which is why we always strive to do our best as a team to prevent injuries and to make sure that every member of our team is safe and that they are practicing safe habits. In fact, to show how serious Arctos is about safety, as this year’s safety captain, I have decided to create our team’s very first safety manual. On top of the general safety knowledge that I have included from this year’s safety manual, I have taken the liberty of adding even more safety precautions that are tailored specifically for our team. Some of the extra safety precautions I have included are safety checklists for not only the pits but also the stands, injury treatment procedures and safety cards that contain the contact information of our supervisors in case of an emergency. Last but not least I hope that this safety manual will not only inspire the members of Arctos to continue being safe but also whoever else is currently reading it.

“Safety should never be ignored, forgotten about or chucked aside after build season is over or during offseason. Instead, safety should be practiced at all times for your personal wellbeing and the wellbeing of others.”

-Alicia Jin, safety captain of Arctos 6135

2 TEAM RESPONSIBILITIES

Everyone who is a part of Arctos, including mentors, are responsible for the safety of themselves and other team members. Additionally, maintaining safety during team meetings and the design, build, travel and event phases of the competition requires a team effort, not just the safety captain's effort.

2.1 TEAM MEMBERS

- All the team members of Arctos are expected to read and be familiar with this manual and the safety requirements it lists.
- Whether its build season or offseason all members are expected to work in a safe and responsible manner.
- Team members are also encouraged to report any unsafe or hazardous conditions or behaviour to either the safety captain or a mentor.
- Lastly all team members are encouraged to promote safe behaviours.

2.2 MENTORS

- The mentors of Arctos are expected to read the team safety manual and practice the same safety behaviours that are expected from the students.

- When it comes to safety and taking safety precautions, mentors should always lead by example and provide students with any additional knowledge or guidance they have about general safety.

2.3 STUDENT SAFETY CAPTAIN

- Safety captains are responsible for reading the safety manual and overseeing team members to make sure that they are being safe
- New safety captains are encouraged to create and or edit the team's safety manual and plans
- Safety captains should encourage team members to display positive safety behaviours at all times and answer questions about safety precautions
- Conduct regular inspections in the robot construction area and pit station
- Have safety data sheets (SDSs) and emergency procedures readily available
- Make a team safety plan in case of an event emergency
- Attend the daily safety captain meetings at events

3 GENERAL SAFETY REQUIREMENTS

Whether at an event or in the robotics room these are some general safety practices that all team members should practice and follow.

*Running and horse play is not permitted or within realm of possibility at FIRST events or in the robotics room.

- It is advised that all members should follow safe work practices, ex; safe tool and personal protective equipment usage.
- Have full control of the robot at all times, especially when it's on and operating.
- Be alert and careful when around high-speed rotating components and make sure that they are functioning the way they are designed to.
- Always fully open a ladder before climbing it and never climb a table even if another team member is supporting it.
- Be cautious when using heat generating tools such as heat guns and soldering irons as the heat emitted from these devices can cause nearby objects to catch on fire. Furthermore, these tools often retain heat even after they have been turned off or unplugged which is why it's important to set them down on a solid surface and away from combustible objects.

3.1 STORED ENERGY

Always make sure to take the necessary precautions before making robot repairs to prevent unnecessary injuries.

3.1.1 ELECTRICAL ENERGY:

- Disconnect the electric power source after use
- Best Practice: Always de-energize the robot before working on it by opening the main circuit breaker (“re-set” lever is released) and unplugging batteries

3.1.2 PNEUMATIC ENERGY:

- Always vent any compressed air to the atmosphere
- Open the main vent valve and verify that all pressure gauges on the robot indicate zero pressure

3.1.3 MISCELLANEOUS ENERGY SOURCES:

- Relieve any compressed or stretched springs or tubing
- Lower all raised robot arms or devices that could drop down to a lower position on the robot.

3.2 HAND TOOLS

Every year, Hand tools are always used to assemble and make parts of the robot. Although, the term hand tools is often associated with wrenches, screwdrivers and Allen key sets the term also applies to any hand-held tool used to accomplish a task. So, always use the proper tool for whatever task you have been assigned to do.

3.2.1 TOOL RULES:

- Always check to see if a tool is in good condition before using it. Never use a defective, dull or broken tool. If there is a defective tool don’t put it back on the shelf, instead remove it from service and notify the safety captain and mentor so that the tool can be replaced or sent for repair.
- When using a tool, place the work on a bench or a hard surface and clamp it down with a clamp, vise grip or vise rather than just holding it in the palm of your hand.
- When using knives or blades, always direct the cutting strokes away from your hand and body. It’s also a good idea to wear gloves for extra protection.

3.2.2 TOOL STORAGE:

- All sharp-edged or pointed tools should be stored in a safe place.
- When carrying tools, always cover the point or blade with a shield. Never carry unsoiled tools in your pocket.
- Tools should also never be left on overhead work surfaces such as shelves as they could fall and strike whoever is standing below it.
- Store equipment in a location where it will not create a safety hazard or get damaged.

3.3 MECHANICAL GUARDS

Machine guards are important as they help to reduce the likelihood that an accident will occur because of things like mechanical failure, human error and electrical failure.

- Never use equipment without its safety guard in place.
- If there isn't a safety guard or if it's broken, inform the safety captain and mentor so that it can be repaired. Meanwhile the equipment must remain out of service until the new guard arrives to prevent accidents.

3.4 ELECTRICAL SAFETY

- Periodically inspect equipment cords and extension cords to ensure that they are in good condition.
- Don't plug a power strip into another power strip as it could cause a fire of electric shock if the circuit overloads.
- Extension cords also shouldn't be plugged into a power strip.
- Multi-device receptacles shouldn't be plugged into a power strip or extension cord.

3.5 BATTERY SAFETY

Batteries contain an acid called H2SO4. Sulfuric acid is a corrosive, colourless liquid that will burn your eyes, skin and clothing upon contact.

3.5.1 GENERAL DAMAGED BATTERY INFORMATION AND WARNINGS

- If a battery is visibly damaged don't use it.
- Since batteries contain stored electrical energy, it could cause the battery to rapidly heat up due to an internal electrical short circuit, and possibly explode.
- Additionally, the 12V batteries FIRST provided in the Kit of Parts contain sulfuric acid that will burn human tissue on contact.

*Information on how you should handle a leaking battery is located on page 11

3.5.2 CHARGING AND HANDLING

- Keep the battery-charging area clean and orderly.
- The battery charger should be placed in a position where cooling air can freely circulate around the charger. It should be known that battery chargers can fail without proper ventilation.
- Keep metal tools/parts out of the contact of the terminals to prevent creating a short circuit. If a short circuit is created, it could cause high heat to develop in the battery terminal/part/tool area which means the battery could explode.
- To avoid the possibility of shorting out the battery terminals and creating a hazardous situation all exposed battery terminals and connections should be covered with appropriate insulating material such as electrical tape or tubing.
- Do not charge battery at greater than the manufacturer's maximum recommended rate.

3.5.3 ONGOING BATTERY INSPECTION

- Batteries should always be inspected periodically for any evidence of damage, such as a cracked case or leaking electrolyte (looks like rock crystals).
- It is also a good idea to check for bent terminals as they can be a potential leak source.
- At competitions, batteries should aways be inspected before and after each round for damage.

3.6 CHEMICAL SAFETY

- Chemical containers should always be kept in good condition with the manufacture's label intact and legible.
- Read the safety precautions and instructions located on the back of the chemical's label as well as its safety data sheets (SDSS).
- If you have been exposed to a chemical notify the safety captain and mentor immediately and consult the SDS if necessary.
- The use of highly flammable materials such as cleaning solutions are banned at FIRST events.

3.7 SOLDERING

Soldering can be dangerous because of the heat from the iron and the chemical fumes and vapours that are released from the solder and flux

- Always use a lead-free solder only and solder with an electrically heated soldering iron/gun only.
- Torches and open flames are not allowed at FIRST events, except by authorized personnel in specified areas (such as the event machine shop).
- Always wear eye and face protection.
- Solder in well-ventilated areas.
- Never touch the iron/gun as it heats to extreme temperatures that will cause serve burns upon contact.
- To prevent receiving burns, wear cotton clothes that covers your arms and legs.
- After handling a solder wash your hands with soap and water.
- Work on a fire resistant surface.
- Always keep soldering irons in their protective holder when its not in use.
- Never leave any hot tools in a place where someone can accidentally touch it.

4 PERSONAL PROTECTION

Personal Protection Equipment (PPE) must be worn accordingly to ensure that you are protected from hazards in the robotics room, in the pits and when transporting the robot on and off the field. All PPE must be ANSI-approved, Ul-Listed, CE EN 166 rated, AS/NZS certified or CSA rated.

4.1 EYE AND FACE PROTECTION

At Arctos we have several forms of eye/face protection available. We have safety glasses, safety goggles, and face shields which get checked periodically for damage.

At Arctos we also have a strict rule where team members must put on a pair of safety glasses before entering the Robotics room. People are always using tools and working on the robot so it's better to be safe than sorry. Furthermore, safety glasses and protective eye wear are designed so that they can protect you from eye hazards such as splashes from liquids, burns from steam, compressed air, and flying wood or metal debris.

IN GENERAL, EYE AND FACE PROTECTION MUST BE WORN:

- When performing any work on the robot including grinding, drilling, soldering, cutting, welding, etc.
- When there is a risk of exposure to flying particles or chemical exposure (such as splashes, splatters, and sprays).
- At FIRST events when you're in the pit station, in the walkways, in the team pits, at the machine shop and on the playing field and practice field.

4.1.1 SAFETY GLASSES PROHIBITIONS

- If glasses are tinted, only lightly tinted yellow, rose, blue, and amber tints are FIRST approved.
- Reflective lenses are also prohibited as your eyes must be clearly visible to others.
- The use of anything other than ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated eye protection is prohibited.

4.1.3 PRESCRIPTION GLASSES

- Prescription glasses can only be worn as safety glasses if they have a marked safety rating.
- For those with safety rated glasses, you may also use ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated side shields.
- If you don't have safety rated prescription glasses then you must wear safety rated googles or safety glasses over them to achieve adequate protection.

4.2 CLOTHING AND HAIR

- Sweater strings should be tucked into your sweater to prevent them from getting caught in machinery.
- If you have long hair it should be tied up to prevent it from getting caught in machinery.

*If you don't have a hair elastic, please inform the safety captain who will provide you with one.

4.3 HAND PROTECTION

- Always use the proper gloves and mechanical tool guards when working to protect yourself against heat, electrical, chemical and mechanical hazards. Ex; wear chemical-resistant gloves when handling chemicals.
- Check your gloves to make sure that they are the proper size for your hands, are free from cracks and holes and have a good amount of flexibility and grip before you use them.

4.4 HEARING PROTECTION

- If the noise of a task starts to become too high, ear plugs are always readily available in the safety kit to reduce the sound.

4.5 FOOT PROTECTION

- To enter the robotics room and participate at FIRST events, team members must always wear close-toed shoes that have heels that protect against foot injuries.
- Flip-flops, sandals, mules, lightweight slippers, etc. are not acceptable when working on or near the robot.

5 SAFETY KITS AND EQUIPMENT

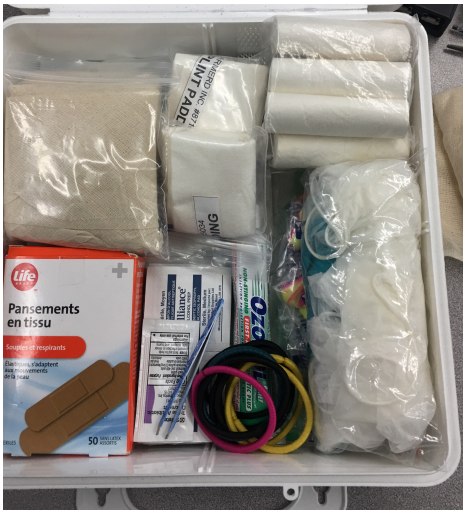
When using all sorts of materials and building with all sorts tools, its always a good idea to keep safety kits and equipment in an accessible place in the area in case of an emergency. At Arctos we always keep a first aid kit, battery spill kit and fire extinguisher in the robotics room in a visible and reachable location (on the row of shelfs to the left of the door).

5.1 FIRST AID KIT

The first aid kit contains all the basic first aid items needed to provide immediate and emergency care to an injured person. Having a first aid kit is important as it helps to minimize injuries and prevent them from becoming serious ones that can become life threatening.

The first aid kit contains:

- A box with over 150 bandaids
- Hair elastics
- Tweezers
- 2 pairs of gloves
- Antibacterial Ointment
- 9 Ear plugs
- 5 Non woven sponges
- 1 Dressing pad
- 2 Splint pads
- 5 Mesh cloth bandages
- 6 Rolls of thin gauze bandages
- 2 Bags of medical cheese cloth gauze bandages
- 10 Alcohol Pads
- 1 wire mesh splint

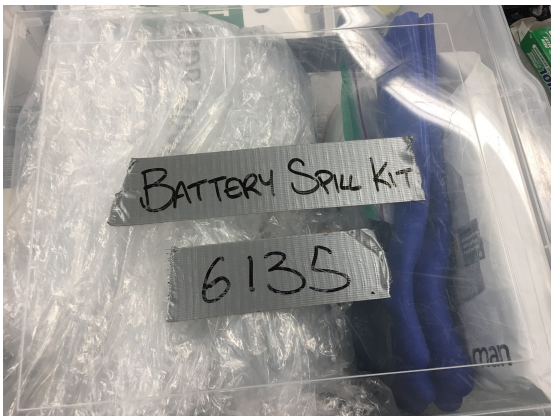


5.2 BATTERY SPILL KIT

Battery spill kits make it simple to safety contain, absorb and neutralize hazardous acid spills and help to meet safety requirements. It's always important to have a battery spill kit on hand and strategically placed so in the event of an acid spill or leak, response can be as quick and swift as possible.

The following items that are contained in our battery spill kit are:

- A bag of baking soda
- A pair of acid-resistant rubber gloves
- A container to place the defective battery
- A spade for scooping up the baking soda
- Several strong disposable garbage bags



5.2.1 PROCEDURE FOR HANDLING A LEAKING BATTERY

First neutralize it by pouring the baking soda on the area. The baking soda will react with the acid in the electrolyte and leave a safe residue behind that can be disposed with the use of water.

- Follow the emergency handling instructions on the SDS of the batteries and notify a mentor right away.
- Put on acid-resistant gloves before handling the battery
- Place the battery in a leak-proof container for removal
- Remember to neutralize any acid on the gloves before removing and storing them.
- Go and seek medical attention if your skin came into contact with any chemicals.
- Properly dispose of the battery, which is now a hazardous material. Most retailers of automotive batteries will accept and properly dispose of them at no cost.

At a FIRST event:
•Immediately send members who have been in contact with acid to the First Aid Station/ EMTs.

- Report incident to the pit administration supervisor so that the individual can fill out a Medical Incident Report form. Remember to provide the team's number and all available information.
- Pit Administration will immediately contact Event Management for further instruction from event and venue authorities.

5.3 FIRE EXTINGUISHER

Fire extinguishers are extremely important when it comes to safety as they help to put out fires before they have a change to grow and destroy even more.

Although our team has never had to use it we always keep a fire extinguisher in the robotics room for unexpected fire emergencies. To make sure that it's still functional, we get it checked every few months and if it doesn't get approved we do our best to get a replacement as soon as possible.

6 INJURY TREATMENT METHODS

Although we always make sure that everyone is wearing safety glasses, personal protective equipment (PPE) and using the proper tools and equipment for their tasks, accidents resulting in injuries do happen occasionally. This is why there is a whole chapter dedicated on how to handle the most common and uncommon but possible injuries that you can receive while you're a FIRST participant.

6.1 CUTS

- Stop the bleeding by applying direct pressure on the area
- Clean the area with warm water and gentle soap
- After the area has been dried apply a layer on antibiotic ointment to reduce the chance of infection.
- Place a sterile band aid on the area

*If it's a very deep cut and you cannot stop the bleeding after ten minutes of firm pressure on the area then call 911.

6.2 BRUISES

- Put a cover ice pack over your bruise after you get injured. The cold from the ice pack can help to reduce the size of the bruise and allow it to heal faster.
- Remove the ice after 10 minutes to give your skin a break.

6.3 BURNS

There are three types of burns that you can receive, first-degree burns which cause your skin to turn very red, second-degree burns which is when blisters start to form and third degree burns which is when your skin starts to turn white and leathery.

Important Notes:

- Never apply ice to a burn as it can make the damage worse
- Never apply cotton balls to a burn as the small fibres can stick to the injury and increase the risk of infection

6.3.1 FIRST-DEGREE BURN

- Soak the wound in cool water for five minutes or longer if necessary
- Apply either cream or antibiotic ointment to soothe the skin
- Wrap a loose layer of gauze around the area to prevent infection

6.3.2 SECOND-DEGREE BURN

- Soak the wound in cool water for fifteen minutes or longer if necessary
- Apply either cream or antibiotic ointment to soothe the skin
- Wrap a loose layer of gauze around the area to prevent infection

6.3.3 THIRD-DEGREE BURN

- Call 911 immediately don't try treating it yourself

6.4 BROKEN BONES

- Immediately call for 911

While waiting:

- If the person has any wounds that are bleeding stop them by applying pressure with a clean cloth or sterile bandage.
- If you have been trained on how to splint get the safety kit and use the materials in it to splint the area above and below the fracture sites.
- Apply a covered ice pack to the area to limit swelling and to help relieve pain
- Treat for shock in the injured person. For example, if they feel faint or they are breathing in short, rapid breaths, lay them down with their head slightly lower than the trunk and, if possible, elevate their legs.

6.5 CONCUSSIONS

- Call 911 and take the concussed person to a doctor where they can be properly treated.

7 SAFETY DATA SHEETS

Safety data sheets are important to have because they contain all the information on the potential hazards of the product (health, fire, reactivity and environmental) and how to work safety with the chemical product. This is why it's crucial to always collect and store Safety Data Sheets (SDSs) in the safety binder for any chemicals, chemical compounds or chemical mixtures (e.g. the paint and batteries that our team uses). Most safety data sheets can be obtained from the manufacturer's web site or by calling the manufacturer directly.

8 TEAM EDUCATION

At Arctos, we believe that it's important to educate all our team members about safety and safe behaviour when in our robotics room, in the stands or in the pit at events. This year we have decided to create a brand new safety plan that we will implement next year to improve safety even more at Arctos.

8.1 SAFETY CLASSES

Starting this fall (2019) Arctos will start safety classes to train it's new members all about wearing the proper personal protection equipment for tasks, how to safely use all the tools and devices in the robotics room and additional safety and safe behaviour at FIRST events. Furthermore, these classes will be run by the current build lead and last year's build team and the safety captain.

8.2 SAFETY TESTS

Along with the safety classes, Arctos will also start giving out safety tests to both old and new members to make sure that they have read the safety manual or that they still remember all the proper safety precautions and procedures. The tests will be short with a maximum of ten questions, the passing grade for these tests will be 100% because even if you don't know the smallest of details that knowledge gap could lead to all sorts of dangerous behaviours. Additionally, test takers can take the test as many times as they want until they pass. But note that for those who have properly read through the safety manual the test will be a breeze.

8.3 SAFETY CONTRACT

Safety contracts are important for maintaining a safe working environment in the robotics room. Safety contracts also serve as a promise to the team, the safety captain and the team's mentor/co-captains that you will be responsible and take the proper safety precautions to prevent preventable injures. Furthermore, it's an assurance that you have read the safety manuals and that you will use all the knowledge that you have gained to protect your self and your other team mates from safety hazards and make sure the robotics room is as safe as possible.

Safety Test

Name:_____

1. What does SDS stand for?

   _____

2. Circle all the proper forms of PPE

   Gloves Hat Safety Glasses Hair Elastic Flip flops

3. The proper way to lift heavy objects, such as the robot, is to…
   a. Keep your arms extended so the object is away from your body at all times
   b. Keep one hand free at all times
   c. Keep your back slightly bent at all times
   d. Lift with your legs rather than your back

   _____

4. The substance found in batteries is…

   _____

5. Where can you find ear plugs?

   _____

6. What type of shoes should you wear in the robotics room?

   _____

7. How do you know if the robot is enabled?

   _____

8. Where can you fill out the injury report sheet?

   _____

Safety Contract

For the safety of other team members and myself I agree to:

- Read and practice all the safety regulations that have been taught to me and that are listed in both the annual game and the team's safety manual
- Act in a responsible manner at all times in the robotics room and at competitions
- Use the tools in the robotics room in a proper and careful manner
- Follow all the instructions that have been given to me by my mentor or safety captain
- Immediately report any unsafe condition or activity to my mentor or safety captain
- Learn where all the safety equipment (first aid kit, battery spill kit and fire extinguisher) is located in the robotics room
- Wear safety glasses at all times when in the robotics room or in the pits at events
- Tie back long hair, remove dangling jewelry, secure loose clothing, and wear shoes with closed toes before entering the robotics room or the pits
- Clean all work areas and put equipment away before the end of each meeting

Student Permission

I, _____, understand and agree to the safety contract and all the rules and regulations that have been listed above.

Student
Signature: _____ Date: _____

Arctos 6135 Safety

Injury Log

Date	Name	Injury	Cause	Treatment	Capt Signature

Corrective and Preventive Action Plan

Name	Description and Action	Initiated	Closed	Signature

8.4 END OF THE DAY CLEANING PLAN

Cleaning the robotics room at the end of the day is an important part of safety because it gets rid of all safety hazards in the room. Maintaining clean floors helps to precent slips and falls in the robotics room. Putting away tools and throwing away trash also helps to keep the robotics room clean and clutter free. Furthermore, a clean room means that it's easier to find tools and devices the next day.

9 EVENT SAFETY

When the team is away at events, it's very important that every member that is a part of Arctos acts in a safe and responsible manner. Although competitions are fun and exciting it's important for members to remember to stay alert for any safety hazards that could result in injuries or major emergency accidents in the pits, in the stands or back at the hotel if it's an overnight trip.

9.1 SAFETY CHECKLISTS

Safety checklists are an important part of maintaining safety at events. Safety checklists help to remind users to identify potential safety hazards and develop a well thought out procedure to handle them and ensure future safety.

9.2 STAND SAFETY

When you are in the stands it's important to always be mindful of your surroundings. Keep the aisles and stairs clear of tripping hazards such as bags, coats and food. Also, don't throw objects in the stands or onto the field.

9.3 LIFTING SAFETY

- Lift with your legs and keep your back straight
- Although gloves are not mandatory, always be careful of where you place your fingers as finger injuries are the most common type of injuries
- Make sure that the robot has been powered off and that all mechanical subsystems are brought down before lifting
- If you are lifting the robot onto a cart make sure that the cart is stable and in place before placing the robot down

9.4 PIT SAFETY

Team pit spaces are small, so it's always important that they are kept as clean and orderly as possible.

HERE IS A LIST OF SAFETY PRECAUTIONS THAT THE PIT CREW SHOULD ALWAYS BE AWARE ABOUT:

- Are stacked items at least 18" below sprinkler heads?
- Are stacks stable and secure against sliding and collapse?
- Are heavy or bulky items stored below shoulder level?
- Are floors free of slipping and tripping hazards?
- Are all light fixtures functional?
- Is the lighting sufficient for the detail of work performed?

- Are the power strips being used properly? No daisy chaining or overloading the power strip's capacity.
- Keep the aisle immediately outside the pit station clear for pedestrians and robot transit.
- Is everyone wearing approved personal protective equipment, PPE? This includes spectators.
- Are all team structures such as signs, banners, and displays below the 10 feet height limit?
- If you see a hazard in our pits or in another team's pit always alert them of it.

9.5 FIRE EVACUATION PLAN

Our fire evacuation plan consists of a map that shows all of the event building's exit points and a meeting place for our team in case of a fire or other emergencies in which we need to exit the building.

The fire evacuation plan will be given to you before we leave for the event by the team's safety captain. An additional copy will be posted on Ryver if the physical copy gets lost.

IN CASE OF A FIRE:

- Find the nearest exit from where you are
- Keep calm when exiting the building
- Travel with a partner if possible to the designated meet up point

9.6 HOTEL POLICY

When the team is staying overnight at a hotel, there are safety rules that all team members must follow.

- Don't go swimming in the pool
- Don't leave your hotel room after the set curfew
- Be respectful of the other hotel guests by not making too much noise
- When leaving the hotel always make sure that you have a buddy and that you have informed either a teacher or a mentor