Ergonomics

Repetitive Motion/Posture Injuries

DMME

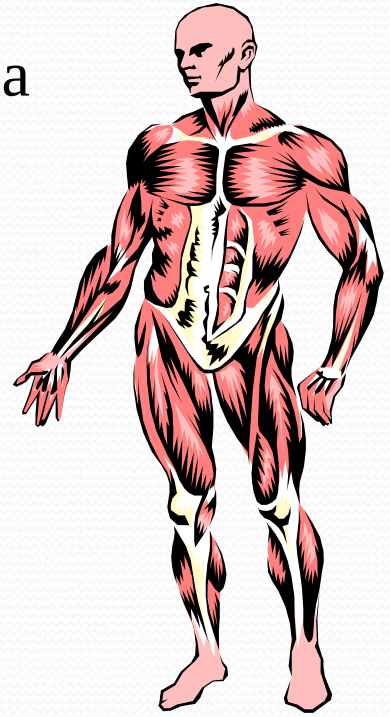
Division of Mineral Mining

2012

Work-related Musculoskeletal Disorders

They are cumulative (occur over time and not a result of a single incident):

- Often occur when the physical demands of work cause wear and tear.
- Involve soft tissues such as muscles, tendons, ligaments, joints, nerves, blood vessels.
- Older workers or those performing a job for an extended period of time are more at risk.



WMSD Risk Factors

(2004 NIOSH Study)

- Prolonged, awkward postures/positions.
- Forceful exertions (frequent heavy lifting).
- Forceful Gripping.
- Highly repetitive motions.
- Jolting/jarring.
- Vibration exposure.
- Contact Stress (impacts).
- The first step is to identify activities involving high levels of these risk factors, or a combination of these factors.

Risks and Activities

- Standing or sitting in the same position for long periods:
  - Mobile or stationary equipment operators.
  - Mechanics and welders standing on a concrete floor continuously.
- Awkward or confined positions for extended periods.
  - Welders
- Constant twisting, bending, or reaching:
  - Mobile equipment operators frequently looking to the rear.
  - Plant operators monitoring material flow or accessing controls.
  - Lifting, carrying, and stacking materials (this would include forceful exertion).
- Continued gripping of tools, controls, etc.
  - Excavator operators gripping joysticks.
  - Welders gripping the electrode holder.
- Constant motion or use of specific body parts; arms, hands, or fingers.
  - Welders
- Repeated bouncing, jarring, or vibration.
  - Mobile equipment operators.

Body Parts Most At Risk

(2004 NIOSH Study)

- Shoulders.
- Upper back.
- Neck.
- Knees.
- Others not shown in the study:
  - Wrist.
  - Hand.
  - Fingers.
  - Lower back.

Factors Associated With Back Disorders

Back disorders result from exceeding the capability of the muscles, tendons, or discs. Or, the cumulative effect of several contributors:

- **Reaching** while lifting
- **Twisting** while lifting
- **Bending** while lifting
- **Poor posture -- how one sits or stands**
- **Staying in one position for too long**
- **Bad body mechanics** -- how one lifts, pushes, pulls, or carries objects
- **Poor physical condition** -- losing the strength and endurance to perform physical tasks without strain
- **Poor design of job or work station**
- **Repetitive lifting of awkward items or equipment**
- **Heavy lifting**
- **Fatigue**

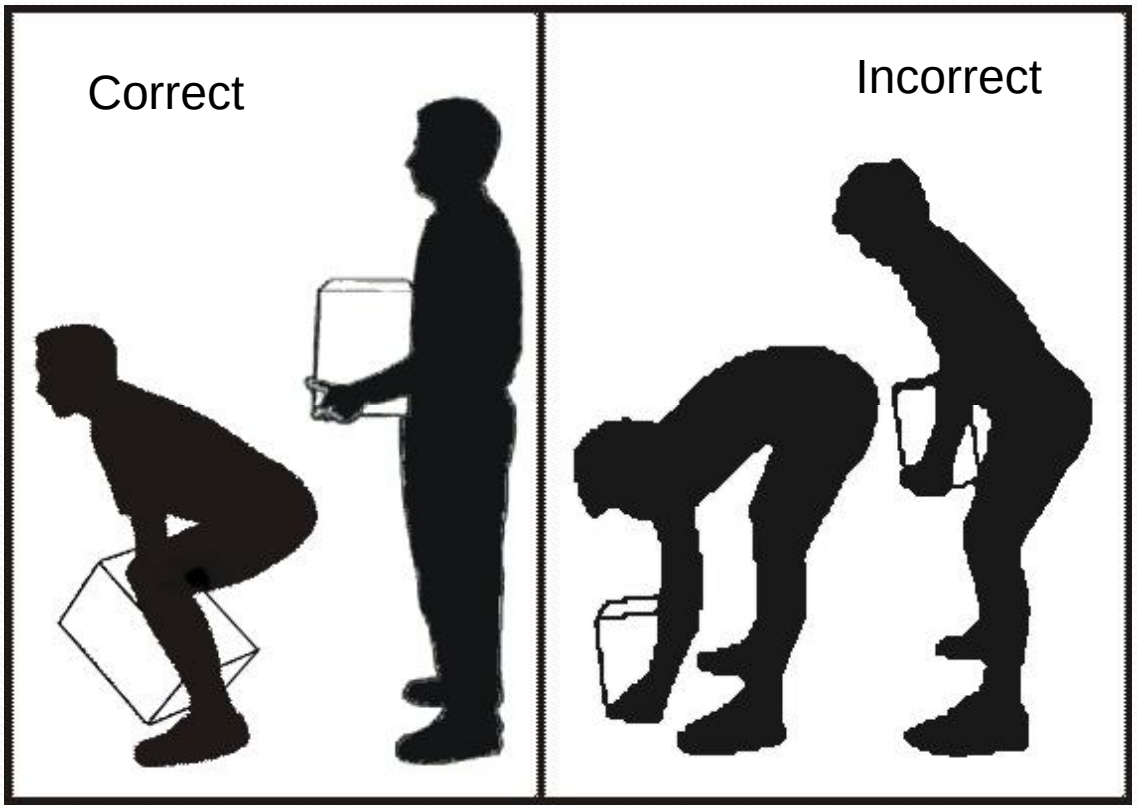
Proper Lifting

First:

- Test the weight
- Plan your route

Then:

- Take a wide stance
- Bend your knees
- Get close
- Get the best hold
- Stable position
- Tighten the stomach
- Use your legs
- Keep back straight
- Lift smoothly

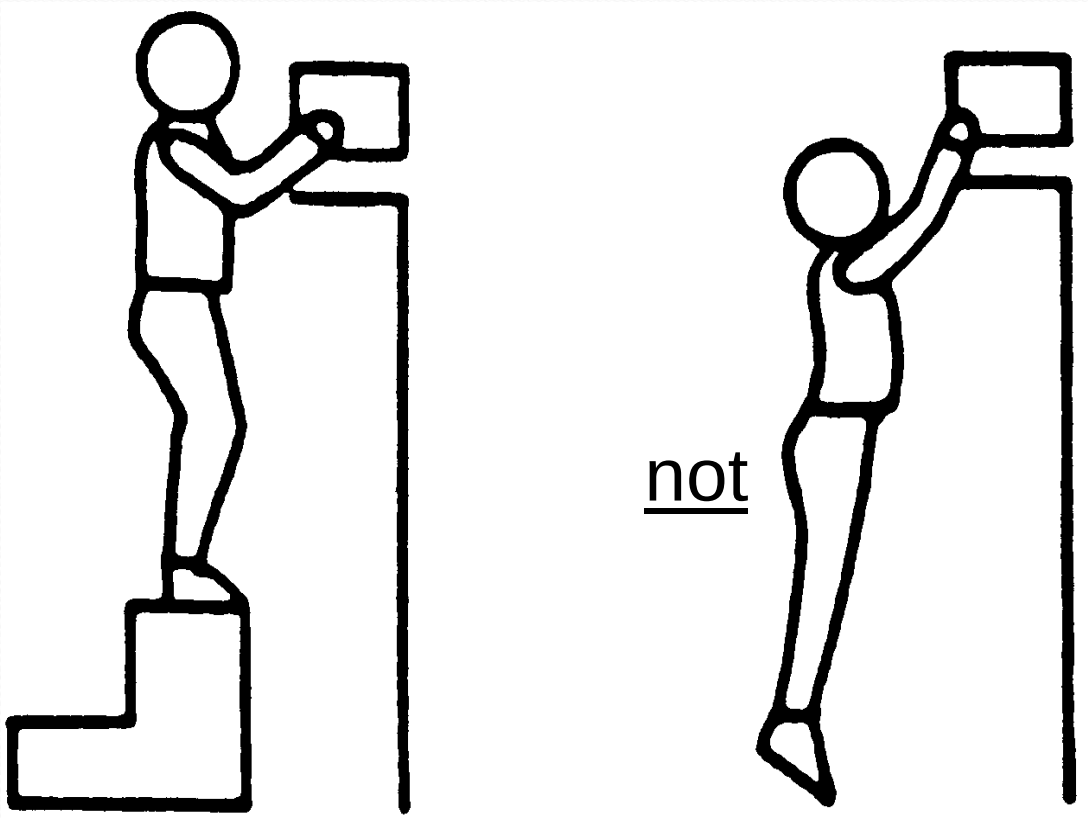


Avoid or Minimize:

- Bending and twisting
- Reaching out with the weight

Reaching Overhead

- Wide, sturdy base of support.
- Safe platform or step stool.
- Avoid lifting above shoulder height.
- Heaviest items should be stored at waist height.



Back Support Belts

- While they can be helpful, avoid:
  - Lifting more than you normally would. This puts you at greater risk for other injuries such as hernias, pulls and strains.
  - Prolonged use will actually weaken your back muscles making injury more likely. Bad ergonomics!!

WMSD Hazards For Welders

Welding also includes musculoskeletal disorders (WMSD) hazards such as:

awkward body postures,

lifting heavy equipment or materials,

static postures for prolonged periods,

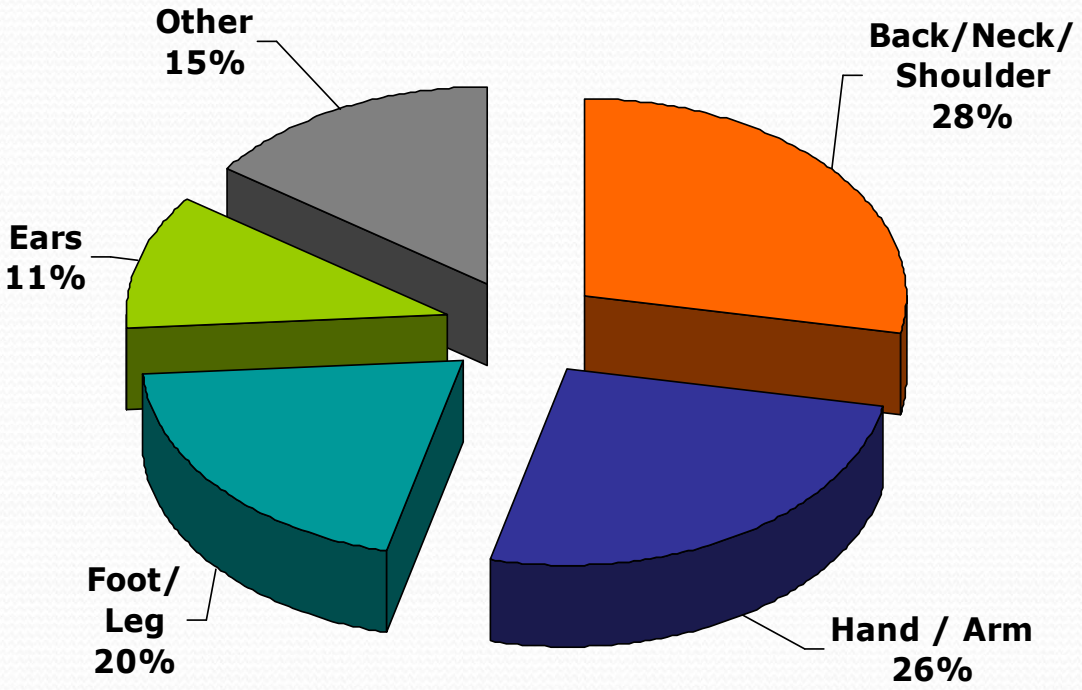
awkward postures of the wrist, hand, etc.

Washington State Injury Results 1994-2004
Welders & Cutters

By Body Part

The back, neck and shoulder together with the arm and hand regions make up more than one half of the injuries among welders.

Preventive efforts should therefore focus on those body parts among welders at your workplace.



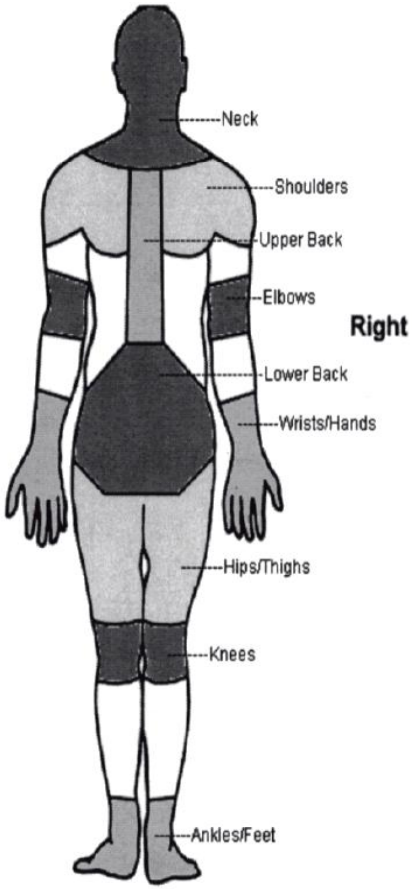
Welding is a strenuous occupation involving work in awkward postures and handling heavy equipment, usually with a high degree of sustained stress to arm and shoulders.

Common Disorders Among Welders

- Back injuries
- Shoulder pain/loss of range of motion
- Tendinitis/Bursitis
- Reduced muscle strength
- Carpal tunnel syndrome
- White finger
- Knee joint diseases

NIOSH Study - 2004

- Two underground and two surface mines were selected.
- Supervisors were given questionnaires and interviewed to identify jobs/activities in their areas that they thought contained the most risk factors.
- Employees were given questionnaires and then interviewed to identify activities with the most risk factors and body parts most effected. Two key questions asked in the interviews:
  - What are the most physically demanding aspects of this job?
  - What improvements would you like to see for this job?
- Results indentified the jobs and body parts most effected and recommendations were made for improvements.



Back View

To be answered by everyone	**To be answered by those who have had trouble**	
Have you at any time during **the last 12 months** had trouble (ache, pain, discomfort, numbness) in:	Have you at any time during the **last 12 months been prevented from doing your normal work** (at home or away from home) because of the trouble?	Have you had trouble at any time during **the last 7 days?**
Neck ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Shoulders ☐ No ☐ Yes, right shoulder ☐ Yes, left shoulder ☐ Yes, both shoulders	☐ No ☐ Yes	☐ No ☐ Yes
Elbows ☐ No ☐ Yes, right elbow ☐ Yes, left elbow ☐ Yes, both elbows	☐ No ☐ Yes	☐ No ☐ Yes
Wrists/Hands ☐ No ☐ Yes, right wrist/hand ☐ Yes, left wrist/hand ☐ Yes, both wrists/hands	☐ No ☐ Yes	☐ No ☐ Yes
Upper Back ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Lower Back (small of back) ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Hips/Thighs ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Knees ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Ankles/Feet ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

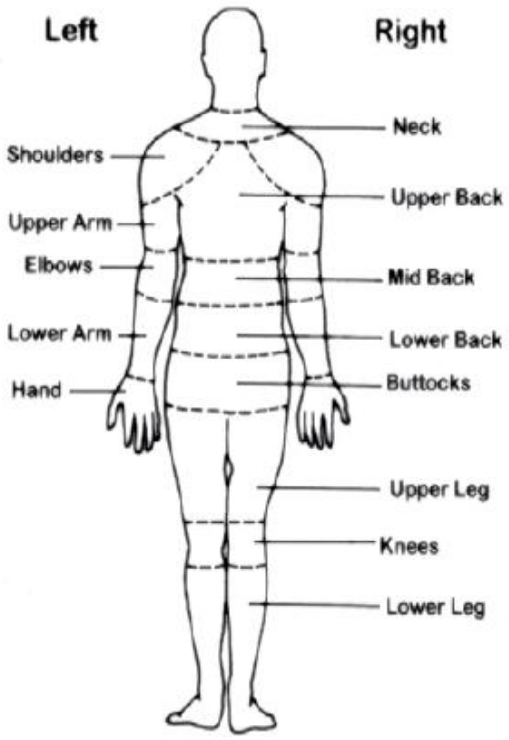
***Based on the Nordic Questionnaire**

Body Part Discomfort Interview

As a result of doing this job, have you experienced discomfort or pain **within the past year** in your:

Body Part	Freq.	Sev.	Related Work Activities	Comments (Describe Pain/Treatments)
Neck	1 2 3 4	1 2 3 4		
Shoulders	1 2 3 4	1 2 3 4		
Elbows	1 2 3 4	1 2 3 4		
Wrists	1 2 3 4	1 2 3 4		
Hands	1 2 3 4	1 2 3 4		
Upper Back	1 2 3 4	1 2 3 4		
Mid Back	1 2 3 4	1 2 3 4		
Lower Back	1 2 3 4	1 2 3 4		
Upper Legs	1 2 3 4	1 2 3 4		
Knees	1 2 3 4	1 2 3 4		
Lower Legs	1 2 3 4	1 2 3 4		
	1 2 3 4	1 2 3 4		
	1 2 3 4	1 2 3 4		

Please shade in area(s) of discomfort
(Indicate Front or Back when appropriate)



Back View

Frequency: (1) 1-2 Times/Year (2) 1-2Times/Month (3) 1-2 Times/Week (4) Every Day

Severity: (1) Mild pain or discomfort (2) Moderate pain with no reduction in activity (3) Severe pain with reduction in activity (4) Unbearable pain requiring time off work

Results/Recommendations

Table H–7.—Surface phosphate: dozer operation – moving material

Target task	Risk factors
Operating dozer (N=4) Dozers are used for pit preparation, assisting in pit setup, and prep work for pipelines.	Primary risk factors: • Repetitive control usage • Variable amounts of force required to operate controls • Whole-body v bration and jolting/jarring • Frequent twisting and turning of head and neck • Awkward seated postures
Part of the body affected: Discomfort surveys were used. All four workers reported neck and low back pain in which the pain severity was on average mild, but occurred weekly.	
Ideas for improvement • Proper standardized control handles should be used to reduce hand, arm, and shoulder stress. • Better mirror placement would eliminate some neck turning. • Additional training of mine workers to alert them of hazards of working around dozers and one-on-one training of dozer operators can minimize the hazards of working around dozers and relieve some of the stress experienced by dozer operators. • Replace or redesign the dozers to meet the following design issues: suspensions that result in less jolting, jarring, and bouncing, and equipped with better cutting blades.	

Table I–7.—Underground limestone: quality control technician – gathering and testing samples

Target task	Risk factors
Gathering samples (N=1) A sample is shoveled into a bucket at a stockpile and driven back to the lab. The sample is then carried down 13 steps to the lab.	Primary risk factors: • Forceful exertions with shoulders and back when shoveling • Concentrated pressure points to hand from a power grip on the bucket handle • Lifting and carrying heavy loads, 40- to 70-lb buckets • Asymmetric load handling when carrying one bucket • Ascending and descending steps while carrying loads • Ascending and descending steps with hand(s) occupied
Testing sample (N=1) A sample is split, weighed, and dried, shaken for 10 min, and weighed again. When testing is done, the sample is dumped back into the bucket.	Primary risk factors: • Twisting, turning, and bending while handling sample pans • Lifting loads above shoulders to dump • Pulling trays and lifting loads from below knuckle height • Dust in the lab when analyzing a sample
Part of the body affected: Discomfort surveys were used. One worker reported pain. Average to moderate pain: upper, mid, and lower back; knees; neck; shoulders; and upper legs.	
Ideas for improvement • Use a shovel/spade that will push more easily into the sampling pile. • Park the truck as close as possible to the sampling pile to reduce carrying distances and worker exposure to equipment traffic. • Attach a platform to the rear of the truck to place samples in instead of into the truck bed. • Use soft rubber padding around the bucket handle to reduce concentrated pressure to hand. • Use a bucket size that holds a maximum of 40 lb without overfilling. • When collecting a heavier sample, shovel into two buckets. When carrying two buckets, keep the weight balanced and a maximum of 35 lb per bucket. • If possible, place the lab at ground level. This would eliminate the need to go up and down stairs and would significantly reduce materials handling. • If a ground level lab is not poss ble, develop an electric winch or other conveyance system that would transport samples down to and up out of the lab. • A better lab layout would improve process flow and reduce handling and twisting. • When dumping or transferring samples, try to keep the pan at hip height and do not raise the elbow above shoulder. • Antifatigue mats could help reduce aches and pain to lower extremities and lower backs.	

Results From A Mining Company Study
(2005 with NIOSH)

- Problems identified:
  - Loader operator twisting neck and back to check behind the loader.
  - Crusher operator twisting and standing to monitor operation and reach controls.
  - Mechanic continually standing on a concrete floor.
- Actions taken:
  - Mirrors added to loader cab reducing the need to twist and look behind.
  - Crusher operator seat placed on a raised platform to increase visibility. Controls were moved for easier accessibility.
  - Anti-fatigue mats were placed in key areas of the shop. Different types of shoe insoles were experimented with.

Mining Company Report Card

RISK FACTOR REPORT CARD Name: _____

1. Work area: _____

2. Describe task: _____

_____

_____

3. Check all risk factors that apply:

- ☐ Poor Posture
- ☐ Repetitive Work
- ☐ Vibrating Tools
- ☐ Static Position
- ☐ Forceful Gripping
- ☐ Heavy Lifting/Carrying
- ☐ Bouncing/Jarring
- ☐ Heavy Shoveling

Other risk factors: _____

4. Place X on affected areas.

5. Comments/suggestions: _____

_____

_____

_____

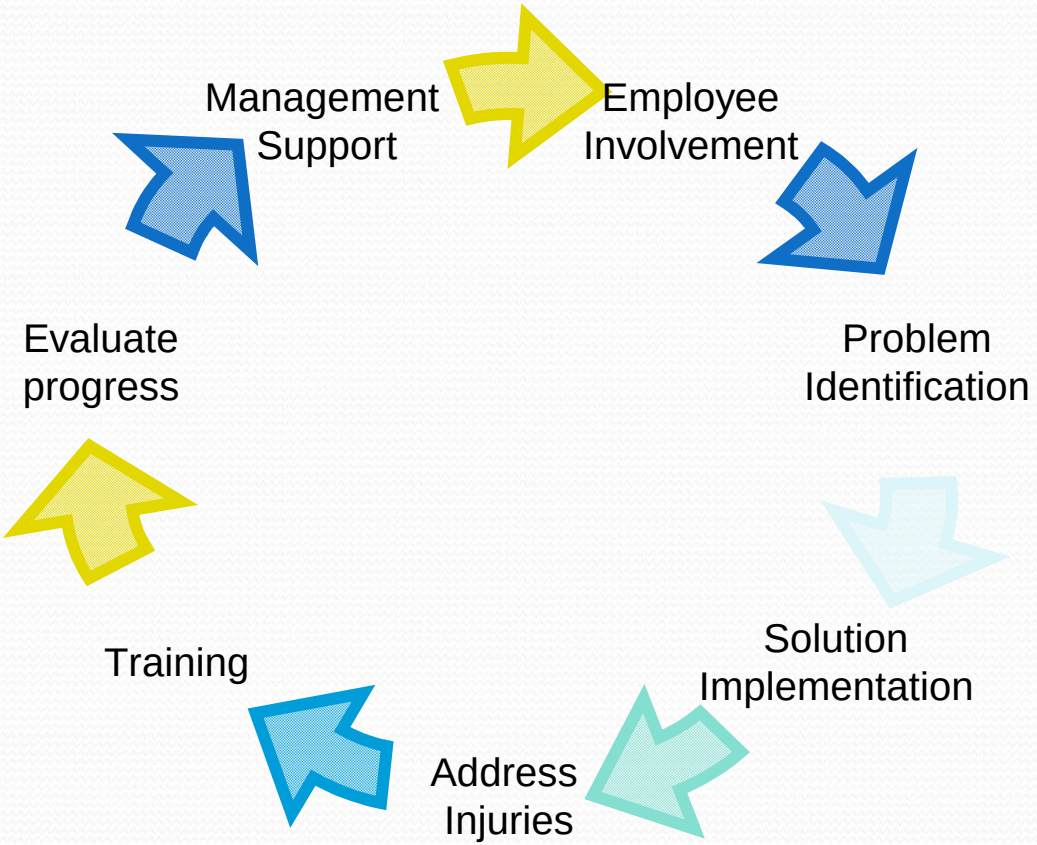
6. Plant/Mine Name: _____

Figure 1. Risk factor report card used by employees to identify risk factor exposures and body discomfort.

Similar to those used in the NIOSH study, given to all employees.

The Ergonomics Cycle

The ergonomics cycle provides an organized way to start your ergonomics improvement effort.



It Does Not Have To Be Time Consuming Or Expensive

- In many cases, changes in procedures/habits can be very effective:
  - Change positions frequently if possible, move around as often as possible. Stretch!
  - Better posture, sitting or standing. When standing, shift weight from one leg to the other.
  - Training or re-training in recommended procedures. Evaluate tasks and procedures for improvements.
- Minor changes in tools and equipment or work station design can cure the problem:
  - Installing mirrors or changing seat positions.
  - Moving or improving controls.
  - Installing foot rests or rails.
  - Shoes, gloves or other PPE changes.