

# HELEN JANE WING

## CURRICULUM VITAE

### CONTACT INFORMATION:

School of Life Sciences  
University of Nevada, Las Vegas  
4505 S. Maryland Pkwy  
Las Vegas, Nevada 89154-4004

**Telephone:** 702 895 5382 (office)  
702 895 3968 (lab)

**FAX:** 702 895 3956  
**Email:** helen.wing@unlv.edu

### EDUCATION:

1993-1997      Ph.D. University of Birmingham, UK. Prokaryotic transcription  
1990-1993      B.Sc. (Hons.) Nottingham University, UK: Biology, specializing in microbial genetics and molecular biology

### PROFESSIONAL EXPERIENCE:

July 2011-present    **Associate Professor**, School of Life Sciences, University of Nevada, Las Vegas.  
2005-2011          **Tenure-track Assistant Professor**, School of Life Sciences, University of Nevada, Las Vegas. **Date of hire:** January 2005.  
2000-2004          **Postdoctoral Research Associate**, Massachusetts General Hospital, Infectious Disease Division, Boston, MA  
1997-2000          **Postdoctoral Research Associate**, University of Birmingham, Edgbaston, UK & University of Sheffield, UK

### RESEARCH INTERESTS:

Mechanisms of Bacterial Pathogenesis, Bacterial Transcription and Gene Regulation, Protein Localization Studies, Anaerobiosis, Bacterial Motility and Chemotaxis, Outer Membrane Proteases, Bacterial Resistance to Cationic Antibacterial Peptides, Extra-host Survival of Bacterial Pathogens

### PROFESSIONAL SOCIETIES:

- Member of the Executive Committee of the Wind River Prokaryotic Meeting.
- Member of the American Society for Microbiology (ASM)
- Treasurer and Secretary of Arizona and Southern Nevada Branch of the ASM
- Chair of the 10<sup>th</sup> Boston Bacterial Meeting

### HONORS AND AWARDS:

2009            **UNLV CSUN Faculty Excellence award** (Student nominated)  
2008            **UNLV Merit Award** \$3,000 (last year merit applications solicited in NV)

2007 **UNLV Merit Award** \$2,000

2006 **UNLV Merit Award** \$1,000

2002-2004 **Postdoctoral Fellowship** from the Medical Foundation/ Charles H. Hood Foundation Boston, MA  
Title: "Regulation of the Shigella virulence factor IcsP"

2001-2002 **Postdoctoral Fellowship** from the Fund for Medical Discovery, Massachusetts General Hospital,  
Boston, MA Title: "Characterization of Shigella proteins required for bacterial spread"

1995 **Poster Prize** presented at the Biochemical Society's Wales and West Post-graduate meeting.

1995 **Chandler Poster Prize** awarded at "Graduate Research Day" within the School of Biochemistry,  
University of Birmingham, UK.

1993 **B.B.S.R.C. Post-Graduate Studentship** awarded to Prof. S. Busby, University of Birmingham

1993 **Graduated with Honors:** University of Nottingham

1992 **Wellcome Summer Research Fellowship**, awarded to Dr. R. E. Sockett, University of  
Nottingham, UK.

## FUNDING:

### Federal/Extramural Grants

#### Current:

1 R15 AI090573-01: (reviewed by Prokaryotic Cell Molecular Biology; **Impact Score: 11**)  
NIH: NIAID 07/01/10-06/30/13  
"Understanding transcriptional silencing & anti-silencing mechanisms in Shigella" (\$405,488)  
Role: PI

0649267

NSF- Research Experience for Undergraduates Regner (PI) 03/06/07-02/28/10  
"A broad view of Environmental Microbiology at UNLV" (\$254,637)  
This study provide 8 summer studentships for undergraduates to work with UNLV faculty in the field of  
environmental microbiology  
Role: Key Personnel

USDA-NIFA Elekonich (PI) 11/01/10-10/31/13  
"New treatments for American Foulbrood; using the microbe's biology against it" (\$335,417)  
Role: Co-PI  
Other Co-PIs: Drs. Abel-Santos, & Amy (UNLV faculty)

#### Complete:

0649267

NSF- Research Experience for Undergraduates Regner (PI) 03/06/07-02/28/10  
"A broad view of Environmental Microbiology at UNLV" (\$254,637)  
This study provide 8 summer studentships for undergraduates to work with UNLV faculty in the field of  
environmental microbiology  
Role: Key Personnel

0649267

NSF Supplement - Research Experience for Teachers Wing (PI) 06/06/08-02/28/10  
"A broad view of Environmental Microbiology at UNLV" (\$15,000 x 2)  
This supplement supports a high school teacher to work with Dr. Wing in the field of Environmental  
Microbiology  
Role: Mentor

0649267

NSF Supplement - Research Opportunity Award

Wing (PI)

06/06/09-02/28/10

“A broad view of Environmental Microbiology at UNLV” (\$17,500)

This supplement supports a professor from a tertiary college to work with Dr. Wing in the field of Environmental Microbiology

Role: Mentor

**Unfunded:**

1. National Institutes of Health: NIAID: R21 (\$275,000) (resubmission)

“Exploring the roles and regulation of the *Shigella* protease IcsP”

Role: PI

Consultants: James Huntley National Center for Genome Research, NM; Christian Ross, Bioinformaticist UNLV

2. NSF Undergraduate Research Mentoring Program

“URM Preliminary Proposal: Research and Mentoring in molecular cell Biology and Microbiology at UNLV”

Role: Co-PI; PI: Kurt Regner

3. National Institutes of Health: NIAID: R21 (\$275,000)

“Exploring the roles and regulation of the *Shigella* protease IcsP”

Role: PI

Consultants: James Huntley National Center for Genome Research, NM; Christian Ross, Bioinformaticist UNLV

4. Request for instrumentation: (\$79,122 )

Title: “Tissue culture instrumentation to further studies on gene expression in hibernators and assess *Shigella* virulence and primary defense mechanism in human cells.”

Department of Defense: Defense University Research Instrumentation Program (DURIP)

Role: PI

Co-Pi: Dr. van Breukelen

5. National Institutes of Health: NIAID: RFA: U01: International Collaboration in Inf. Dis. (\$2,519,378.00)

Title: “Novel therapies & strategies against Shigellosis”

Role: PI

Major Foreign Collaborator: Rubhana Raqib, International Center for Diarrheal Disease Research, Bangladesh (ICDDR,B)

Co-PI: Birgitta Agerberth, Karolinska Institutet

Collaborators: Marcia Goldberg, Massachusetts General Hospital, Gudmundur Gudmundsson, University of Iceland, Jan Andersson, Karolinska University Hospital, David Sack, ICDDR,B

**State/Local/Intramural Grants**

**Current:**

None

**Pending:**

2P20 RR 016464 – 05 (reviewed with **Impact Score 20**)

NIH/IDEA network of Biomedical Research Excellence (INBRE)

06/01/10-05/31/11

“Roles and regulation of a *Shigella* protease” (\$50,000)

This study investigates the roles and regulation of an outer membrane protease found in *Shigella*

Role: Target Faculty

**Complete:**

1. IDEA network of Biomedical Research Excellence (INBRE) target faculty in NV

06/01/08-5/31/10

“Roles and regulation of a *Shigella* protease” (\$270,000)

2. UNLV President's Research Award (partially funded \$6,000) 07/01/07-6/30/09  
"Support of graduate projects focusing on microbial interactions with plant and animal cells." (\$50,000)  
Role: PI  
Co-PIs: Ernesto Abel-Santos and Eduardo Robleto
3. New Investigator Award 06/01/06-05/31/08  
University of Nevada, Las Vegas (\$15,000)  
"Identification of additional roles of IcsP, a bacterial protease of the pathogen *Shigella flexneri*"  
This study demonstrated that IcsP does not protect *Shigella* from the action of cationic antimicrobial peptides  
Role: PI

#### Unfunded:

1. Institute for Security Studies: Summer Research Award  
"Measuring the survival of bioterrorism agents in water" (\$20,000)  
Role: PI; Co-investigators: Debbie Soukup and Brenda Buck
2. IDEA network of Biomedical Research Excellence (INBRE) target faculty in Nevada  
"Characterization of the roles and regulation of a family of bacterial proteases during growth and differentiation in the host environment" (\$270,000)
3. Department of Defense - EPSCoR  
"Assessment of health risks associated with *Shigella* contaminated water using molecular and cellular approaches" (\$698,665)  
Ranked: Second tier (118/180)
4. Nevada NASA Space Grant Program & NSHE Research Infrastructure Award  
"Planetary protection of Mars: infectious dose" (\$44,849)  
Role: Co-PI; PI: Henry Sun
5. Nevada EPSCoR White paper  
"Nevada Microbial Geoscience Research and Education (NMGRE)"  
Role: Team member; PI: Alison Murray; Co-PI: Dennis Bazyliniski

#### PUBLICATIONS:

- 1) Savery NJ, Rhodius VA, **Wing HJ**, Busby SJW. 1995. Transcription activation at *Escherichia coli* promoters dependent on the cyclic-AMP receptor protein – effects of binding sequences for the RNA polymerase alpha subunit. *Biochem. J.* 309: 77-83.
- 2) **Wing HJ**, Williams SM, Busby SJW. 1995. "Spacing requirements for transcription activation by *Escherichia coli* FNR protein." *J. Bacteriol.* 177: 6704-6710.
- 3) Savery N, Belyaeva T, **Wing H**, Busby S. 1996. Regulation of promoters by two transcription activators: Evidence for a 'simultaneous touching' model. *Biochem. Soc. Trans.* 24: 351-353.
- 4) Williams SM, Savery NJ, Busby SJW, **Wing HJ**. 1997 Transcription activation at Class I FNR-dependent promoters: identification of the activating surface of FNR and the corresponding contact site in the C-terminal domain of the RNA polymerase alpha subunit. *Nucl. Acid Res.* 25: 4028-4034.
- 5) Li B, **Wing H**, Lee D, Wu HC, Busby SJW. 1998. Transcription activation by *Escherichia coli* FNR protein: similarities to, and differences from, the CRP paradigm. *Nucl. Acid Res.* 26: 2075-2081.
- 6) Williams SM, **Wing HJ**, Busby SJW. 1998. Repression of transcription initiation by *Escherichia coli* FNR protein: repression by FNR can be simple. *FEMS Microbiol. Letts*, 163: 203-208.
- 7) **Wing HJ**, Green J, Guest JR, Busby SJW. 2000. Role of activating region 1 of *Escherichia coli* FNR protein in transcription activation at class II promoters. *J. Biol. Chem.* 275: 29061-29065.

- 8) Lee DJ, **Wing HJ**, Savery NJ, Busby SJW. 2000. Analysis of interactions between activating region 1 of *Escherichia coli* FNR protein and the C-terminal domain of the RNA polymerase alpha subunit: use of alanine scanning and suppression genetics. *Mol. Microbiol.* 37: 1032-1040.
- 9) Marshall FA, Messenger SL, Wyborn NR, Guest JR, **Wing H**, Busby SJW, Green J. 2001. A novel promoter architecture for microaerobic activation by the anaerobic transcription factor, FNR. *Mol. Microbiol.* 39: 747-753.
- 10) **Wing HJ**, Yan AW, Goldman SR and Goldberg MB. 2004. Regulation of IcsP, the outer membrane protease of the *Shigella* actin tail assembly protein IcsA, by virulence plasmid regulators VirF and VirB. *J. Bacteriol.* 186: 699-705.
- 11) **Wing HJ**, Goldman SR, Ally S, Goldberg MB. 2005. Modulation of an outer membrane protease contributes to the virulence defect of *Shigella flexneri* strains carrying a mutation in the *virK* locus. *Inf Immun.* 73:1217-1220.
- 12) Castellanos M, Harrison DJ, Smith JM, Labahn SK, Levy KM and **Wing HJ**. 2009. "VirB alleviates H-NS repression of the *icsP* promoter in *Shigella flexneri* from sites over 1 kb upstream of the transcription start site" *J. Bacteriol.* 191: 4047-4050
- 13) Hensley CT, Kamneva O, Levy KM, Labahn SK, Africa LAA and Wing HJ. 2010. Two promoters and two translation start sites control the expression of the *Shigella flexneri* outer membrane protease IcsP. *Arch. Microbiol.* 193: 263-274.
- 14) Africa, LA, Murphy ER, Egan, NR, Wigley AF and Wing HJ. The iron responsive Fur/RyhB regulatory cascade modulates the *Shigella* outer membrane protease IcsP. *Infect. and Immun.* (Accepted August 22<sup>nd</sup>)

## INVITED LECTURES AND INTERNATIONAL/NATIONAL SYMPOSIA PRESENTATIONS

- Invited Seminar at University of Louisiana, Lafayette. Hosted by Dr. Don Ennis. (January 21<sup>st</sup> 2010) "Roles and Regulation of a *Shigella* protease, IcsP"
- Invited Seminar at Touro University, Nevada. Hosted by Dr. Mahboob Qureshi. (February 3<sup>rd</sup> 2010) "Roles and Regulation of a *Shigella* protease, IcsP"
- Invited Seminar at University of Ohio. Hosted by Dr. Erin Murphy. (October 23<sup>rd</sup>, 2009) "Roles and Regulation of a *Shigella* protease, IcsP"
- Gordon Conference on Bacterial Pathogenesis and Toxins (2008)
- Wind River Conference on Prokaryotic Biology, Estes Park, CO (June 2008)
- Southern Utah University. Seminar in Department of Biology. Host: Charlotte Pedersen (Nov 2006)
- Invited Seminar in the Department of Veterinary Sciences & Microbiology, University of Arizona. Host: Stephen Billington (Oct 2006)
- Invited Seminar at Touro University, Nevada. Host: Dr. Mahboob Qureshi. (Sept 2005)
- Wind River Conference on Prokaryotic Biology, Estes Park, CO (June 2005)
- American Society for Microbiology Arizona./ Southern Nevada Branch Meeting, Tempeh, AZ (April 2005)
- Association of Pre-Health Professionals, UNLV (March 2005)
- University of Nevada, Las Vegas, NV (May 2004)
- University of New Hampshire, Durham, NH (March 2004)
- Gordon Conference on Bacterial Pathogenesis and Toxins (2002)
- Microbial Pathogenesis and Host Responses, Cold Spring Harbor (2003)
- 101<sup>st</sup> ASM General Meeting
- FASEB Microbial Pathogenesis (2002)

## TEACHING

### Course Development

**Microbiology (formerly Microbial Systems):** Survey of general microbiology including microbiological prokaryotic cell structure and function, genetics, ecology, and pathogenesis. Three hours lecture, three hours laboratory; class meets twice a week.

**Bacterial Pathogenesis:** This course addresses the molecular mechanisms by which bacterial pathogens cause disease. Basic principles of bacterial pathogenesis will be considered before a survey of bacterial pathogens and their specific virulence factors is conducted. This course includes aspects of bacterial genetics, physiology, immunology and the cell biology of host-parasite interactions. Three hours lecture, class meets twice a week.

**School of Life Sciences, UNLV (status, enrollment, average student evaluative GPA from 0 to 4)**

2010, Spring	BIOL 351: Microbiology (lecture, 97, 3.56) BIOL 492: Undergraduate Research: Nick Egan BIOL 493: Undergraduate Seminar "Current topics in Microbiology" (seminar, 2, N.D.) BIOL 796: Graduate Seminar "Current topics in Microbiology" (seminar, 4, N.D.)
2009, Fall	BIOL 464: Bacterial Pathogenesis (lecture, 87, 3.6) BIOL 664: Graduate Course: Bacterial Pathogenesis (lecture, N.D., 1) BIOL 492: Undergraduate Research: Nick Egan and David Basta
2009, Spring	BIOL 351: Microbiology (lecture, 3.5, 81) BIOL 492: Undergraduate Research: Lia Africa
2008, Fall	BIOL 464x: Bacterial Pathogenesis ( <b>NEW COURSE for NSHE</b> ) (lecture, 43, 3.65) BIO 730C: Graduate Problems in Biology: Bacterial Pathogenesis (lecture, 2, 4.0) BIOL 492: Undergraduate Research: Maria Castellanos
2008, Spring	BIOL 351: Microbiology (lecture, 69, 3.64) BIO 730C: Graduate Problems in Biology: Bacterial Pathogenesis (lecture, 4, 4.0) BIOL 492: Undergraduate Research: William Ingersoll and Karen Levy
2007, Fall	BIOL 464x: Bacterial Pathogenesis ( <b>NEW COURSE for NSHE</b> ) (lecture, 32, 3.54) BIO 730C: Graduate Problems in Biology: Bacterial Pathogenesis (lecture, 4, 4.0) BIOL 492: Undergraduate Research: William Ingersoll and Karen Levy
2007, Spring	BIOL 493: Undergraduate Seminar "Current topics in Microbiology" (seminar, 4, N.D.) BIOL 492: Undergraduate Research: Tara Sutherland BIO 796: Graduate Seminar "Current topics in Microbiology" (seminar, 6, N.D.)
2006, Fall	BIOL 464x: Bacterial Pathogenesis ( <b>NEW COURSE for NSHE</b> ) (lecture, 32, 3.54) BIO 730C: Graduate Problems in Biology: Bacterial Pathogenesis (lecture, 4, 4.0) BIOL 492: Undergraduate Research: Ashley Connell
2006, Spring	BIOL 351X: Microbial Systems ( <b>NEW COURSE for NHSE</b> ) (lecture, 45, 2.82) BIOL 492: Undergraduate Research: Tim Struve
2005, Fall	BIOL 493: Undergraduate Seminar "Current topics in Microbiology" (seminar, 4, 4.0) BIOL 492: Undergraduate Research: Noam Moas BIO 796: Graduate Seminar "Current topics in Microbiology" (Seminar, 6, 4.0)
2005, Summer	BIO 492: Undergraduate Research: Lisa Locaynia and Julius de Leon

**TRAINEES:****Graduate Students Mentored:**

Darla deStephanis (joins Fall 2010)  
 Krystle Pew (M.S. in progress)  
 Christopher Hensley (M.S. in progress)  
 Sara M. Kienzle (M.A.S. in progress)  
 Lt. Dustin Harrison (Ph.D. graduated 2010)  
 Eun-Hae Kim (M.S. graduated 2008)  
 Bilal Zaatiti (Ph.D. Left program)

**Other Graduate Student Committee Memberships:**

Adelbert Villosio (M.S. School of Life Sciences, UNLV in progress)  
 Israel Alvarado (Ph.D. School of Life Sciences, UNLV in progress)  
 John Perry (Ph.D. School of Life Sciences, UNLV in progress)  
 Hyelee Lee (M.S. School of Chemistry, UNLV in progress)  
 Patricia Ringler (Ph.D. School of Life Sciences, UNLV in progress)  
 Mohammed Abdul Ata-Ur Rahman (Ph.D. School of Chemistry, UNLV in progress)  
 Holly Martin (M.S. School of Life Sciences, graduated 2010)  
 Andy Phui (M.S. Department of Chemistry, graduated 2010)  
 Randy Boyles (Ph.D. School of Life Sciences, graduated 2010)  
 Nicole Bond (Ph.D. School of Life Sciences, graduated 2010)  
 Caitlin Murphy (M.S. School of Life Sciences, graduated 2009)  
 Tom Welch (Internship, School of Public Health, graduated 2009)  
 Zadkiel Alvarez (M.S. Department of Chemistry, graduated 2009)  
 Linh Nguyen (Ph.D. School of Life Sciences, graduated 2009)  
 Katila Varivarn (M.S. School of Life Sciences, graduated 2009)  
 Vanja Velickovska (M.S. School of Life Sciences, graduated 2008)  
 Robin Miller (M.S. School of Life Sciences, graduated 2008)  
 Rowena Manalang (M.S. School of Life Sciences, UNLV left the program)  
 Ryan MacDonald (Ph.D. School of Life Sciences, UNLV left program)  
 Yasmin Younas (Ph.D. School of Life Sciences, UNLV left program)

**Undergraduate Students:**

Lisa Locaynia\*, Julius de Leon<sup>></sup>, Noam Moas, Tim Struve, Meghann Ditsworth, Aerial Carlson, Young Park, Ashley Connell\*, Jennifer Smith♦, Tara Sutherland\*, William Ingersoll, Karen Levy\$, Maria Castellanos\*, David Basta\*, Lia Africa\*, Amanda Yates♦, Monique Gomez♦, Nick Egan, Nateira Magnuson, Juan Duhart\*

\* Recipient of Summer INBRE Undergraduate Fellowship; <sup>></sup> Recipient of Center for Math and Science Education EPSCoR Undergraduate Research Award; ♦Recipient of NSF "Research Experience for Undergraduates" (REU) fellowship; \$ Recipient of National Goldwater Scholarship

**SERVICE****Profession:**

2010 **NSF Panelist** (reviewed 15 grants for Molecular and Cellular Biosciences)  
 2010 **Chair** of organizing committee of Annual meeting of AZ/NV ASM branch in Las Vegas, NV  
 2006 – to date **Treasurer/Secretary**, AZ/Southern NV branch of ASM  
 2009 - to date **Member of Executive committee for the Wind River Conference on Prokaryotic Biology**  
 2009 **Reviewer of manuscript** for FEBS journal  
 2009 **Judge**, Graduate Research Talks and Posters at the Wind River Conference on Prokaryotic Biology, CO

- 2006 **Co-organizer**, Annual meeting of AZ/NV ASM branch in Las Vegas, NV
- 2006 **Judge**, Graduate Research Talks and Posters at the Wind River Conference on Prokaryotic Biology, CO
- 2005 **Ad hoc reviewer** of NSF grant
- 2005 **Session Chair** at Wind River Conference on Prokaryotic Biology, Estes Park, CO
- 2005 **Judge**, Undergraduate & Graduate Research Talks at Arizona/Southern Nevada Branch Meeting
- 2003 **Chair**, 10th Boston Bacterial Meeting
- 2002 **Fundraiser**, 9th Boston Bacterial Meeting

**System:**

- 2009 **Hosted Prof. Robin Herlands research project** in Summer. Project sponsored by the NSF
- 2009 **Mentored Clark County High School Teacher** in Summer. Project sponsored by the NSF
- 2008 **Mentored Clark County High School Teacher** in Summer. Project sponsored by the NSF
- 2006 **Petitioned Colleges in the Nevada System Higher Education** to introduce the new microbiology course Biol 351X
- 2005 - to date **Adjunct Assistant Professor** at Touro University, Henderson, NV
- 2006 – to date **McNair Program Faculty Mentor** for Undergraduate Projects
- 2005 - to date **INBRE Faculty Mentor** for Undergraduate Projects
- 2005 - to date **EPSCoR Faculty Mentor** for Undergraduate Projects

**University:**

- 2008 Attended Graduate & Professional Student Association Meeting
- 2008 **New Graduate Course** approved Biol 664
- 2006 **Interview** with Erin O'Donnell, UNLV magazine
- 2005 **Ad hoc reviewer** of UNLV SITE proposals

**College:**

- 2010 **Interviewed** by the NWCCU accreditation agency
- 2008 **Presented poster** at NevBIO's Award Ceremony (Harry Reid present)
- 2008 **Attended seminars** during the COS Dean Search
- 2006 **Coordinator**, Science and Engineering Building, UNLV proposal
- 2005 **Presenter**, Association of PreHealth Professionals at UNLV

**School:**

- 2005-to date **Graduate Operations Committee**. Monitored all graduate students' progress through the graduate program. Co-revised Graduate Handbook and Catalog
- 2006-2008 **Personnel Committee**. Co-revised new bylaws for the School of Life Sciences
- 2006 **Judge**, Undergraduate and Graduate talks at BIOS Symposium
- 2006 **Microbiology Search Committee**. Resulted in the hiring of Dr. Dennis Bazyliiski
- 2005-to date **Ad hoc committee** for autoclave maintenance and safety training

**Unit:**

- 2005- to date **Maintenance of the Microbiology group website**  
([www.unlv.edu/faculty/hjwing/microbiology.htm](http://www.unlv.edu/faculty/hjwing/microbiology.htm))
- 2005 **Member**, Ad hoc Committee Member for Integrated Cell Biology and Microbiology Graduate Program Reform
- 2005 **Member**, Ad hoc Committee for Undergraduate Microbiology Curriculum reform
- 2005 - to date **Host**, 7 School Seminar Speakers: Dr. Gudmundur Gudmundsson, Dr. Lawrence Goodridge and Dr. Carolyn Hovde-Bohach, Dr. Doug Crabb, Dr. Marty Roop, Dr. Erin Murphy and Dr. George Munson

**Community:**

- 2010 **Invited Speaker** at the Mathematics Integrated with Science using Technology (MIST) Summer Institute “Living with Radiation”. Clark County School District
- 2008 **Invited Speaker** at the Middle School Teachers Summer Workshop on “Infectious Disease”. Clark County School District
- 2005 **Television Interview** for Channel 13 News-Expert on Bacterial Pathogenesis. Story concerned bacterial contamination on shopping cart trolleys