Summary of research findings on six key benefit areas of garden-based learning for children, youth, adults, and families:

1. Nutrition Awareness
2. Environmental Awareness
3. Learning Achievements
4. Life Skills
5. Health and Wellness
6. Community Building and Social Connections

Nutrition Awareness

*Gardening improves opportunities for children, youth, adults and families to gain interest and eat fruits and vegetables.*

Results from this study of middle school-aged students indicate that school gardening may affect children’s vegetable consumption, including improved recognition of, attitudes toward, preferences for, and willingness to taste vegetables. Gardening also increases the variety of vegetables eaten. (Ratcliffe, M.M., et al. (2011) *The Effects of School Garden Experiences on Middle School-Aged Students’ Knowledge, Attitudes, and Behaviors Associated with Vegetable Consumption.* Health Promotion Practice 12.1: 36-43.)

The article reports that school gardens can positively impact children’s food choices by improving their preferences for vegetables and increasing their nutrition knowledge. (Graham, H. et al. (2005) *Use of School Gardens in Academic Instruction.* Journal of Nutrition Education and Behavior. 37: 3: 147-151.)

A study in Tucson, AZ showed that children who participated in the garden learned to like healthy foods. The vegetables that the children grew had a high intrinsic value. (Cavaliere, D. (1987). *How Zucchini Won Fifth-Grade Hearts.* Children Today, 16(3), 18-21.)

After gardening children have shown more positive attitudes toward fruit and vegetable snacks and an improvement in vegetable preference scores. (Lineberger, S. (1999). *The Effect of School Gardens on Children’s Attitudes and Related Behaviors Regarding Fruits and Vegetables.* Thesis, Texas A&M University.)

This study reports that the adolescents who participated in the garden-based nutrition intervention increased their servings of fruits and vegetables more than students in the two other groups. Although further research is needed, the results of this study seem to indicate the efficacy of using garden-based nutrition education to increase adolescents’ consumption of fruits and vegetables. (McAleese, J. D. & L. L. Ranklin. (2007). *Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents.* Journal of the American Dietetic Association, 107:662-665.)

This study assessed school teachers’ perceived attitudes and barriers associated with school gardens, as well as the purpose and use of gardens in schools, specifically in relation to the link
between gardens and nutrition. Results indicate that the teachers perceived the garden to be somewhat to very effective at enhancing academic performance, physical activity, language arts, and healthful eating habits. This research provides evidence for needed standards-based curricula materials and teacher training in relation to gardening and nutrition. (Graham, H. & S. Zidenberg-Cherr. (2005). *California teachers perceive school gardens as an effective nutritional tool to promote healthful eating habits*. Journal of the American Dietetic Association, 105:1797-1800.)

In a project that involved integrating nutrition and gardening among children in grades one through four, the outcomes have gone well beyond an understanding of good nutrition and the origin of fresh food, to include enhancing the quality and meaningfulness of learning. (Canaris, Irene. (1995). *Growing Foods for Growing Minds: Integrating Gardening and Nutrition Education into the Total Curriculum*. Children’s Environments, 12(2): 264-270.)

Two programs, a standard nutrition program titled Professor Popcorn (PP) and a gardening and nutrition program using lessons from the Junior Master Gardener: Health and Nutrition from the Garden were compared to investigate their influence on nutrition knowledge improving fruit and vegetable preference, and improving self-efficacy in gardening and eating fruit and vegetables in an out-of-school setting. There was a change in gardening self-efficacy for the summer JMG group compared with that of the fall JMG group. Gardening self-efficacy of the summer JMP group increased whereas that of the fall JMG group decreased. (Poston, S. A. et al. (2005). *A Comparison of a Gardening and Nutrition Program with a Standard Nutrition Program in an Out-of-school Setting*. HortTechnology. 15(3), pages 463-467.)

An eight-lesson gardening and nutrition curriculum with a hands-on gardening emphasis was taught as an after-school program to determine the effect it had on increasing children’s nutrition knowledge, fruit and vegetable preference, and improving children’s self-efficacy and outcome expectations for gardening and for consuming fruit and vegetables. Seventeen fourth grade students participated in the experimental group as part of an after-school gardening club, and 21 fourth grade students served as the control group. At baseline, measurements of gardening self-efficacy and outcome expectations were significantly different between the groups. The experimental group was able to maintain high self-efficacy and outcome expectations scores during the program, but the control group’s scores increased significantly for gardening self-efficacy and outcome expectations at the end-program assessment. Further research to clarify aspects of gardening that have the greatest impact on influencing preference, self-efficacy and outcome expectations is needed. (O’Brien, S. A. et al. (2006). *An After-school Gardening Club to Promote Fruit and Vegetable Consumption among Fourth Grade Students: The Assessment of Social Cognitive Theory Constructs*. HortTechnology. 16(1), pages 24-29.)

After participating in the nutritional program, children’s knowledge about the benefits of eating fruit and vegetables significantly improved, but there were no significant differences found in participants’ attitude scores toward fruit and vegetables. However, the participants did report eating healthier snacks after participation in the nutritional program. (Koch, S., Waliczek, T.M., and Zajicek, J.M. (2006). *The Effect of a Summer Garden Program on the Nutritional Knowledge, Attitudes, and Behaviors of Children*. HortTechnology. 16(4), pages 620-624.)
This study highlights the advantages of solar cookers and gardens to nutrition, health, and the environment. Study results indicate that growing their own vegetables encouraged adults and children to try new foods, which in turn improved their eating habits. Free seeds were distributed for container gardens, which motivated new and experienced gardeners to make gardens. Both rural and urban participants gained enthusiasm for the fresh, flavorful, nutritious, and economical vegetables they grew, and for the varied foods they cooked in solar cookers. They realized that gardening helped to improve their nutrition, health, family, economics and the environment. (Dow, R. M. & C.R. Dow. (1999). Using solar cookers and gardens to improve health in urban and rural areas. Alfatil International, Inc. 99: 9).

This study measured food security and hunger of households in a rural Appalachian county and assessed factors that could affect food security and hunger. Hunger was related to a variety of household characteristics including participation in food banks, dependence on family members and friends outside of the household for food, lacking reliable transportation, and not having a garden. (Holben, D.H. et al. (2004). Food Security Status of Households in Appalachian Ohio with Children in Head Start. Journal of the American Dietetic Association. 104: 238-241.)

Being a single parent, lack of savings, larger household size, having unexpected expenses, adding $50 or more to food stamps to purchase sufficient food, and having low food expenditures were variables linked to food insecurity. The variables contributing to low levels of household food supplies were low educational level, low food expenditures and not vegetable gardening. (Olson, Christine M., Barbara S. Rauschenbach, Edward A. Frongillo, Jr. and Anne Kendall (1996). Factors Contributing to Household Food Insecurity in a Rural Upstate New York County. Institute for Research on Poverty Discussion Paper no. 1107-96.)

The rural low-income sample was significantly more likely to give food to family, friends, and neighbors and obtain food such as fish, meat, and garden produce from friends and family compared to the urban low-income group. Further, 58% of the low-income rural group had access to garden produce while only 23% of the low-income urban group reported access. In a rural random sample of the whole population access to garden produce increased chances of attaining recommended vegetable and fruit servings controlling for income, education, and age. Access to a garden also significantly increased the variety of fruits and vegetables in diets. (Wright M. et al. (2008). Accessing food resources: Rural and urban patterns of giving and getting food. Agriculture and Human Values. Volume 25, Number 1.)

This study examined the life-course experiences and events associated with current fruit and vegetable consumption in 3 ethnic groups. Results showed that black, Hispanic and white respondents differed fruit and vegetable consumption. Among white respondents, having a garden as an adult was positively associated with fruit and vegetable consumption. An understanding of the determinants of food choice in different subcultural groups can be used to design nutrition interventions. Experiences such as eating fresh-picked fruits and vegetables while growing up or vegetable gardening as an adult may enhance the fruit and vegetable consumption among members of some ethnic groups. (Devine, C. M. et al. (1999). Life-course events and experiences: Association with fruit and vegetable consumption in 3 ethnic groups. Journal of the American Dietetic Association. 99: 309-314)
This study found that neighborhood aesthetics, social involvement, and community garden participation were significantly associated with fruit and vegetable intake. Community gardeners consumed fruits and vegetables 5.7 times per day, compared with home gardeners and non-gardeners (3.9 times per day). Moreover, 56% of community gardeners met national recommendations to consume fruits and vegetables at least 5 times per day, compared with 37% of home gardeners and 25% of non-gardeners. (Litt, J. S. et al. (2011). The Influence of Social Involvement, Neighborhood Aesthetics, and Community Garden Participation on Fruit and Vegetable Consumption. American Journal of Public Health, Vol. 101, No. 8, pp. 1466-1473.)

The purpose of this study was to identify whether or not there are associations between frequency of eating homegrown produce among rural parents and their preschool children and overall intake in eight rural Southeast Missouri counties. Frequency of eating homegrown fruits and vegetables promoted a positive home environment with increased availability of produce, preschooler’s preference for them, and parental role modeling. (Nanney, M.S., et al. Frequency of Eating Homegrown Produce Is Associated with Higher Intake among Parents and Their Preschool-Aged Children in Rural Missouri. Journal of the American Dietetic Association (2007) 107.4: 577-584.)

This is a systematic review summarizing evidence on environmental influences on fruit and vegetable (FV) consumption among adults (18–60 years old). Findings showed there was a great diversity in the environmental factors studied, but that the number of replicated studies for each determinant was limited. Most evidence was found for household income, as people with lower household incomes consistently had a lower FV consumption. Married people had higher intakes than those who were single, whereas having children showed mixed results. Good local availability (e.g. access to one’s own vegetable garden, having low food insecurity) seemed to exert a positive influence on intake. Improved opportunities for sufficient FV consumption among low-income households are likely to lead to improved intakes. Carlijn, B. M. et al. Environmental determinants of fruit and vegetable consumption among adults: a systematic review. British Journal of Nutrition (2006) 96: 620-635.

Environmental Awareness


“Gardens are often the most accessible places for children to learn about nature’s beauty, interconnections, power, fragility, and solace.” (Heffernan, M. (1994). The Children’s Garden Project at River Farm. Children’s Environments. 11(3): 221-231.)

Both passive and active interactions with plants during childhood are associated with positive adult values about trees. However the strongest influence came from active gardening, such as picking flowers or planting trees as a child. (Lohr, V.I. & Pearson-Mims, C.H. (2005). Children’s Active and Passive Interactions with Plants Influence Their Attitudes and Actions toward Trees and Gardening as Adults. HortTechnology. 15(3): 472-476.)
Gardening has been shown to increase scores on environmental attitude surveys of elementary school children. (Skelly, S. & J. Zajicek. (1998). The Effect of an Interdisciplinary Garden Program on the Environmental Attitudes of Elementary School Students. Hort Technology, 8(4): 579-583.)

**Learning Achievements**


Several variables may have affected the outcome of the study, but the results show once weekly use of gardening activities and hands-on classroom activities help improve science achievement test scores. (Smith, L. L., and Motsenbocker, C. E. (2005). Impact of Hands-on Science through School Gardening in Louisiana Public Elementary Schools, HortTechnology. 15(3), pages 439-443)

The purpose of this study was to develop three cognitive test instruments for assessing science achievement gain of third, fourth, and fifth grad students using a garden curriculum. The development of the test instruments occurred in three phases: 1) an initial set of test instruments which served as a prototype for length, scope, and format; 2) an adapted set of test instruments which were piloted; and 3) a final set of test instruments which were used for the assessment of the school gardening curriculum. (Klemmer, C.D., Waliczek, T.M., and Zajicek, J.M. (2005). Development of a Science Achievement Evaluation Instrument for a School Garden. HortTechnology. 15(3), pages 433-438.)

**Life Skills**

A 2010 study by Farming Concrete (www.farmingconcrete.org) measured total vegetable yields and produce value from 110 gardeners in 67 community gardens in New York City. These 110 gardeners, collectively only using a total of 1.7 acres, grew 87,700 pounds of produce worth more than $200,000. This means the average community gardener in the study got produce valued at $1,818 out of their plot. Farming Concrete. (2010 Harvest Report).


Students in a one-year school gardening program increased their overall life skills by 1.5 points compared to a group of students that did not participate in the school gardening program. The gardening program positively influenced two constructs: “working with groups” and “self-understanding.” (Robinson, C.W. & Zajicek, J.M. (2005). Growing Minds: The Effects of a One-year School Garden Program on Six Constructs of Life Skills of Elementary School Children. HortTechnology. 15(3): 453-457.)

As early as 1909, Montessori had identified several benefits to children’s gardens: enhances moral education, increases appreciation for nature, increases responsibility, develops patience, and increases in relationship skills. (Montessori, M. (1964). The Montessori Method. Schocken.)


Studies have shown that fifth, sixth, and seventh grade students developed better interpersonal relationship skills after participating in a garden program. (Waliczek, T. & J. Zajicek. (1998). The Effect of a School Garden Program on Self-Esteem and Interpersonal Relationships of Children and Adolescents. Hort Technology (submitted).

Since 2002, a variety of methods has been employed to train teachers and administrators in using gardens, and this has resulted in establishment of successful gardening programs. Southern Nevada has experienced a 400% population increase in 25 years. Results of surveys of area stakeholders between 2000 and 2002, Clark County elementary school staff in 2001, and Clark County school principals in 2004, indicate a desire to incorporate gardens in schools, but concerns about establishing and maintaining them persist. When offered training in use of gardens, however, a majority of principals surveyed responded positively. They also expressed interest in tracking the educational and social impacts of gardens on students and faculty. (O’Callaghan, A. M. (2005). Creating a School Gardens Program in the Challenging Environment of Las Vegas, Nevada. HortTechnology. 15(3), pages 429-433.)

Health and Wellness

Gardeners directly experience nearby nature by ‘getting their hands dirty’ and growing food. They enjoy the way vegetables taste and form emotional connections with the garden. The physical and social qualities of garden participation awaken the senses and stimulate a range of responses that influence interpersonal processes (learning, affirming, expressive experiences) and social relationships that are supportive of positive health-related behaviors and overall health. This research suggests that the relational nature of aesthetics, defined as the most
fundamental connection between people and place, can help guide community designers and health planners when designing environment and policy approaches to improve health behaviors. (James H., et al. (2011) Connecting food environments and health through the relational nature of aesthetics: Gaining insight through the community gardening experience. Social Science Medicine, 72: 11: 1853-1863.)


This study reports that consumption of fruits and vegetables, as a habit in childhood, is an important predictor of higher fruit and vegetable consumption as adults and can help to prevent or delay chronic disease conditions. (Heimendinger, J. & M. Van Duyn. (1995). Dietary behavior change: the challenge of recasting the role of fruit and vegetables in the American diet. American Journal of Clinical Nutrition, 61:1397S-1401.)

Beneficial bacterium in soil makes us happier. This study discusses a strain of bacterium in soil, Mycobacterium vaccae, that has been found to trigger the release of serotonin, which elevates mood and decreases anxiety. This bacterium has also been found to improve cognitive function. (Lowry C.A., et al. (2011). Identification of an immune-responsive mesolimbocortical serotonergic system: potential role in regulation of emotional behavior. Neuroscience 146.2: 756–772.

Gardening promotes relief from acute stress. Stress-relieving effects of gardening were hypothesized and tested in a field experiment. Thirty gardeners performed a stressful task and were then randomly assigned to 30 minutes of outdoor gardening in their own plot or indoor reading. Gardening and reading each led to decreases in cortisol during the recovery period, but decreases were significantly stronger in the gardening group. Positive mood was fully restored after gardening, but further deteriorated during reading. These findings provide the first experimental evidence that gardening can promote relief from acute stress. (Van Den Berg, Agnes and Custers, Mariëtte H.G. (2011). Gardening Promotes Neuroendocrine and Affective Restoration from Stress. Journal of Health Psychology 16.1: 3-11.)

Greenery makes life more manageable. In a study conducted in a Chicago public housing development, women who lived in apartment buildings with trees and greenery immediately outside reported greater effectiveness and less procrastination in dealing with their major life issues than those living in barren but otherwise identical buildings. In addition, the women in greener surroundings found their problems to be less difficult and of shorter duration. Exposure to green surroundings refreshes the ability to concentrate, leading to greater effectiveness at coping with major life issues. And, in this study, even small amounts of greenery—a few trees and a patch of grass—helped inner city residents to feel and do better. (Kuo, F.E. (2001). Coping with poverty: Impacts of environment and attention in the inner city. Environment & Behavior 33.1: 5-34.)
Community gardening has great potential to help alleviate some of the stress experienced by military spouses. It offers recreation, physical and mental health benefits and the potential to help cultivate community by fostering social networking and mentorship platform. (Fairleigh, Megan E. “Gardens for the Green Machine: Investigating the Use of Community Gardening For Stress Treatment in Marine Corps Families.” MLA Thesis. California State Polytechnic University, Pomona, 2004.)

*Participation with nature enhances health and well-being.* Participation with nature enhances mental health, reduces stress, and can produce physiological benefits such as lower blood pressure and reduced muscle tension. (Relf, D. People-Plant Relationship. in *Horticulture as Therapy*. Ed. S.P. Simson and M.C. Straus. New York: The Food Products Press, 1988. 21-42. Print.

This study examines the history of healing gardens, problems facing veteran populations today, current treatment methods for PTSD, and how healing gardens could be beneficial to veterans with PTSD. A Veterans Affairs (VA) healthcare facility that is in the process of implementing a healing garden was used to determine how their PTSD patients will potentially use a healing garden space during treatment. Anderson, B. J. (2011). *An Exploration of the Potential Benefits of Healing Gardens on Veterans with PTSD*. All Graduate Reports and Creative Projects. Paper 50.

Results from survey respondents at the Tennessee Green Industries Field Day (McMinnville), and the Tennessee State Fair (Nashville) suggest that although gardeners select from a wide range of plant materials and activities in an individualistic manner, the interaction with nature in a nurturing environment provides a number of benefits important to them, including an opportunity for self-expression, physical and physiological benefits, and restorative experiences. (Catanzaro, C. and Ekanem, E. (2004). *Home Gardeners Value Stress Reduction and Interaction with Nature*. Acta Hort. (ISHS) 639:269-275.)


Results from this study reinforce findings of an earlier investigation of New Zealand mid-aged women gardeners that gardening serves a wide range of needs and benefits on many levels, including psychological, emotional, social, and spiritual. The data also provide an understanding of the type of persons who engage in gardening and give an overall picture of their motivations for gardening. Finally, the study identifies which factors are apparent indicators for someone to find satisfaction and a sense of well-being from gardening. (Kidd, J.L. and Brascamp, W. (2004). *Benefits of Gardening to the Well-Being of New Zealand Gardeners*. Acta Hort. (ISHS) 639:103-112.)
This study revealed important benefits of gardening on physical, emotional, social, and spiritual well-being, and highlighted a key role of gardening as a coping strategy for living with stressful life experiences. The prospective nature of the study revealed the personal and subjective ways in which interest in gardening might change in response to the person’s own situation and needs. (Unruh, A.M. (2004). *The Meaning of Gardens and Gardening in Daily Life: A Comparison Between Gardeners With Serious Health Problems And Healthy Participants.* Acta Hort. (ISHS) 639:67-73.)

**Community Building and Social Connections**

In a study conducted at a Chicago public housing development, residents of buildings with more trees and grass reported that they knew their neighbors better; socialized with them more often; had stronger feelings of community; and felt safer and better adjusted than did residents of more barren, but otherwise identical, buildings. Such settings support frequent, friendly interaction among neighbors—the foundation of neighborhood social ties. These ties are the heart of a neighborhood’s strength, encouraging neighbors to help and protect each other. (Kuo, F.E., et al. (1998). *Fertile ground for community: Inner-city neighborhood common spaces.*” American Journal of Community Psychology 26.6: 823-851.)

A study on a youth gardening program in Detroit reports that after gardening, children have an increased interest in eating fruit and vegetables, possess an appreciation for working with neighborhood adults, and have an increased interest for improvement of neighborhood appearance. In addition, they made new friends, and showed increased knowledge about nutrition, plant ecology, and gardening. (Pothukuchi, K. (2004) *Hortaliza: A Youth “Nutrition Garden” in Southwest Detroit.* Children, Youth and Environments, 14(2): 124-155.)

Results from this study examining formal and informal community-based social networks and family adaptation in military communities suggest that communities can be important sources of tangible information and expressive support. Further, a sense of real belonging in a distinct place can help to balance the turmoil of the deployment cycle. (Bowen, G. L. et al.(2003). *Promoting the Adaptation of Military Families: An Empirical Test of a Community Practice Model.* Family Relations. 52, 33–44.)

This survey of community gardens in upstate NY indicated gardens in low-income neighborhoods (46%) were four times as likely as non low-income gardens to lead to other issues in the neighborhood being addressed; reportedly due to organizing facilitated through the community gardens. (Armstrong, D. (2000). *A survey of community gardens in upstate New York: Implications for health promotion and community development.* Health & Place. 6: 4: 319-327).