

the  
botany  
of desire



## Summative Evaluation Report

Prepared for  
Kikim Media

*Knight Williams Inc.*

Valerie Knight-Williams, Ed.D.  
Divan Williams Jr., J.D.  
Eveen Chan, B.A.  
Ora Grinberg, B.A.  
Tal Sraboyants, B.S.  
David Tower, B.S.

November 2010



This material is based on work supported by the National Science Foundation under grant award No. 0307967. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

# Table of Contents

INTRODUCTION .....	2
METHOD .....	3
SAMPLE INFORMATION.....	6
THE VIEWING CONTEXT .....	7
FINDINGS.....	8
PART 1: HOW APPEALING AND ENGAGING DID VIEWERS FIND <i>THE BOTANY OF DESIRE</i> ?.....	9
1.1 How did viewers rate <i>The Botany of Desire</i> in terms of overall appeal, content interest, visual engagement, storytelling, clarity, and their likelihood of recommending the program?.....	9
1.2 What did viewers like most about <i>The Botany of Desire</i> ?.....	13
1.3 What did viewers like least about <i>The Botany of Desire</i> ?.....	19
PART 2: HOW SUCCESSFUL DID VIEWERS FIND <i>THE BOTANY OF DESIRE</i> IN TERMS OF: DENSITY OF INFORMATION, SCIENCE, AND SCIENTIFIC EXPLANATIONS AND IN COMMUNICATING ABOUT THE NATURE OF PLANTS?.....	24
2.1 How did viewers feel about the amount of information, science, and explanations of scientific principles in <i>The Botany of Desire</i> ?.....	24
2.2 Did viewers feel that <i>The Botany of Desire</i> was successful in communicating information about the nature of plants? .....	26
PART 3: WHAT DID VIEWERS LEARN FROM <i>THE BOTANY OF DESIRE</i> ? .....	28
3.1 What did viewers feel were the most interesting things they learned from the <i>The Botany of Desire</i> ?.....	28
3.2 What information surprised viewers while watching <i>The Botany of Desire</i> ?.....	35
3.3 Did viewers think or feel about plants in a new or different way after watching <i>The Botany of Desire</i> ? .....	40
3.4 Did <i>The Botany of Desire</i> increase or decrease viewers' interest in learning more about the connection between human nature and plants or how to affect biodiversity by making educated plant and food choices?.....	45
3.5 What was the impact of <i>The Botany of Desire</i> on viewers' knowledge of history and characteristics of the people, the tulip, the potato and cannabis?.....	48
PART 4: WHAT WERE THE EXTENDED INFLUENCES OF <i>THE BOTANY OF DESIRE</i> ?.....	67
Issue 1: Did interviewees discuss <i>The Botany of Desire</i> with others?.....	68
Issue 2: Were interviewees reminded of the program when encountering other print, visual, or audio media?.....	69
Issue 3: Did interviewees do anything new or different as a result of seeing <i>The Botany of Desire</i> ?.....	71
Issue 4: Did interviewees think about anything new or different as a result of seeing <i>The Botany of Desire</i> ? .....	71
Issue 5: Did interviewees visit <i>The Botany of Desire</i> website?.....	73
Issue 6: Did interviewees have additional comments they wanted to share with the producers?.....	74
CONCLUSIONS .....	75
PART 1: HOW APPEALING AND ENGAGING VIEWERS FOUND <i>THE BOTANY OF DESIRE</i> ?.....	77
PART 2: HOW SUCCESSFUL VIEWERS FOUND <i>THE BOTANY OF DESIRE</i> IN TERMS OF: DENSITY OF INFORMATION, SCIENCE, AND SCIENTIFIC EXPLANATIONS AND IN COMMUNICATING ABOUT THE NATURE OF PLANTS? .....	78
PART 3: WHAT DID VIEWERS LEARN FROM <i>THE BOTANY OF DESIRE</i> ? .....	78
PART 4: THE IMPACT OF <i>THE BOTANY OF DESIRE</i> ON VIEWERS' THOUGHTS, PERSONAL CONNECTIONS, AND ACTIONS TWO WEEKS AFTER VIEWING .....	83
FINAL REMARKS .....	85

# Introduction

Kikim Media's television documentary *The Botany of Desire* explores how human desires are both an essential and intricate part of natural history. Based on the 2002 book of the same title by Michael Pollan, the 120-minute broadcast focuses on "the natural history of four plants – the apple, the tulip, marijuana, and the potato – and the corresponding human desires– sweetness, beauty, intoxication and controlling nature – that link their destinies to our own." <http://www.kikim.com/xml/projects.php?projectId=5>.

Following the 2010 PBS broadcast premiere of *The Botany of Desire*, Knight Williams Inc., an independent evaluation firm specializing in the evaluation of informal science education media, conducted a summative evaluation to assess the extent to which the program accomplished the goals specified in the project's grant to the National Science Foundation (NSF).<sup>1 2</sup>

The evaluation assessed the extent to which *The Botany of Desire*:

- Afforded Viewers an entertaining, appealing, engaging, clear, comprehensible, and personally relevant viewing experience.
- Raised viewer awareness about biodiversity and genetic diversity in domesticated plant species, and in particular about: a) the importance of biodiversity and genetic diversity in both domesticated and wild plant species, and b) the risks to – and consequences of the loss of – biodiversity and genetic diversity in domesticated plant species.
- Increased viewer understanding of the connected nature of plants and people, and in particular that human desires continue to be intertwined with the evolution of diverse plants, and by extension affect global economic and ecological systems.

---

<sup>1</sup> We would like to acknowledge: i) producer and director Michael Schwarz for helping to coordinate the evaluation and assist with the evaluation materials and procedures, and ii) Valentine Kass from the NSF for assisting in grant administration related to the evaluation.

<sup>2</sup> Kikim Media's proposal to the NSF described the program's target audience as follows. *The Botany of Desire offers an opportunity for non-technical, non-scientist people to understand science in action by revealing how it affects their everyday lives. It also has the potential to reach a broad audience, including many people who may think they aren't interested in science. For these Viewers, Pollan's accessible personality and gift for weaving compelling narrative with hard science will be the hook. These four plants are not just gateways to scientific inquiry, but have great stories to tell which will pique the interest of a broad audience. This program will appeal to a sizeable segment of Viewers, including families, home-owners, aging baby boomers, and recent retirees. We anticipate that most Viewers will be men and women age 35-64 and their families. The National Gardening Association identifies this demographic as the most important consumers of lawn and garden products.<sup>2</sup> Gardening is \$37.7 billion business in America, but it's also a workshop where individual gardeners tinker with the natural world, altering the landscape and manipulating plants to fit their wants and needs. This demographic includes many families, suggesting that it's an audience primed to learn and with a stake in the future, the sort of Viewers whose interest will be piqued by this program. As a child, it was Michael Pollan's parents who first put him to work in the backyard topsoil, planting the seeds of his love for gardening. The Botany of Desire presents an opportunity for parents to use the garden to teach children that what we grow and how we grow it ultimately affects the ecosystem in which we live.*

- Increased viewer awareness of various human impacts on the evolution and biodiversity of domesticated plants, as well as global economic and ecological systems.
- Increased viewer awareness of the global agricultural/economic implications of preserving biodiversity.
- Enhances viewer understanding that individuals participate in the reciprocal relationship between people and plants through their choices of plants and foods.
- Increases viewer awareness that individual gardeners and consumers can affect biodiversity by making educated choices in the plants and foods they use.
- Motivates Viewers to consider acting on their heightened awareness, by for example pursuing conversations with family members, friends, or co-workers about food, plant, and land use choices and/or by taking positive actions regarding such choices.

## Method

Knight Williams Inc. addressed the evaluation questions listed on page 3 by conducting a two-group posttest only randomized study of recruited participants' ("Viewers") experience viewing *The Botany of Desire* in an at-home setting, as compared to participants ("Control") who didn't view the program but completed the same set of demographic/background questions and a short "quiz" about the main content covered in the program. The evaluation further explored the longer-term impact of the program within a few weeks of viewing, in this case focusing on the extent to which selected Viewers ("Interviewees") made personal connections with the program and discussed, thought about, or engaged in any program-related activities.

### Recruitment

The recruiting strategy relied on a planned sample of adults who met the project's target audience criteria assessed through a short pre-viewing screening survey. Eligible individuals: 1) had DVD and internet access; 2) were 18 years or older; 3) indicated at least some interest in science or history topics; 4) were not scientists or science teachers; 5) watched PBS at least occasionally; and 6) had no previous exposure to *The Botany of Desire*.

Recruiting was conducted principally through evaluation associates located in the Northeast, North Central, South Atlantic, South Central, and Western regions of the US using diverse and regionally targeted methods of announcing the evaluation opportunity to individuals fitting the target audience demographics, background, and media habits.<sup>3</sup> Knight Williams also notified individuals within the firm's database of museum visitors, PBS Viewers, Viewers of science, nature, and history programming on other channels, and NPR radio listeners who: had participated in no more than one prior media evaluation project in the past year, fit the screening criteria, and had expressed interest in participating in other informal science evaluation projects.

As part of the recruiting process, participants were informed that: their participation in the evaluation was voluntary, their responses were confidential, and that they would be randomly assigned to complete one of two different sets of activities, in one case an online survey activity about topics featured in a new PBS program and in the other an online survey and viewing of a PBS program. Honorariums were offered in each case to help ensure timely completion and scaled to reflect the amount of time required to complete each activity.

## Design

The evaluation design comprised a two-group posttest randomized experimental design.<sup>4</sup> The evaluators randomly assigned eligible respondents from the pre-viewing screening questionnaire to an experimental (“Viewer”) group or a non-exposure (“Control”) group. The Viewer and non-exposure Control groups then performed the following activities:

*Viewer group:* Participants in this group viewed *The Botany of Desire* program at home and completed an online post-viewing survey. A random sample of Viewers who completed the post-viewing questionnaire also completed a follow-up telephone interview two-three weeks after viewing.

*Control group:* Participants in this group did not view the program but instead only completed a questionnaire containing the same background, demographic, and content questions as completed by the Viewer group, except for those asking for participants’ reactions to the program itself.

The evaluation then compared the results of the Viewer and Control groups as outlined under Analyses.

## Questionnaires

The initial screening questionnaire included demographic and background questions about participants’ age, gender, ethnicity/race, educational level, occupation, interest in history and science/nature, television viewing habits, and prior exposure to PBS programs including *The Botany of Desire*.

The subsequent Viewer and Control group questionnaires included a 35 point knowledge assessment of content covered in the program related to the history and characteristics of the apple, tulip, cannabis, and potatoes. Within the four question sets addressing each of the four respective plants featured in the program, additional questions were asked about the program’s broader themes of biodiversity and monocultures.

---

<sup>4</sup> Although all participants completed a pre-viewing background and demographic questionnaire, administering a content-based pretest and posttest to the same group of participants in this case was neither a) practical given the challenges of maintaining participant cooperation, nor b) desirable given the specialized nature of the content addressed in the program and the potential for the pretest to sensitize Viewers to the program’s content and affect their posttest performance given the evaluation timeframe. Typically, the shortcomings with the separate-sample design involve its failure to control for history, maturation, mortality and their interaction. However, in the case of this program treatment, where the Viewer and Control group respondents completed the evaluation activities over a matter of days, group changes of this nature are unlikely. The separate-sample design controls for the main and interactive effects of testing and was deemed in this case a useful and cost-effective strategy for evaluating the program.

Viewers also completed questions that asked about the program's appeal, clarity, density of information, and personal learning value, focusing on the following issues:

- To what extent did the program appeal to the Viewers? What did Viewers like and dislike?
- How did Viewers rate the program in terms of storytelling, visual engagement, and content interest, and their likelihood of recommending the program to others?
- How did Viewers respond to the program's clarity of presentation and the amount of information and science presented?
- What did Viewers learn from the program that interested them most?
- To what extent did the program cause Viewers to think or feel differently about human's relationship with plants?
- To what extent did Viewers discuss, think about, or engage in any program-related activities a few weeks subsequent to viewing?

The evaluation team identified the above set of evaluation themes and procedures by: reviewing *The Botany of Desire* project proposal submitted to the NSF, consulting with the producers, and reviewing the DVD, transcript and website. Although the evaluators typically select or adapt science knowledge, interest, and opinion survey items from nationally validated sources when evaluating informal science education projects, given the unique nature of the botanical and history content provided in *The Botany of Desire*, this was not feasible. Instead, the evaluators devised questionnaire items with the assistance of the producers and then pilot tested the evaluation instruments with adults fitting the target audience for readability, length, clarity, and level of difficulty.

### Data analysis and reporting

Statistical analyses were conducted on all quantitative data generated from the evaluation. To explore for possible significant differences within and between the Viewing and Control groups, T-tests, Chi-Square, and Mann-Whitney tests were applied as appropriate.<sup>5</sup> Statistically significant findings (hereafter referred to as "significant") at  $p \leq .05$  are reported in the text. To help determine whether a significant difference was a difference of practical concern, effect sizes were also computed and reported in the text where appropriate.<sup>6 7</sup> As explained by Thalheimer and Cook (2002) "*whereas statistical tests of significance tell us the likelihood that experimental results differ from chance expectations, effect-size measurements tell us the relative magnitude of the experiment treatment. They tell us the size of the experimental effect.*"<sup>8</sup>

Content analyses were performed on the qualitative data generated in the open-ended questions. All analyses were conducted by two independent coders. Each coder independently coded randomly ordered open-ended responses, blind to group assignment. The analysis was both deductive, drawing on the program's objectives, and inductive, by looking for overall themes, keywords and key phrases. Any differences that emerged in coding were resolved with the assistance of a third coder.

---

<sup>5</sup> When examining subgroups with two categories (e.g., gender) using the two-independent-samples *T-test*, Levene's test was first used to determine whether the separate-variance *t* test or pooled-variance *t* test was appropriate for testing the means of the measured variables. If the test indicated the variances were significantly different, the separate-variance *t* test was used.

<sup>6</sup> Following Cohen's (1992) interpretation, for T-tests  $d=.2$  indicates a small effect,  $.5$  a medium effect, and  $.8$  a large effect. For non-parametric tests,  $r=.10$  indicates a small effect,  $r=.30$  a medium effect, and  $r=.50$  a large effect.

<sup>7</sup> Cohen, J. (1992). A Power Primer. *Psychological Bulletin*, 112 (1), 155-159.

<sup>8</sup> Thalheimer, W. and Cook, S. (2002). How to Calculate Effect Sizes from Published Research: A simplified methodology, *Work-Learning Research*, p. 2.

# Sample Information

A total of 125 participants, including 65 Viewer and 60 Control group participants completed questionnaires that formed the basis for the evaluation findings. Table 1 summarizes the demographic and background information for each group. The Viewer portion of the sample included:

- A balance of females (52% to males (48%).
- A wide range of ages, spanning 20-70 years, with a mean age of 40.
- A racial/ethnic distribution comprising 79% Whites, 5% Asian, 3% African-Americans, and 12% mixed-race Viewers. Eight percent (8%) were of Hispanic origin
- Residents from 19 different states, including: AZ, CA, FL, GA, IL, KY, MA, MI, NC, NY, OH, OR, PA, TN, TX, UT, VA, WA, and WI.
- A combination of high school through graduate level educated respondents, including: 2% with a high school education or less, 49% with some college education or a college degree, and 49% with some graduate school education or a graduate degree.
- A majority of participants who watch science/nature programs weekly (52%) or monthly (17%).
- A majority of participants who watch PBS programs daily (17%) or weekly (40%).
- A majority of participants who look for science information online regularly (54%) or occasionally (45%).

Table 1 Sample demographics/background			
Demographic/ background factor	Categories	Control (n=60)	Viewers (n=65)
Gender	Female	61%	52%
	Male	39%	48%
Age Group	Age range	(20-70)	(19-71)
	Mean	43	40
Geographic residence	US Northeast	8%	9%
	US North-Central	2%	9%
	US South Atlantic	33%	28%
	US South-Central	15%	11%
	US West	42%	43%
Racial/ethnic background	African-American/Black	5%	3%
	Asian	10%	5%
	White	77%	79%
	Multiracial/Other	8%	12%
	Hispanic Origin	7%	8%
Highest level of education	Less than high school	0%	2%
	High school degree	0%	0%
	Some college	10%	15%
	College degree	45%	34%
	Some graduate school	20%	6%
	Graduate degree	25%	43%
Occupational status	Work in science/tech	10%	12%
	Work in education	16%	26%
	Work in other field	40%	45%
	Homemaker	8%	8%
	Retired	3%	0%
	Unemployed	3%	3%
	Student	18%	6%
Frequency of watching science/nature programs	Daily	12%	8%
	Weekly	53%	52%
	Monthly	20%	21%
	Less than once a month	15%	17%
	Never	0%	2%
Frequency of watching PBS programs	Daily	21%	17%
	Weekly	33%	40%
	Monthly	17%	23%
	Less than once a month	20%	19%
	Never	7%	2%
Frequency of looking for science information online	Regularly	50%	54%
	Occasionally	43%	45%
	Seldom	7%	0%
	Never	0%	2%

### Group comparability

The evaluation gathered demographic and background information to determine whether the two independent samples (Viewers vs. Control) should be evaluated as having come from the same population. T-test and Chi-square analyses indicated that the two groups did not differ significantly with respect to the measured variables, which included: gender, race/ethnicity, age group, education, and occupation.

## The Viewing Context

### With whom Viewers watched the program

Viewers were asked whether they watched *The Botany of Desire* program alone or with others, choosing from the following response options: alone, spouse/partner, children, friends, and other.

As Table 2 shows, most Viewers (69%) watched the program alone. Those who watched with someone else most often (15%) said they watched the program with a spouse/partner. Smaller percentages reported watching with children (9%) or some combination of spouse/partner or children (7%). None reported watching with a friend.

Viewers watched:	Total (n=65)
Alone	69%
With spouse/partner	15%
With child(ren)	9%
With spouse/ partner, child(ren)	7%
With friend(s)	0%

### Whether and how viewing was disrupted

Viewers were asked whether and how their viewing of *The Botany of Desire* program was disrupted in some way.

As Table 3 shows, while two-thirds (66%) of the Viewers said they watched the program without disruption, the remaining Viewers experienced some disruption that briefly interrupted their viewing experience, as they: tended to children (12%), answered phone or door (8%), or briefly dozed off/zoned out (5%).

Other disruptions mentioned by individual Viewers (9%) related to their: making a snack, tending to a family member, getting distracted by a barking dog, or having to use the restroom.

	Total (n=65)
No disruptions	66%
Some disruption	34%
Dozed off	5%
Had to attend to children	12%
Answered phone or door	8%
Other ( <i>made snack, tended to family member, distracted by dog barking, restroom</i> )	9%



# Findings

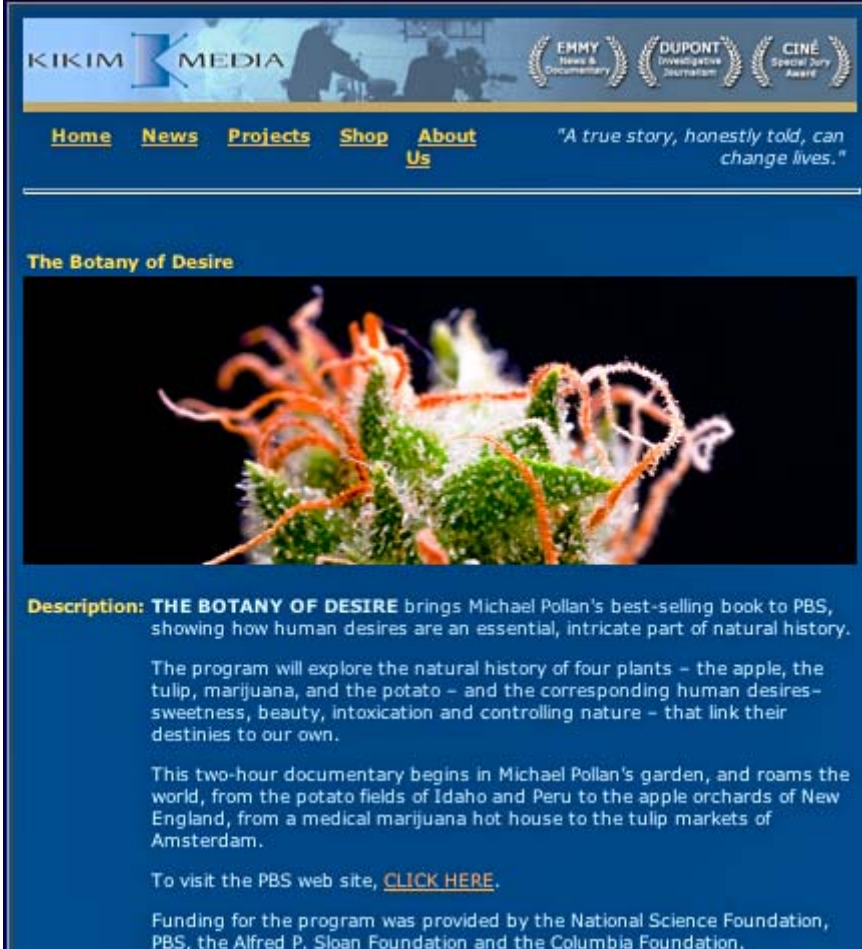
This section includes findings on the overall appeal, clarity, comprehensibility, and learning value of *The Botany of Desire* as determined by the recruited Viewers and, in some instances, Control group participants' responses on the questionnaires completed for the evaluation. The evaluation findings are presented in 4 parts as follows:

*Part 1: How appealing and engaging did Viewers find The Botany of Desire?*

*Part 2: How successful did Viewers find The Botany of Desire in terms of: clarity, amount of information, science, and explanations of scientific principles, and communicating information about the nature of plants?*

*Part 3: What did Viewers learn from watching The Botany of Desire?*

*Part 4: What were the extended influences of The Botany of Desire?*



The screenshot shows the Kikim Media website interface. At the top, there is a navigation bar with links for Home, News, Projects, Shop, and About Us. To the right of the navigation bar, there are three award logos: EMMY News & Documentary, DUPONT Investigative Journalism, and CINÉ Special Jury Award. Below the navigation bar, a quote reads: "A true story, honestly told, can change lives." The main content area features a large image of a plant with orange and green flowers. Below the image, the text reads: "Description: THE BOTANY OF DESIRE brings Michael Pollan's best-selling book to PBS, showing how human desires are an essential, intricate part of natural history. The program will explore the natural history of four plants - the apple, the tulip, marijuana, and the potato - and the corresponding human desires - sweetness, beauty, intoxication and controlling nature - that link their destinies to our own. This two-hour documentary begins in Michael Pollan's garden, and roams the world, from the potato fields of Idaho and Peru to the apple orchards of New England, from a medical marijuana hot house to the tulip markets of Amsterdam. To visit the PBS web site, [CLICK HERE](#). Funding for the program was provided by the National Science Foundation, PBS, the Alfred P. Sloan Foundation and the Columbia Foundation."

*Screenshot of The Botany of Desire program description on Kikim Media website*

## Part 1: How appealing and engaging did Viewers find *The Botany of Desire*?

### 1.1 How did Viewers rate *The Botany of Desire* in terms of overall appeal, content interest, visual engagement, storytelling, clarity, and their likelihood of recommending the program?

Viewers generally liked the program, thought it featured interesting content, and felt it was visually engaging and had engaging storytelling. Viewers also expected that they were likely to recommend the program to others.

Viewers were asked to rate *The Botany of Desire* for the extent to which they liked or disliked the program and found: the content boring or interesting, the program visually engaging or dull, the storytelling boring or engaging, and the presentation clear or confusing. They were also asked to evaluate how much they felt they learned from the program and estimate their likelihood of recommending the program to others. Table 1 presents the median ratings based on a scale 1 (rated the lowest) to 7 (rated the highest).

Table 1: Median Viewer ratings of overall rating of The Botany of Desire (n=65)								
	1	2	3	4	5	6	7	
Disliked						6.0		Liked
Boring content						6.0		Interesting content
Boring storytelling						6.0		Engaging storytelling
Visually Dull						6.0		Visually Engaging
Confusing presentation						6.0		Clear presentation
Learned nothing						6.0		Learned a lot
Would not recommend							7.0	Would recommend

The median ratings in each case indicate that, overall, Viewers liked the program (6) and generally agreed that the program was visually engaging (6), had engaging storytelling (6), contained interesting content (6), and had high learning value for them personally (6). Viewers were even more enthusiastic about their likelihood of recommending the program to others (7).

Mann-Whitney tests did indicate a few subgroup differences relating to the film's appeal, clarity, and learning value. First, female Viewers rated their overall liking of the program (6)<sup>9</sup> and their interest in the program's content (7)<sup>10</sup> significantly higher than did male Viewers (6). Second, females rated the program's visual engagement, clarity and learning value (7 each)<sup>11</sup> significantly higher than did males (6 each). Finally, older Viewers (40 years and older) rated their overall liking of the program (6.5)<sup>12</sup> and their interest in the program's content (7)<sup>13</sup> significantly higher than did younger Viewers (6 each). They also rated the film's clarity and their likelihood of recommending the program higher (7 each) than did younger Viewers (6).<sup>14</sup>

When Viewers were invited to explain their ratings, most mentioned that they would recommend *The Botany of Desire* to others, particularly for the *experts* featured in the program and for the *history* presented about apples and tulips. A few Viewers, however, indicated that they would not recommend the program since the content wasn't particularly interesting to them or they felt the program's audience would be limited primarily to gardening enthusiasts. Viewers that elaborated on the program's storytelling especially liked the format the producers chose, although some wished that the storytelling featured more dramatization or felt the pace was slow in places. Those who commented on the show's visual engagement praised the visuals as *beautiful, emotionally moving, and/or engaging*.

Examples of Viewers' comments follow below:

- **Liked or disliked**
  - *Excellent program. My 15 year old son watched it with me. He got a lot out of it.*
  - *I really enjoyed this show and it made me more interested in organic farming and why we should stop trying to fool with mother nature by using too much technology. Defenses are already in place we just need to know the right way to use them.*
  - *I recognize that it is difficult to present science in a way that is as exciting as some of the other options on TV, but this was extremely good.*
  - *All in all, a good use of time. I'm glad I chose to watch Botany over WWE Smackdown. Thanks for giving me the opp to participate.*
  - *Truly I enjoyed the entire program immensely and look forward to watching it again, thus thank you for the allowance to keep the disc.*

---

<sup>9</sup> (  $U=358$ ,  $p=.018$ ,  $r=.29$ )

<sup>10</sup> (  $U=366$ ,  $p=.027$ ,  $r=.28$ )

<sup>11</sup> Visual engagement: (  $U=382$   $p=.039$ ,  $r=.26$ ); Clarity (  $U=298$   $p=.001$ ,  $r=.40$ ); Learning value (  $U=329$   $p=.005$ ,  $r=.35$ )

<sup>12</sup> (  $U=259$   $p=.001$ ,  $r=.47$ )

<sup>13</sup> (  $U=312$ ,  $p=.003$ ,  $r=.37$ )

<sup>14</sup> Clarity (  $U=321$   $p=.003$ ,  $r=.36$ ); Recommend (  $U=291$   $p=.001$ ,  $r=.42$ )

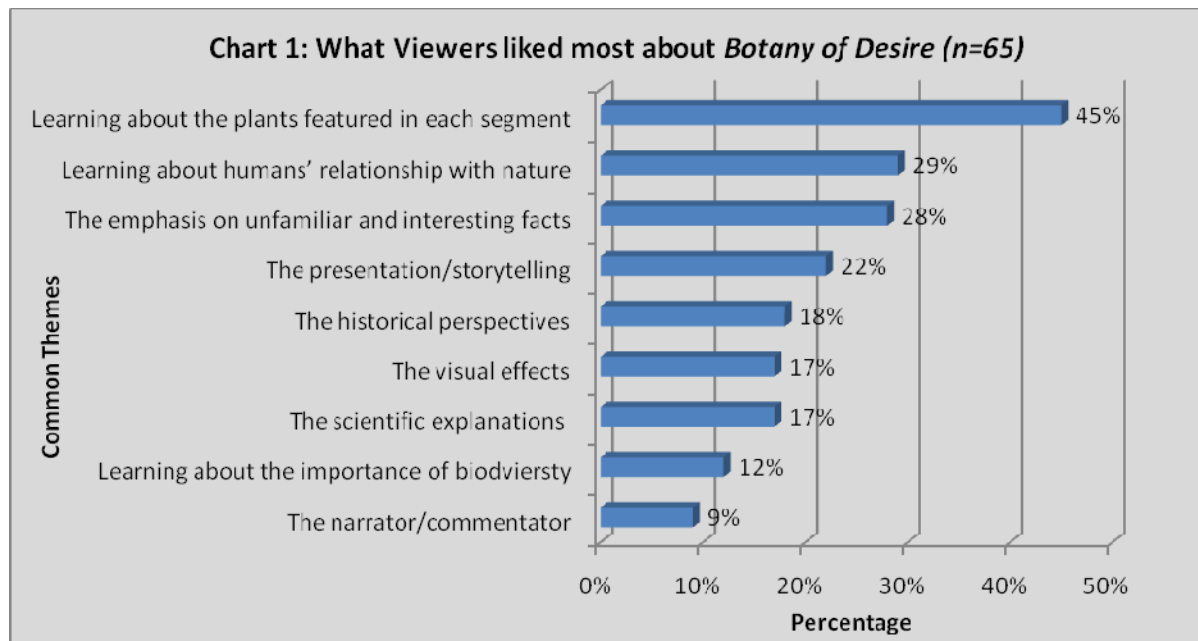
- **Interesting or boring content**
  - *I am very interested in plants. I read the Secret Life of Plants long time ago and lost the book, but remember clearly the premise. I am also interested in natural history which is why I think I paid particular attention to the information presented in this DVD.*
  - *Interesting facts that I will likely engage in conversation with in my personal life.*
  - *It took a somewhat dry topic and made it very engaging. It's fun when "contrarian" material is presented that challenges or contradicts what we all "know" - the history of apples (as cider), the pomegranate in the Garden of Eden, and the story of Johnny Appleseed - it's fun to know that conventional wisdom is wrong. Lots of material that is relevant to modern living.*
  - *It was interesting to watch something I don't think I would have normally watched. I think I'm more into animals than plants/flowers. I do like history, so that it had a connection to history; I think made it more interesting to me.*
  - *The content on potatoes was a bit boring and lost me in parts. I thought it unnecessary to bring in the medical marijuana issue and not mention the state, Oregon is the only state that does it...so it's not a big secret. What the growers were doing was a crime and given that this airs on PBS, which has a decidedly liberal slanted audience, it seemed like more emphasis was placed on the growers as being revolutionary botanists instead of drug dealers. It glorified their crime WAY too much and made it sound like they were doing society a favor when in fact Mary Jane is criminal for a reason. I know I am bias, but you could have done an entire show on tulips. They are sorely underappreciated in some circles.*
- **Visually engaging or dull**
  - *Most of the visuals were wonderful, artful, emotionally engaging ... yet, there were jarring moments when, for instance, the chemical sensor plant's visual just after beautiful nature*
  - *Visually it was quite superb, but if anything was ever so slightly critical, perhaps just a hair more researchers speaking and just a hair shy of the imagery that all of your programs is so well known for.*
- **Engaging or boring storytelling**
  - *I liked the dialogue of the presentation, and also the way real life was incorporated into the topics. Hearing from pot and potato farmers was very helpful. Great information.*
  - *I thought it was very well done, but I just couldn't get hooked in the story. I'm not sure if it's just that the topic of botany wasn't interesting to me, or if there was something underneath that was lacking. I think I might have liked it as several unique stories (e.g.,-the potato, the tulip, etc.).*
  - *Some of the storytelling did not have enough pre-explanations for me, i.e., there were statements that were surprising to me and yet no explanations or insufficient explanations were given to help me out*
  - *Sometimes I think there's a formula presentation to PBS shows, with drawings and voice overs and just a "certain way of doing things" that makes the visual and story line predictable and less gripping than it could be.*
  - *The stories told within each segment didn't reveal anything completely surprising... However...! The storytelling in knitting these facts together was very compelling. Splicing in footage, prints, paintings while the narrator voice-overed the historical context of the story drew me into the flow. Choice of host, as mentioned earlier was also a good call. He provided a common string to tie the viewer along a main storyline and acted as any good tour guide would in keeping guests entertained and curious...while making sure they don't get sidetracked and cross the velvet ropes.*
- **Clear or confusing presentation**
  - *I do feel that most of the content was presented clearly.*
- **Learned a lot or nothing**
  - *I had read the books some four or five years ago. I read the section on Cannabis while waiting four hours to get a new copy of my driver's license at the DMV... it seemed appropriate. So I am not certain that I learned much that was new, but it was decidedly reaffirming to my belief system and interests.*

- *The examples used were well chosen and helped make the learning points stick. For example, learning that Johnny Appleseed planted trees from seed instead of from grafting helped clearly illustrate the points about diversity and the widespread use of apples to make hard cider.*
- *While I did learn interesting factoids (apple forest clip was very cool, as was the fact that the highest-values bulbs in Tulipomania was actually flawed, diseased bulbs), there was no WHOA moments in there.*
- ***Was a bit slow/too long***
  - *I did learn a lot from this program but felt it dragged somewhat.*
  - *I would recommend this but I do think that it is long.*
- ***Would or would not recommend***
  - *I thought of so many people that I wanted to share the film with while watching it. Michael Pollrn is a great speaker and without a doubt THE expert. The passion of the gentleman... Jan I think... that was growing the tulips was contagious. I could feel his joy!*
  - *Would definitely recommend this program to a friend! I plan on having my husband watch it; he is a forage specialist, so plants are his "thing". I know he will enjoy it!*
  - *I would not likely recommend this show simply because the content was not already of interest to me. I would not recommend use of this in a secondary school classroom for the reasons I outlined above, but it could work as a general audience presentation for an older demographic.*
  - *I think I would recommend to people who like plants/flowers, maybe my gardening friends.*
  - *I can't think of anyone to whom I would recommend this program. Except maybe my mother-in-law, because she's Dutch, so she'd probably appreciate the part on tulips.*

## 1.2 What did Viewers like most about *The Botany of Desire*?

All of the Viewers identified at least one aspect of *The Botany of Desire* that appealed to them and most mentioned two or more aspects. Viewers were especially enthusiastic about the subject matter of the program, as communicated through the four segments on the apple, tulip, cannabis, and potato. Viewers also frequently enjoyed learning about the importance of humans' relationship with nature.

Viewers were asked to describe what they liked most about *The Botany of Desire*. Chart 1 shows the aspects of the program that Viewers said they most frequently liked and the percentage of Viewers citing each aspect.

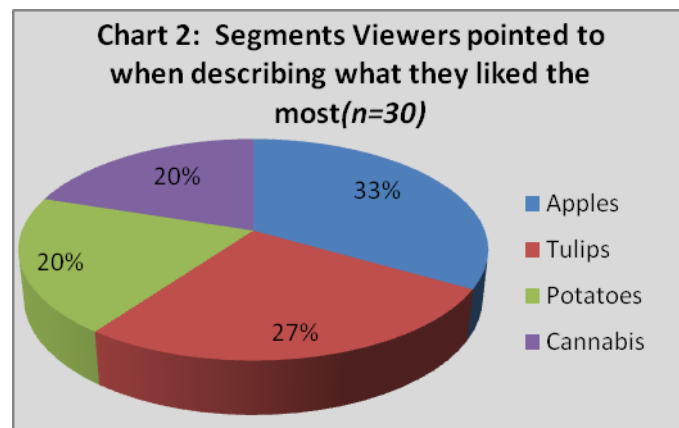


Nearly half the Viewers (45%) were drawn to the information they learned about the plants featured in the four segments of the program (apples, tulips, cannabis, and potatoes). About one-third (29%) liked learning about humans' relationship with nature, especially from the point of view of plants and the theory that humans are actually the plants "puppets". About one-third (28%) of the Viewers also liked the program's emphasis on *interesting and unfamiliar* facts, particularly involving the history and properties of the featured plants and our relationship with nature. Many Viewers were drawn to the program's style of presentation and storytelling (22%). Others enjoyed hearing about the historical perspectives provided about each of the four plants featured in the program (18%), praised the visual effects (17%), or appreciated the use of clear and interesting scientific explanations (17%). Several Viewers also enjoyed

learning more about the importance of biodiversity and the problems that come with monocultures (12%) or listening to the narrator with his obvious enthusiasm for the subject matter (9%).

Among the Viewers that pointed to specific segments of *The Botany of Desire* (n=30), the most liked segment was the apple segment (33%), followed by the tulip segment (27%). The potato and cannabis segments were liked equally to a somewhat lesser extent (20% each).

Chart 2 further breaks down the different segments in the program to show the percentage of Viewers that liked each segment. Examples of Viewers' comments on the above themes follow below.



- **Plant information provided in the different segments (45%)**

The Apple segment

- *It was interesting. It taught several facts that I was unaware of, or that I misunderstood, i.e. Johnny Appleseed. It was entertaining in the way it almost personified the subject plants. The apple segment was particularly interesting. I never knew there was so much to know about apples.*
- *History of ...Johnny Appleseed. I enjoy the History channel and those types of shows that give you the back story behind something that you may have heard a little about, but never explored in depth.*
- *It was interesting to learn about the apples and the history of apples. We take so much for granted.*
- *...Also, the story on apples was very because I was unaware of their origin, and their incredible variety.*
- *I was raised on a farm, and experienced raising potatoes, and grafting apples. Those were two topics of personal interest that easily held my interest. I thought the program was one of the best I've viewer, it was very interesting, and about topics that most of us could relate to.*

The Tulip segment

- *Tulips, because I personally love tulips, learning more about the history of their cultivation was enlightening. Also, the story on apples was very because I was unaware of their origin, and their incredible variety.*
- *I enjoyed the episode on tulips. I buy tulips whenever they are available. It had the most personal appeal. All of the episodes were interesting and thoughtful*
- *I really liked the part about tulips. It was very interesting and I learned a lot about things I didn't know.*
- *The tulip segment; I love tulips, and seeing the beautiful varieties, and learning the history of the flower, was very enjoyable for me!*

The Cannabis segment

- *I learned a lot about cannabis, such as the female plant process. I don't think I would have picked this knowledge up anywhere else.*
- *History of marijuana. I enjoy the History channel and those types of shows that give you the back story behind something that you may have heard a little about, but never explored in depth.*
- *I'm not trying to sound like a typical 30 year old male here, but the section on Cannabis was by far the most interesting. I don't think I've ever seen Cannabis presented in such a non-biased, scientific way before. However, having never tried marijuana before, I will say that it probably wouldn't be the best program for a teenager to watch. After viewing it, I really want to try it and I feel like its perfectly acceptable because the program didn't present any of the negative effects.*

- *I liked the topic on the Cannabis plant mostly because it's such a popular thing that I had no idea about. It furthered my knowledge on the plant and why people like it so much, how it's effective for medicine and what it does to your body.*

#### The Potato segment

- *I didn't know much about GMOs before this either, so now I know a bit more.*
- *I also found the potato segment to be very interesting, particularly learning about the giant farms, and the organic farm, too. I enjoyed the show a lot.*
- *I think I liked the potato part best.*
- *I was raised on a farm, and experienced raising potatoes, and grafting apples. Those were two topics of personal interest that easily held my interest. I thought the program was one of the best I've viewed, it was very interesting, and about topics that most of us could relate to.*

- **Learning about the importance of humans' relationship with nature (29%)**

#### Perspective of plants controlling humans

- *A big favorite of mine was how they said that the plants are actually using us instead of us using them. They have gotten us to make them better for their environments, as well as help them colonize and spread throughout the globe.*
- *This one grabbed me with the premise that "Maybe plants are the ones using humans, and not the other way around?" I never thought of the world from that POV, so it got my attention -- probably would have too, had I been surfing through channels or if that were in the description field on my DVR program schedule.*
- *The different points of view, how plants can answer human needs such as for sweetness, beauty, power, and intoxication. The program forced me to think about plants manipulating us, which was interesting to think about.*
- *I liked the way the one person was fitted in between the three pieces to add a sort of subjective, theoretical holistic perspective to the idea that plants are really using 'us' humans to continue their 'world domination' through the power of the senses such as beauty and sweetness, things that correspond to the human sense of desire. I think it made a very important point that we are at a great telling point in our history and our cultivation of food and plant sources for medicine. It's a very good background and foundation for opening the discussions and debate regarding biogenetics in plant diversity, and similar issues such as why all should return to organic gardening.*
- *Historic elements that I knew nothing about and the relationship to Human desire, as well as plant desires, that had never actually occurred to me before. What never occurred to me before were for instance, the colors of a flower being intended to please the human eye, thus creating a pampering effect, such as the Tulip mania and the extremes to which Marijuana has been nurtured from a weed. What I thought before watching was that the beauty was all about insect appeal for the purpose of propagation.*
- *The metaphoric resemblance that Mr. Pollan used when he introduced the topic was a good grab. I like how he hooked the viewer by pointing out that humans are not necessarily the only ones in control. The plants themselves and the insects as well are very much participants in the "web of life."*
- *Although I have never given any thought to botany and how plants and humans fit into the ecosystem, I was intrigued by the ideas that we are cogs in the same wheel and that humans really have a lot less control over our environment than we think we do. Nature has its ways of manipulating us through our senses to create conditions for the survival of other species.*
- *I found it all so extremely interesting to look at nature as a web of life that we are part of, and not outside of, observing.*
- *I found it very interesting because it gave me an entire new insight into and perception of plants themselves and how we have a symbiotic relationship with them. I had never thought of that before. I found the history of each plant fascinating and how they each have evolved over time.*



### Human's attempts and failures in controlling nature

- *The program thoroughly develops the perspective that attempts to control nature can lead to a host of unanticipated consequences and that it might be better to understand nature and integrate, with it rather than attempting to control it.*
- *I loved the way it was organized by the concepts of sweetness, beauty, consciousness and control and used well-known plants to illustrate each concept. I also loved learning the history of the plant/human relationship.*
- *It was extremely informative about the different industries and history surrounding each type of plant.*
- *Thinking about the plants perspective helped develop a better understanding of the importance of the relationship between humans and plants.*
- *History of humans' relations with plants is easily the part I found most interesting.*
- *It helped me better understand the complexity of nature, and how humans can alter nature in good and bad ways. I liked that it focused on four disparate plants.*
- *Good visuals, interesting facts I wasn't aware of, a good combination of hope and previous failures of how man has dealt with the natural environment.*
  
- **The focus on unfamiliar and interesting facts about plants (28%)**
  - *I enjoy learning about things I do not know and more about things I know a little about, and all four segments taught me something new.*
  - *All aspects of the program were very interesting. Historic elements that I knew nothing about and the relationship to Human desire, as well as plant desires, that had never actually occurred to me before. The other appreciable aspect was due to my low education levels, this type of documentary brings a simplistic approach that I find much easier to relate to, than more scientific research.*
  - *The presentation was very appropriate for the subject matter. In addition, the documentary was never lacking in new material for me to learn unlike some 1 hour documentaries on the History Channel. I really appreciate all of this, since I don't like spending 2 hours of my life watching something only to not have learned anything or to have seen the same visual half a dozen times.*
  - *I thought the program was very informative and presented in an interesting format.*
  - *It was extremely informative about the different industries and history surrounding each type of plant.*
  - *I learned very interesting things that I had no idea about. I liked that it focused on four disparate plants.*
  
- **The overall presentation/storytelling (22%)**
  - *I liked the rational non-sensical approach that it took to film and pose the information on three different food sources.*
  - *The other appreciable aspect was due to my low education levels, this type of documentary brings a simplistic approach that I find much easier to relate to, than more scientific research. Could be why I'm not remembering the specifics of marijuana experimentation, where it did get a little more scientific, but the rest of the program was easy enough for an average person to grasp and connect the associated botany to desire. Makes me want to read the book and hope for more depth on some of the segments. Could also have something to do with being of Dutch immigrant parents :) Growing up on an apple orchard, tulips, and the flower auction and of course Potatoes, made it seem very uniquely designed for my personal pleasure. Even the Cannabis segment has long been a fascinating study and I want a sequel to follow as to why this weed affects some brains in ways that it does not affect others.*
  - *The story telling aspect was the most awesome part and the way the program was structure. It was like reading a book and imagining things at the same time.*
  - *Found myself drawn in from the onset -- with nature/history/documentary programs, the first 3 minutes are so critical to me. Is the premise and hypothesis interesting? Do I flip the channel? This program or WWE Smackdown?*
  - *I thought the program was very informative and presented in an interesting format.*
  - *I really enjoyed the presentation of the scientist's idea across four very different plants and four different human appetites. I know next to nothing about botany and had no trouble following the science. The examples were well developed and presented in easily digestible sections.*

- *I loved the way it was organized by the concepts of sweetness, beauty, consciousness and control and used well-known plants to illustrate each concept. I also loved learning the history of the plant/human relationship.*
- *The stories and connections to topics I had heard about before - Johnny Appleseed, GM potatoes, etc. There was a good flow between moving the overall story forward and the side stories.*
- **The historical perspectives (18%)**
  - *It was really interesting. (I'm a geek, I like that kind of stuff.) I did like the historical detail (Appleseed, potato famine, Tulipmania) and the modern references. I didn't know much about GMOs before this either, so now I know a bit more.*
  - *It was interesting to learn about how plants played a role in history.*
  - *All aspects of the program were very interesting. Historic elements that I knew nothing about and the relationship to Human desire, as well as plant desires, that had never actually occurred to me before.*
  - *History of marijuana and Johnny Appleseed. I enjoy the History channel and those types of shows that give you the back story behind something that you may have heard a little about, but never explored in depth.*
  - *I found the history of each plant fascinating and how they each have evolved over time.*
  - *It gave perspective (including the history) & made me rethink about sweetness and common products like the apple and potato. The photography was beautiful & it made me think of revisiting the Netherlands.*
  - *I also loved learning the history of the plant/human relationship.*
  - *Finding out about the history and origin of each plant. It was interesting to know where their origins were from and how they came to our country. Also, how they were used in the past as opposed to the present.*
  - *I enjoyed how the history and science were woven together because I enjoy both subjects immensely.*
  - *It was very enlightening, I'm love to garden so the information on botany was very informative. The history was all new stuff for me. And the science behind it all was very enlightening.*
  - *I felt a little bit smarter and knowledgeable about agriculture and its history. There was a good amount of background history (John Chapman, 'Tulipmania', potato monoculture in the US) that I had no idea existed or thought I knew the story and I really didn't. It was interesting to hear these stories and to learn about the common these in these four plants.*
  - *History of humans' relations with plants is easily the part I found most interesting.*
- **The visual effects (17%)**
  - *Good visuals, interesting facts I wasn't aware of, a good combination of hope and previous failures of how man has dealt with the natural environment.*
  - *The close up, detail photography, particularly the slow-motion shot of the bees in action. I had to resist freezing the frame.*
  - *The visuals excellent and the researchers all very well spoken, easy to listen to. I found it all so extremely interesting to look at nature as a web of life that we are part of, and not outside of, observing. The cinematography was wonderful and really caught my attention!*
  - *Video production is top-notch too. I'd like to see this again in Blu-Ray -- some of the sweeping panoramic views of the fields of Idaho or the apple forests of K-something-stan beg to be seen in 1080p.*
  - *The photography was beautiful & it made me think of revisiting the Netherlands.*
  - *The visuals were colorful and relevant and there were a lot of unique video clips. In addition, the documentary was never lacking in new material for me to learn unlike some 1 hour documentaries on the History Channel. I really appreciate all of this, since I don't like spending 2 hours of my life watching something only to not have learned anything or to have seen the same visual half a dozen times.*
  - *The images of the plants were very detailed and allowed you to follow the narrative easily.*
- **Scientific explanations – clear, interesting (17%)**
  - *The other appreciable aspect was due to my low education levels, this type of documentary brings a simplistic approach that I find much easier to relate to, than more scientific research. Could be why I'm not remembering the specifics of marijuana experimentation, where it did get a little more scientific, but the rest*

*of the program was easy enough for an average person to grasp and connect the associated botany to desire. Makes me want to read the book and hope for more depth on some of the segments.*

- *I really enjoyed the presentation of the scientist's idea across four very different plants and four different human appetites. I know next to nothing about botany and had no trouble following the science. The examples were well developed and presented in easily digestible sections.*
- *I enjoyed how the history and science were woven together because I enjoy both subjects immensely.*
- *The explanations of how man has been able to effect nature with science. I wasn't very familiar with the science on gene manipulation and its hopes to change farming.*
- *It touched on a lot of things I knew a little about, but includes interesting facts that make me feel smart. The entire show seemed relevant - we've moved to monoculture in nearly every food crop we consume - it's one of the reasons we have amazingly efficient food production that can feed the world, but also puts us at very high risk of losing entire crops.*

- ***The narrator - obvious enthusiasm for the subject (9%)***

- *The non-political tone, Michael Pollan's interesting comments, and all the information I'd never heard before.*
- *Also enjoyed the aptly named Mr. Pollan as main narrator. He was authoritative, but not aloof; passionate, but not maniacal. I also like his choice of words like "exquisitely useless (tulips)" and "kinda extraordinary (potatoes)."*
- *I enjoyed Michael Pollan as the commentator. I like him as an author, and he comes across as a fellow questioner, rather than an expert. He's not a polished presenter, but even better, he's intelligent and asks the kinds of questions I wish I could think of.*
- *I thought Michael Pollan was articulate and interesting to listen to. I found him to be a credible voice for the program. His discussions on the different plant types were thought-provoking and well-reasoned.*

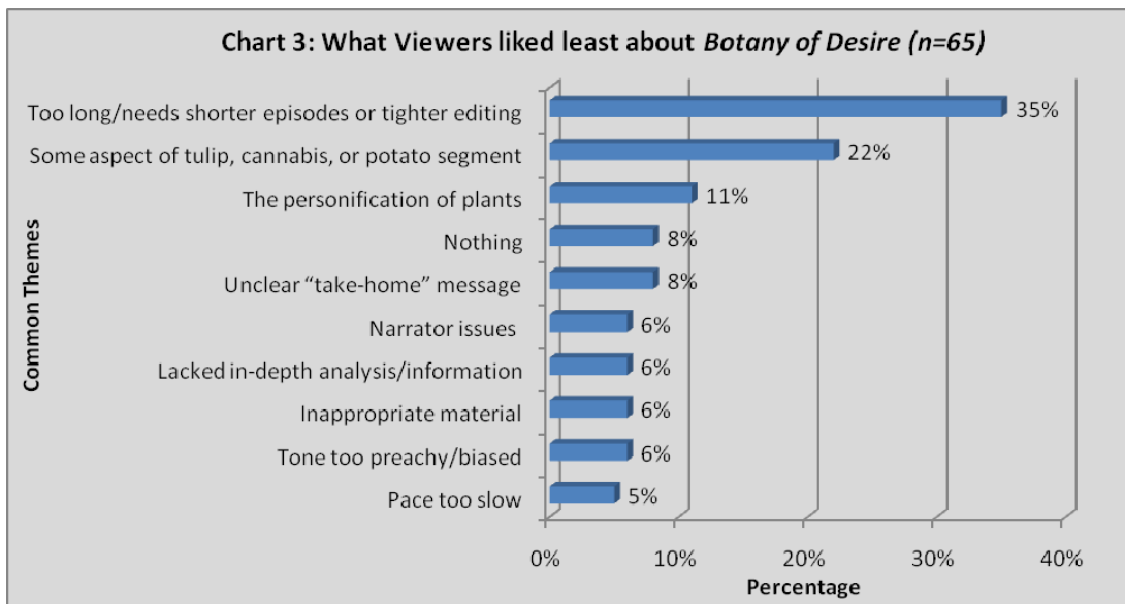
- ***Learning about the importance of biodiversity (9%)***

- *It's a very good background and foundation for opening the discussions and debate regarding biogenetics in plant diversity, and similar issues such as why all should return to organic gardening.*
- *We take so much for granted. Also to learn that by breeding one type of crop, there were disadvantages. Diversity is the way to ensure survival. Also, how it's our preference for certain tastes, colors, shapes etc, that ultimately determine if a species will survive or not.*
- *Nature has its ways of manipulating us through our senses to create conditions for the survival of other species.*
- *The theme that we need diversity in plant life. A mono crop will fail and a more diverse crop make-up will survive.*
- *I think it made a very important point that we are at a great telling point in our history and our cultivation of food and plant sources for medicine. It's a very good background and foundation for opening the discussions and debate regarding biogenetics in plant diversity, and similar issues such as why all should return to organic gardening.*

### 1.3 What did Viewers like least about *The Botany of Desire*?

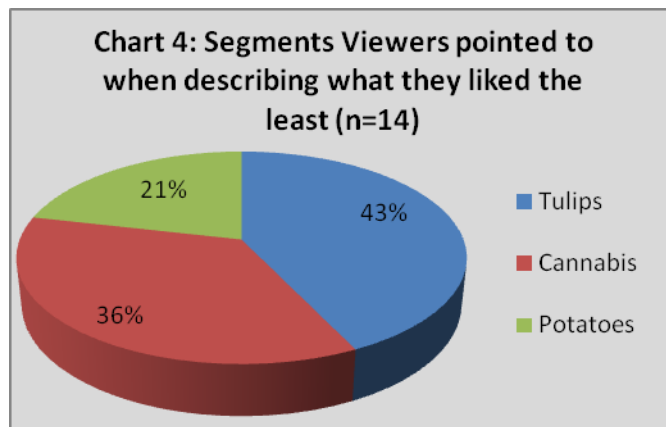
Viewers didn't focus on any one particular theme when asked to identify something they didn't like about the program. The most frequent issue they raised was that the program was too long and could be broken down into shorter episodes. Some focused on specific program segments, most often the potato, tulip, and cannabis segments, while a few felt that the personification of plants was unrealistic.

Viewers were asked to describe what they liked least about *The Botany of Desire*. Chart 3 shows the main aspects Viewers pointed to and the percentage of respondents citing each aspect. Chart 4 further breaks down the different segments in the program to show the percentage of Viewers that disliked each segment.



While no one problem stood out for a majority of the Viewers, the largest group (35%) felt that the program was too long and could be broken into shorter episodes. Over one-fifth (22%) pointed to specific program segments, specifically the tulip, cannabis or the potato stories. Another one-tenth (11%) felt that the program's personification of plants was unrealistic. Smaller groups of Viewers indicated they liked everything about the program (8%) or that the program's "take-home" message was unclear (8%). A few additional Viewers: cited issues with the narration (6%), felt the program needed to clarify or provide more information in certain places (6%), felt the program featured inappropriate subject matter for youth audiences (6%), and/or perceived the program had a tone that was too preachy and/or biased (6%) or was too slow paced (5%).

From the Viewers that said that they disliked specific program segments, the most disliked was the tulip segment (43%), followed by the cannabis (36%) and then potato segment (21%). None of the Viewers raised anything to dislike about the apple segment.



Examples of Viewers' comments on the above themes follow below:

- The program was too long (35%)

Dividing the program into shorter episodes

- *I would have enjoyed it better in two parts. It was a bit long for me.*
- *I think I would have enjoyed it more if it were two one hour long shows. I was ready for the program to be over by the time the potatoes came on. Really, however, there wasn't much I didn't like. If I were watching it on my own, I most likely would have recorded it and watched in three or four sittings.*
- *It was a little long. If it was divided into 4 program series that would be great.*
- *While the information presented was of interest to me, the program was longer than I would have had time or focus to watch. I generally record programs and watch them after 9:00pm. I likely would have watched this program separated into its four different segments.*
- *I enjoyed the whole program however it was a little long to watch in one sitting. Normally I would watch a show like this for about an hour.*

Editing the program to make it shorter

- *I think that the program could be edited down to an hour if the material stayed more true to "Botany of Desire" and stopped focusing on the four plants themselves.*
- *The program seemed to be a bit long in the cannabis and potato segments. I think that could be cut down to about 1.5 hours. Maybe even having a break would be helpful.*
- *I felt certain parts were a little long-winded. I think a few pieces can be condensed into more compact segments.*
- *It was fairly long, though in another context (i.e. watching it recreationally) I think I would've found that more appealing. I'm not sure what would be appropriate to cut.*
- *Perhaps too long for one sitting. I found it fascinating and realize that it tied everything together, but suspect that many would find it too long to sit through, without wandering away from the vibrant content.*

Too long, overall

- *Overall, I enjoyed the program. This isn't a strong objection, but it seemed a little long.*
- *Nothing I can think of. It might have been a bit long, but that could also just be that fact that I have a hard time finding two consecutive hours to do anything!*
- *It was a bit long, but still very interesting.*
- *It was a little long and I found myself tuning out after a while. I enjoyed the apples segment but by the time the marijuana segment rolled around, I had to remind myself to pay attention.*
- *On the whole, I enjoyed the program very much. I don't have a particular dislike, but if I had to pick one aspect that I enjoyed least, it was the duration of the program. It was a bit long and I thought that to be a product of a slower pace. However, I can appreciate that the pace did lend to the program's ambiance.*
- *It was too long, i.e., I wanted to digest each of the 4 segments individually rather than having to leap into the next segments.*

- **Individual parts of the program (22%)**

- The Tulip story

- *There really wasn't much I disliked about the video. The only thing I really wasn't favoring was the part about the flowers. I'm not a big fan of flowers, so that part was no fun.*
    - *I didn't find the tulip segment as interesting as the other three, although I'm not sure why. The foods were the most interesting to me, I suppose because they are more personal to me. Really, however, there wasn't much I didn't like. If I were watching it on my own, I most likely would have recorded it and watched in three or four sittings.*
    - *The tulip segment interested me the least, perhaps because there is no practical value of tulips (as compared to the other plants featured)*
    - *Actually, the part about tulips wasn't particularly interesting either, so I would say it was probably a tie between those two. I liked the part about the flower auction--that was pretty neat.*
    - *The topic on tulips. I felt that that topic was more boring than the other and the fact is, tulips just aren't as interesting.*

- The Cannabis story

- *The talk about cannabis, seemed very pro for the use of the illegal drug also know as pot.*
    - *The inclusion of the segment on Marijuana makes it unlikely that this would be used in an educational setting. It is slightly celebratory on the subject.*
    - *I didn't like the segment on cannabis. The other segments were very interesting, but this one failed to hold my interest and I can tell from the questions that I didn't retain as much.*

- The Potato story

- *The part about potatoes was pretty boring, and in my mind, quite a stretch to represent "control."*
    - *I liked it all; the information I liked least was about how we have consumed lots of GM potatoes without even realizing it.*

- **The personification of plants (11%)**

- *I didn't like or agree with the approach that plants are thinking beings like we are, and control us. I realize that isn't exactly what was being communicated, but some of the insinuations are silly.*
  - *Too much emphasis on the metaphor of how plants "feel, think, control" humans.*
  - *I thought it was a stretch that they kept referring to plants as having a choice/consciousness where they influenced people to do their will. I know he was speaking metaphorically, but it was annoying because it didn't add to the richness of the topic. The topic of plants survival and adaptation was interesting enough without putting any human personification on it. I think it was overkill.*
  - *The personification of the plants - discussion of the plants "motivations" and "strategies" was a little too silly for non-botanists. Discussing the evolution of the plants from the plants' "perspective" or in terms of plant "decisions" did not enrich my understanding of the program.*
  - *I found the premise that plants can influence their destiny a bit of a stretch. I didn't think it worked well for a TV program. It didn't hold together the whole series of episodes.*
  - *I got a little lost when the host was talking about putting yourself in the "shoes" of a tulip.*
  - *The metaphor that plants are controlling us, not the other way around, at least metaphorically speaking. I wasn't buying that premise.*

- **Nothing, it was all good (8%)**

- *Gosh. I can't think of anything that I would place in this category. I enjoyed the entire program from many perspectives including the aesthetic, the creative, and the informative.*
  - *It is very difficult for me to isolate a particular thing that I didn't like.*

- **Unclear take home message (8%)**
  - *I'm still at a loss as to who the target audience is for this. As an adult that enjoys specials on PBS, I enjoyed it, but I guess I'm still unclear as to what the take-home message is for me - what does this program want me to remember, want me to do, want me to share?*
  - *It didn't seem cohesive. Seemed like several separate stories--it was hard to see the thread that connected them.*
  - *As a lifelong Washington State resident, I was surprised that the nation's top apple producer and exporter wasn't featured even briefly (with the exception of one shot of the state's name on a box). I am a little skeptical about the tulip's lofty place in the program (and book), even though I still found that segment interesting. Of the four plants featured, however, the evidence of its influence on botanical and human history seems the most flimsy. Could an equal argument have been made for the rose or another flower or plant?*
  - *There seemed to be two strong themes competing for attention. One is the premise that Plants are Manipulating Humans for its Survival. That theme is strongest in the Tulip and Mary J segments. These were clear in that the characteristics that both tulips and cannabis evolved, encouraged humans to propagate those species. The second is the pros and cons of Monoculture--this theme is strongest in the potato and apple segments. The apple segment covered the first and second theme equally. With the potato though, the monoculture warning seemed to overshadow everything else, even the fascinating exploration of the societal impact of the potato on N. European development. I may need to view the film over again, but it seems that the premise and the wrap were not 100% congruent. Both are compelling themes, and having these together in one show is not unnatural. However, because the monoculture message was so strong near the end, I forgot the original premise of Plants Exercising Influence on Humans theme that was laid out for me in the beginning.*
  - *The ending message was not clear and the integration of the four features (tulips, potato, cannabis and apples) could have been more in-depth pertaining to the takeaway from the human beings perspective.*
- **Narrator issues (6%)**
  - *It would have been interesting to see Michael in a different setting than the same interview seat, clothes, etc.*
  - *The multiple commentators or narrators - sometimes I did not know who was talking at some points.*
  - *One of the persons used in the apple section of the presentation. Her voice was very robotic and unemotional. She seemed uninterested in what she was speaking about.*
- **The need to clarify or provide more information on the material covered in the program (6%)**
  - *Being a history buff, I would have liked more references to the past and in greater sensorial detail about the myths surrounding the apple and even the tree in the garden of paradise. I would have liked to see a short, vignette on Johnny Appleseed in animated form going along the countryside spreading his seeds. Maybe some music and graphics would have also been in order to accentuate the points made by the narrator in between the pieces.*
  - *I wanted to know more about the intricacies of growing the plants sometimes.*
  - *I wanted to know some specifics that may have been assumed to be public knowledge, such as, where is Kazataan specifically (I know central Asia, but exactly where?)*
  - *I felt most of the time spent on the advanced science of studying and experimenting with the genes was not in-depth enough for me to learn how the process works very well.*
- **Inappropriate subject matter for students (6%)**
  - *To put my response in context, I have been working with student teachers for the past few years. The audiovisual material presented in The Botany of Desire format is less and less suitable to the learning style of the contemporary secondary school student. While the section on cannabis would certainly hold the attention of a high school audience, I am afraid that the other three segments would lose their attention.*

- *I took pause when Michael Pollan referred to "god's draft for apples" as this was supposed to be a science program. The inclusion of the segment on Marijuana makes it unlikely that this would be used in an educational setting. It is slightly celebratory on the subject.*
- *I'm still at a loss as to who the target audience is for this. I'm an educator, and although there are parts I would love to show my students in the classroom, I certainly can't show the segment on marijuana, and the hard cider part would not be appropriate.*
- **The program was a bit preachy/biased (6%)**
  - *I took pause when Michael Pollan referred to "god's draft for apples" as this was supposed to be a science program.*
  - *It was a little heavy handed in its message against monocultures, I don't usually like being hit over the head with a moral message.*
  - *The discussion of monoculture seemed fairly repetitive, but obviously that was the point of the program.*
  - *I don't think there was anything in particular I DIDN'T like about the program. If I had to say one thing - it's not necessarily a negative - but something I noticed: it did seem to be a bit biased on the "hot button" issues such as cannabis (for) and genetically engineered plants (against).*
- **Pace was too slow (5%)**
  - *Though very interesting, its pace was generally slow.*
  - *On the whole, I enjoyed the program very much. I don't have a particular dislike, but if I had to pick one aspect that I enjoyed least, it was the duration of the program. It was a bit long and I thought that to be a product of a slower pace. However, I can appreciate that the pace did lend to the program's ambiance.*
  - *In some parts it was a little too drawn out and I got a little bored.*



## Part 2: How successful did Viewers find *The Botany of Desire* in terms of: density of information, science, and scientific explanations and in communicating about the nature of plants?

### 2.1 How did Viewers feel about the amount of information, science, and explanations of scientific principles in *The Botany of Desire*?

Viewers generally found the program struck the right balance in terms of the amount of information, science, and explanations of scientific principles provided. Some Viewers said they would have welcomed the inclusion of even more information about genetic bioengineering and scientific explanations on the main concepts in *The Botany of Desire*.

Viewers rated *The Botany of Desire* for how they felt about the amount of information, science, and explanation of scientific principles in the program using a scale of 1 (too little) to 7 (too much), with 4 being “just right.”

**Table 3: Median Viewer ratings of content, science, and scientific information (n=65)**

	1	2	3	4	5	6	7	
Too little content	4.0							Too much content
Too little science	4.0							Too much science
Too little scientific explanation	4.0							Too much scientific explanation

The median ratings in Table 3 indicate that Viewers generally felt the program struck the right balance in terms of amount of information (4.0), science (4.0), and scientific principles (4.0). When Viewers were

invited to explain their ratings, the majority said that the amount of information and science in the program was just right and well balanced, while some Viewers would have welcomed more information on: generic bioengineering as well as scientific explanations on some of the concepts presented. Some others felt that there was too much information presented in a short amount of time.

Examples of Viewers' comments follow below:

- ***Too little or too much information***

- *As a whole, I like more information as opposed to less. After this film I was left with the desire to know more to all specific and related topics.*
- *From an information standpoint I did not find it overwhelming - it really seemed just right.*
- *Could have talked more about how genetic bioengineering actually works.*
- *Given the time requirements for 4 segments squeezed into an hour show, this was probably the right balance of theory, info and principal. Skewing too much on any of these would have been at the expense of storytelling -- a trade-off not worth making if we want to keep Viewers watching.*
- *Had a lot of information at one go, but it is how science programs are. So it is fine! I could cope with it.*
- *I am a viewer who was never very good at science. However, I am interested in food, and history and social issues. This program was very educational for me and presented in a format that, I think, speaks to a broad audience.*
- *I could not remember specifics regarding the experiments that were conducted. That suggests to me that too little time and effort was spent on those parts of the presentation.*
- *I enjoy learning more about the science behind the concepts. I don't have much opportunity in my daily life to explore science so I rely on PBS to provide me quality and in-depth information. I think there could have been more in each episode. Like the tulip episode seemed to dwell on the history more than the science.*
- *I felt it was adequately explained and presented for the average person with no science background.*
- *I really thought that it was just right, for me. Any more technical may have been over my head, and any less could have made it boring.*

- ***Too little or too much science***

- *I did enjoy it more when they showed the laboratory testing and interviewed the scientists behind the experimentation.*
- *For the science, it is hard to answer this question without knowing what was left out - I can't comment on something I don't know exists. As a geek, I don't think you can put too much science in.*
- *I was already familiar with most of the general scientific principles and would've liked more in-depth discussion of the particulars, but I might be at the over-educated end of your target audience.*
- *I'm not a scientist, but I had no trouble understanding the concepts.*
- *Just right for me b/c most of my questions as I thought about something I might want to know the answer to was answered through continuing to watch the video.*
- *Some of the science was without explanation; for instance, suddenly there were computer graphics, but there was little or no preamble to this; many items were not thoroughly explored, i.e. to me, it presupposed that the audience knew all this, but I did not (and I am a straight A student with a degree)*
- *The author tried to romanticize the concept of plants having a 'soul' instead of explaining the biological mechanics behind how plants adapted to fit new climates. I don't want his interpretation of how he thinks a plant 'decided' to leave its home through bear skat. How about more details on the way in which the plant chemically adapted because of the environment which then attracted specific species.*

- ***Asked a question***

- *Have PBS developed a curriculum for Tulip planting? Elementary and middle school level?*

## 2.2 Did Viewers feel that *The Botany of Desire* was successful in communicating information about the nature of plants and our relationship with plants?

Viewers consistently felt that program was successful in communicating information about the nature of plants and humans' evolutionary, ecological, and economic relationships with plants.

Viewers were asked to rate how successful they felt *The Botany of Desire* was in communicating three different themes relating to the nature of plants and our relationship with plants, using a scale of 1 (not at all successful) to 7 (extremely successful). The median ratings for each theme are presented in Table 4 below.

Table 4: Median Viewer ratings of the successful <i>The Botany of Desire</i> had in communicating information about the nature of plants (n=65)							
	Extremely unsuccessful			Neutral			Extremely successful
	1	2	3	4	5	6	7
How human desires are intertwined with the evolution of diverse plants?						6	
How the connected nature of plants and people affect global economic and ecological systems?						6	
The importance of biodiversity and genetic diversity in domesticated plant species?							7

Viewers felt that the program was successful in communicating all of the intended themes, including: the connected nature of plants and people, particularly how human desires are intertwined with the evolution of diverse plants (6), how the connected nature of plants and people affect global economic and ecological systems (6), and especially the importance of biodiversity and genetic diversity in domesticated plant species (7). Mann-Whitney tests indicated one subgroup difference for the first theme, as females tended to rate the program's success at communicating information about how human desires are intertwined with our own (Mdn=6.5) significantly higher than did male Viewers (Mdn=6.0).<sup>15</sup>

<sup>15</sup> (  $U=376$ ,  $p=.037$ ,  $r=.26$ )

When invited to explain their ratings, several Viewers' touched on each theme. Regarding the human connection to the evolution of plants, some suggested that the program could have spent more time illustrating how human actions within the plant world affect global issues. Regarding the connection between plants and people and how it affects the global economy and ecological systems, several indicated surprised by and interest in the dynamics involved in humans' effects on nature. On the importance of biodiversity, several viewed this to be the main theme, with some looking for further information on the role of genetic modification. Examples of Viewers' comments follow below:

- ***How human desires are intertwined with evolution of diverse plants***
  - *For the "intertwined" one, I'd forgotten about it until the survey (though now I remember it being discussed extensively at the beginning), which is a bit ironic considering it's the title of the program (I've been thinking that "biodiversity" was the key theme). If that's the primary theme you want to convey, then it should be talked up more - not just at the beginning and end.*
  - *The four plants highlighted different geographic origins, but the program did not spend a lot of time illustrating the positive or negative effects of the human footprint on the evolution of plants on a global level. Example: genetic engineering to respond to existing hunger in the world.*
  - *The program's most seen connection was pertaining to the human connection. The other 2 connections were evident but did not feature as well as the human desires option.*
- ***How the connected nature of plants and people affect global economic and ecological systems.***
  - *A very good job showing how different species of things can share a common purpose...survival.*
  - *For the "connected" one, I got it out of the program, but don't really have anything to add.*
  - *I was surprised to learn about how much humans do affect nature & vice versa.*
  - *We are all sharing this planet. Humans think they are the supreme being, but if we were, we wouldn't be fighting so hard against nature to win. People ultimately affect plants and vice versa.*
- ***The importance of biodiversity and genetic diversity in domesticated plant species***
  - *For the "biodiversity" one, I think you communicated that extremely well. I hope you wanted that to be the main theme of the program, as that's the main thing I got out of it. I'm not sure what Pollan wanted to communicate, but this is the theme that seems most relevant to everyday life.*
  - *It seems to me that the importance of bio and genetic diversity in domesticated plants can't be driven home too hard - it is a huge concern and unchecked it will, one day in the not too distant future, lead to one of the greatest human tragedies ever. This process is systematically eradicating species from the planet - no one should think that humans are far enough removed from the oneness of it all to be isolated from that process*
  - *I think a good follow up to the program would be to expand on genetic modification of plants, and demystify, or perhaps de-demonize the science.*
  - *It's clear as consumers of plants we really have to be careful about things like monocultures.*
  - *The program did not sufficiently, to me, explain modified genetic engineering; note: I am a big opponent to genetic engineering and the program downplayed this; I had to make a big effort to put this aside to enjoy the program; it surprised me that the program did not touch on the facts for this; I was put-off and offended by the lack of this.*
- ***Themes overall***
  - *Everything was tied in so well that I think this is self-explanatory, coupled with the other answers. Does make me want to read the book upon which the program was based to catch any minute elements that time may have skirted.*
  - *Extremely successful seems a bit ambitious. There was a lot of content in the video. I feel like I could give the highest rating of "7" if I were to view the program a second time and had the opportunity to glean the info that I missed the first time through.*
  - *These points were made clearly, using factual information rather than rhetoric making it refreshing and interesting.*

## Part 3: What did Viewers learn from *The Botany of Desire*?

The program's learning value was evaluated with a combination of self-report, open-ended, and forced-choice objective content-based assessments. To assess specific knowledge gains relating to the information presented about the history and characteristics of the apple, tulip, cannabis, and potatoes, both Viewer and Control group participants completed a 35 point "quiz" type assessment that included a combination of multiple choice, true-false, and open ended questions. Additionally, Viewers were asked to rate the program for how much they estimated they learned and to describe the most interesting things they felt they learned. Viewers also described what they found most surprising, and whether they felt or thought any differently about plants after viewing. The results from these follow in sections 3.1 – 3.5.

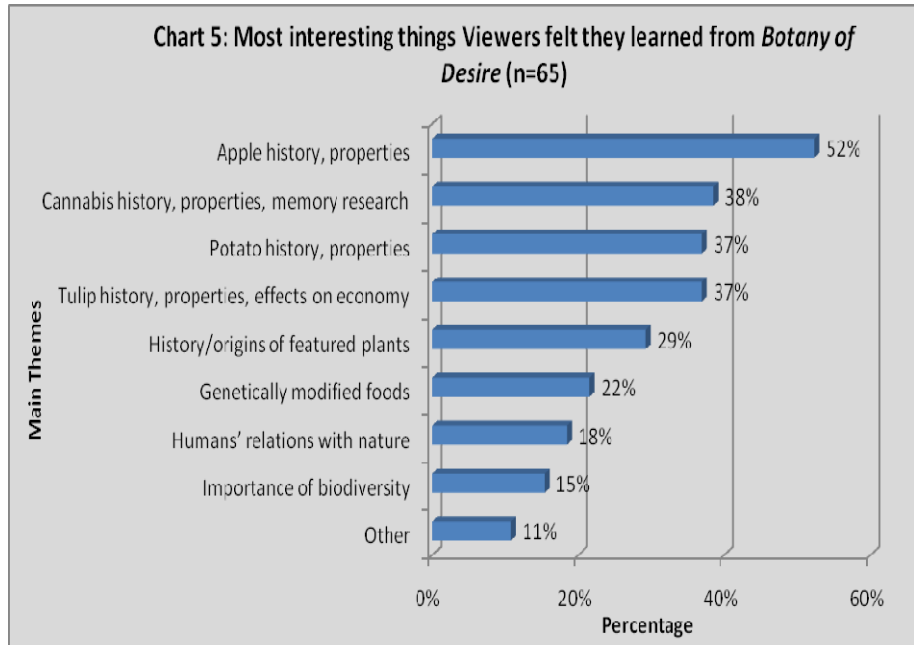
### 3.1 What did Viewers feel were the most interesting things they learned from *The Botany of Desire*?

Viewers were most interested in specific facts relating to the history and properties of the four major plants featured in the program. Most often they pointed to content presented in the program's opening segment on apples, followed by the three other major segments on cannabis, tulips and potatoes respectively. Many Viewers also pointed to learning about the program's broader science and nature themes, involving the genetic engineering of plants, human's relationship with plants, and the importance of biodiversity.

When asked to describe the most interesting things learned from watching *The Botany of Desire*, all of the Viewers identified one or more new things of interest. Chart 5 on the next page shows the nine main topics that Viewers most frequently pointed to and the percentage of Viewers citing each topic.

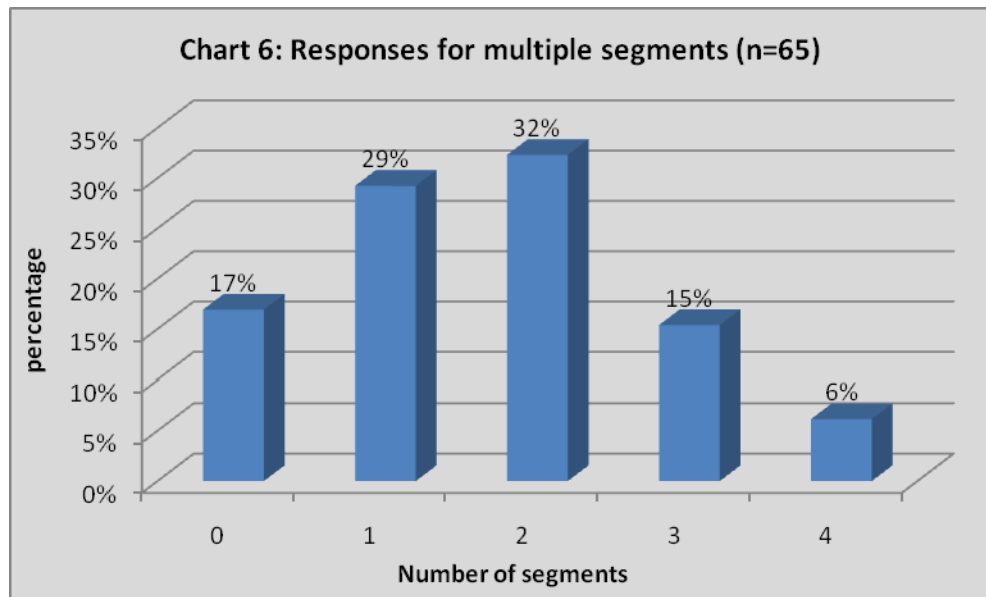
About half (52%) of the Viewers said they enjoyed learning information presented about the apple in the opening segment on apples, particularly relating to the apple's history and properties. Close to two-fifths of the Viewers were each interested in information they learned in the potato (37%), cannabis (38%) and tulip (37%) segments. Here again, in each case information on the history and properties of each plant most intrigued Viewers, with those pointing to the segment on cannabis also interested in the health/memory research and those pointing to the tulip segment interested in the effects on the economy. Nearly a third of the Viewers (29%) were interested in the historical perspectives that were offered throughout the program,

specifically the origin of the featured plants. Just over a fifth (22%) were drawn to information they learned about genetic engineering of crops, specifically as it relates to genetically modified foods, while somewhat smaller groups enjoyed the information given about the biodiversity within plants (15%) and about human's relationship with nature (18%). A small percentage of Viewers (11%) provided other responses, which included comments about enjoying the clear presentation, the inclusion of scientific perspectives, and a general interest in the nature content presented.

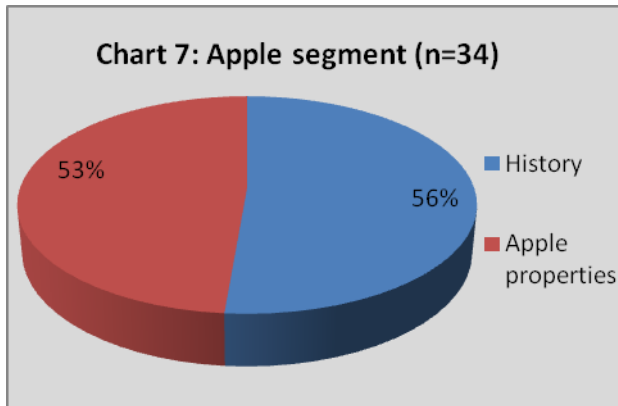


Many Viewers offered in-depth responses that encompassed multiple segments. Chart 6 shows the percentage of Viewers that commented on 1 to 4 segments (with the 4 segments being apples, tulips, potatoes, and cannabis). Just under one-third of the Viewers (29% and 32%) were interested in 1 or 2 segments, respectively. Just under one-fifth (17%) didn't point to any specific segment while 15% pointed to three different segments, and 6% pointed to all four segments.

The four pie charts on the next page further break down the responses from each segment of the program (apples, potatoes, tulips, cannabis, respectively) into subcategories that the Viewers most frequently pointed to and the percentage of Viewers citing each topic.

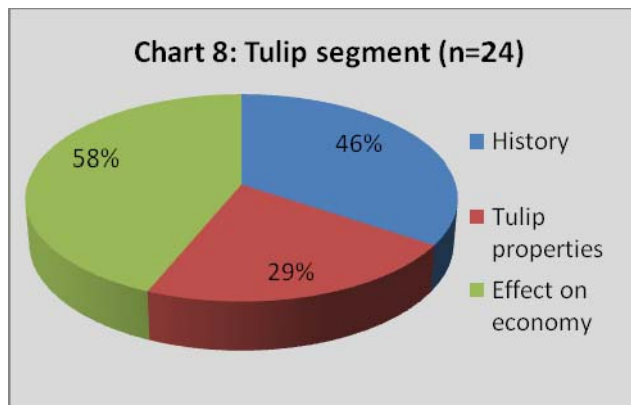


## Subthemes within segments



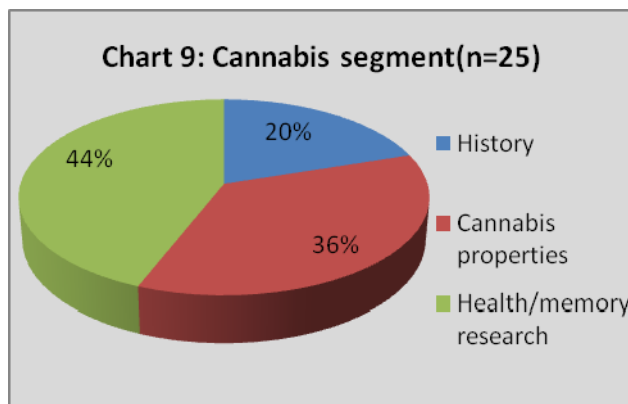
From the Viewers that thought the apple segment was interesting:

- 53% indicated that they were intrigued by the history of apples, most often about Johnny Appleseed.
- 56% enjoyed seeing information about the properties of apples, specifically about the sweetness and the growth of apples.



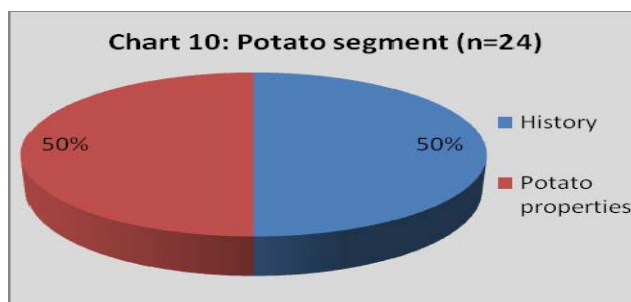
From the Viewers that enjoyed the tulip section:

- 58% were interested in the history of the tulip.
- 46% were interested in the properties, specifically in the growth and the “broken” tulips.
- 29% were interested in the effect tulips had on the economy.



From the Viewers that were intrigued by the cannabis segment:

- 44% enjoyed information about the effects that cannabis has on health and the memory research that is done with cannabis.
- 36% were interested in the cannabis properties, specifically the way it is grown.
- 20% were interested in the history of cannabis.



From the Viewers that commented on the potato segment:

- Half (50%) enjoyed the history of potatoes, specifically the Irish famine and potatoes’ relation to the industrial revolution
- The other half (50%) were interested in the potato properties, specifically the growth, genetic engineering, and diversity.

Examples of Viewers' comments on each theme follow below, ending with a few examples that illustrate the depth and completeness of many of the responses:

- **History (29%)**
  - *The origins of the plants was interesting and something I didn't know. Johnny Appleseed and how/why apples are reproduced was interesting most likely because I thought I knew this and was totally wrong. The history of apples, the reduction of types and their reintroduction was interesting.*
  - *The history of both the Apples and Potatoes that I formerly did not know. Learned the origin of potatoes, about the Irish famine, that John Chapman was real as I always thought that Johnny Appleseed was a fictional fairy tale character.*
  - *I did not know the true history of Johnny Appleseed. This is a subject taught at school for my young children every fall. I appreciate knowing the true history of events and the opportunity to share that with my children at age appropriate times.*
- **Genetic Engineering (22%)**
  - *The genetic potato process to me seems like such a wise alternative to pesticides.*
  - *The most interesting thing I learned was about the genetically modified potatoes that were used by McDonald's and the fast food industry for several years before public outcry forced the industry to stop using GMOs in their food production. It is unclear to me why people concerned about what they are putting into their bodies would so strongly reject genetic modification and not show the same concern for the chemical pesticides farmers must use to support potato monocultures. So often large powerful companies are perceived to be the bad guys, but consumers are also responsible for feeding the demand with their desires.*
  - *I feel that the most interesting thing is that McDonald's has been producing genetically altered potatoes without me even knowing. It's interesting because McDonald's is such a popular company and I myself probably ate some of these potatoes.*
- **Human relation with nature (18%)**
  - *Nature really does somewhat control us. We humans like to think we are in control so it is interest to approach the subject of "control" from a different vantage point.*
  - *How humans' interaction with plants was depicted. It was interesting to think of it more as us doing their bidding, than the other way around.*
  - *I appreciated Mr. Pollen's thoughts on co-existing with the forces of nature and the mutual adaptation that exists between the natural world and society.*
- **Biodiversity (15%)**
  - *Diversity and variety is essential to sustaining life! Bio diversity is crucial! We are part of the web of life and with everything we do our "evolutionary votes are cast"! When we do share in this web of life we become members of the biotic community, and this act will help secure our future, and the future of our children will continue to prosper.*
  - *Mostly, this emphasized in my mind the importance of biodiversity. I particularly enjoyed seeing the concepts tied to historical events.*
  - *I was unaware that there are so many different varieties in apples and tulips.*
- **Apple segment (52%)**
  - **History**
    - *I found the section on apples very intriguing. The section on Johnny Appleseed and his history was interesting as well as the part on grafting the apples to create the perfect apple.*
    - *The history of apples - the population has taken this fruit for granted and after knowing where it originated, what it took to make it sweet and fresh today makes me want to appreciate more.*



- *The history of Johnny Appleseed - I grew up in New England and used to pick apples, so I really enjoyed this entire segment.*

#### Apple properties

- *I enjoyed learning many things. Very interesting to me was all the varieties of the apple and that most of them did not taste sweet.*
- *I found it interesting to learn wild apples are not naturally sweet, and that for years most apples were used only to make hard cider. I suppose I had assumed most apples were naturally crunchy and tasty.*
- *That the seeds of an apple will not necessarily produce a tree of that same variety; I never knew that! I assumed it would be like a flower, or most vegetables, where seeds are used to produce the specific plant they came from.*

- **Tulip segment (37%)**

#### History

- *History of tulip commerce, and how crazy it was. Had never heard the Tulipmania story before. Not sure how it fit into the whole monoculture theme of the rest of the show*
- *I learned some historical information about the tulip that surprised me. Modern day production of flowers is mind-baffling.*
- *Enjoyed the history of Tulipmania, again, many translations. The flower market, the size of it was new to me - 100 times the size of a football field is impressive...*

#### Tulip properties

- *I didn't know that a "broken" tulip is caused by a virus. I also didn't know that tulips once had a smell...I don't think I've ever found one that does, today.*
- *How a simple flower like a tulip, was so overvalued, and how humans can cross breed them to create amazing new varieties.*
- *I did not know the origin of the color streaks in the tulips was fungus related and that it had an attrition effect on the plant.*

#### Effect on economy

- *The flower market, the size of it was new to me - 100 times the size of a football field is impressive. The size of the potato farm - 100 miles! The sheer magnitude of just this one farm shows the staggering amount of food it takes to feed the world.*
- *I really enjoyed the discussion of the tulip speculation boom and bust. I'd never heard of that before, but I found the parallels to the stock market fascinating.*
- *That Tulips became a thing so desirable that it caused the veritable economic collapse of an entire nation. That the flower auction in Holland processes the majority of flowers for world-wide public consumption. The warehouse is the size of "200 football fields" and is the largest building in the world. I had no idea....*

- **Cannabis segment (38%)**

#### History

- *Cannabis's history is completely foreign to me and I appreciated that info, too.*
- *As stated earlier, I loved learning the history of our relationship to plants: hard cider, Peruvian farmers, potato famine, and the jazz musicians smoking marijuana.*
- *Learning paraquat was used on the fields of cannabis in Mexico led to the surge in popularity in the states was interesting. That's significant to our drug culture.*

### Cannabis Properties

- *I found the way cannabis is grown today versus many years ago is so dramatically different (scientific) to be very interesting. The current cannabis growth process is so much more sophisticated than I would have ever imagined. I visualize some teenagers with a hot lamp in a basement. It's way beyond that.*
- *The desirable product behind cannabis growth and usage. I thought it was interesting to learn that male and female strains of cannabis needed to grow in separate spaces to enhance the growth of resin/THC.*
- *How marijuana cultivation is such a high tech field and that the criminalization of marijuana drove its cultivation indoors and resulted in even more potent varieties.*

### Health/memory research

- *That we have receptors in our brain that is used for forgetting and why forgetting is just as important as memory. I am now curious as to how the forgetting receptors can be engaged and if we can be selective about what is forgotten.*
- *The most interesting point to me was the work of the Israeli scientist who used what was known about THC to learn more about the functioning of the human brain.*
- *The most interesting aspect from this program was why Humans need to forget the data or information coming towards them. How the receptors in the memory function. I found these facts interesting because of the uniqueness of the concepts that I never pondered on, while thinking about life.*

## • Potato segment (37%)

### History

- *The Monsanto gene project and how it could change the plant to kill the beetle. I remember the controversy, but at the time didn't understand why there was the uproar. I would like to know more. magnitude of just this one farm shows the staggering amount of food it takes to feed the world.*
- *The historical and societal impact of plants, especially in the potato segment, was something I did not know. It was surprising, yet logical after hearing the explanation, on how one food crop literally changed the balance of population and history. First, the potato allowed the population of Ireland to explode, then (though not covered in the episode), the resulting collapse of the crop lead to the mass migration of Irish people elsewhere. East Coast, railroad building, history is tied to this plant. Fascinating context.*
- *Source of the Irish potato famine. Interrelation between potatoes and the Industrial Revolution and development of Northern Europe.*

### Potato properties

- *I did not know potato plants could be grown from a slice of potato, going to have to try that myself now!*
- *In the potato section, I learned about the genetically engineered potatoes that I've probably eaten at McDonald's. Again, it's something I never knew*
- *The natural world is interesting and I am concern that Monsanto is changing the natural selection with genetic engineering.*

## • Other (11%)

- *I found the history of each item to be interesting. The material presented about each was clear and not something usually found in history books.*
- *How nature works!*
- *I realized that people are truly passionate about growing the perfect crop and a lot of work and science goes into perfecting it. In fact, food I guess is a science.*

## • Examples of in-depth responses

- *The origins of the plants was interesting and something I didn't know. Johnny Appleseed and how/why apples are reproduced was interesting most likely because I thought I knew this and was totally wrong. The history of apples, the reduction of types and their reintroduction was interesting. The crazy money spent on*

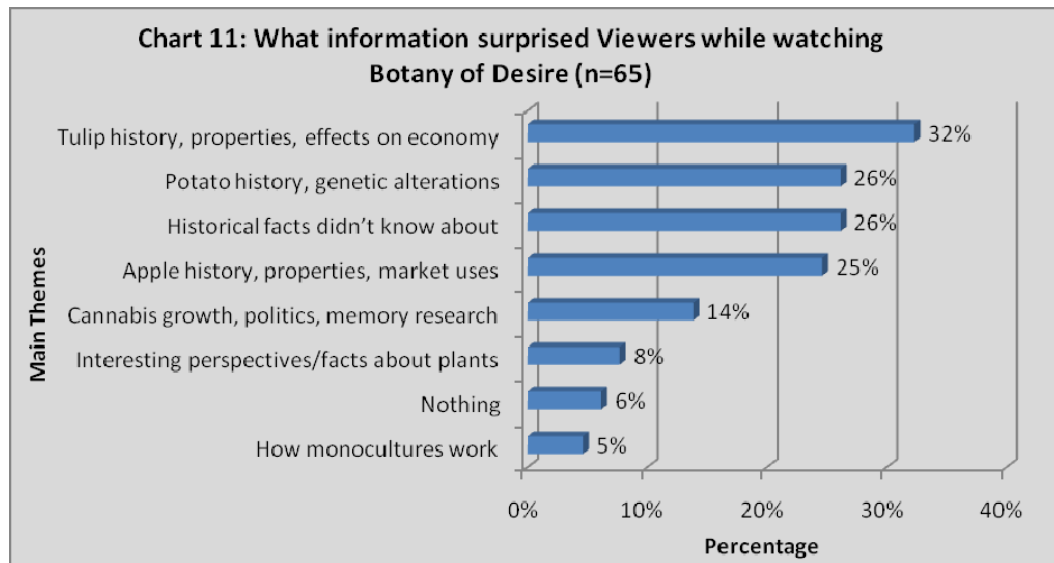
*tulips was interesting and made me think of buying Beanie Babies several years ago. I think I knew quite a bit about growing marijuana from other programs (Weeds!), although it was interesting to learn of the memory theories. Because my state (Michigan) now has legal medicinal marijuana, it was also interesting to learn how the couple grew it. Potatoes - the picture of the different potatoes grown in Peru was interesting - I had no idea there were so many different ones. The farming segments were also interesting and educational. It was interesting to see protest of the WTO and genetically altered crops together. I'm currently taking an international economics class, so the WTO protest sign stuck out to me.*

- *That the apple came from central Asia. I had always assumed that it was a domestic plant. That the apple has fallen in and out of favor in our society. I had no idea about the apples role in promoting alcoholism. That there are so many varieties of apples and that the diversity of the species is what keeps it healthy. That tulips became a thing so desirable that it caused the veritable economic collapse of an entire nation. That the flower auction in Holland processes the majority of flowers for world-wide public consumption. The warehouse is the size of "200 football fields" and is the largest building in the world. I had no idea. That it is the female cannabis plant that we cultivate for consumption. I did not know about the relationship between the male/female plant and THC production. That THC actually mimics a chemical that our brains naturally possess. I guess this explains our affinity for the drug. That the potatoes originated in South America. That a monoculture was responsible for the Irish potato famine. I am interested in this event in particular. I am surprised that we are walking a similar path in the nearly excluding growing of a single variety of potato to supply the fast food trade. Apparently we didn't learn our lesson the first time.*

### 3.2 What information surprised Viewers while watching *The Botany of Desire*?

Viewers were most surprised by specific facts they learned about the history and properties of the four major plants featured in the program. Most often they pointed to content presented in the program's segment on tulips, followed by the segments on potatoes, apples, and cannabis respectively. Several Viewers also mentioned they were surprised by what they learned about the genetic alteration of plants, while others mentioned that they were surprised that the program was as interesting as it was. A few Viewers mentioned that nothing particularly surprised them.

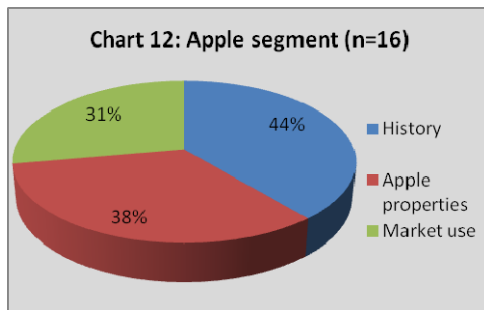
When asked to describe what were the most surprising things learned from *The Botany of Desire*, most of the Viewers identified one or more things that surprised them, with just a few indicating that nothing in the program surprised them. Chart 11 shows the seven main topics Viewers most frequently pointed to. The four pie charts on the next page further break down the responses relating to each segment (apples, potatoes, tulips, cannabis, respectively) into subcategories.



About a third of the Viewers (32%) were surprised by the information presented in the tulip segment, in particular relating to the tulip's history, properties, and effect on economy. About a quarter of the Viewers (26%, 26%, 25%) were surprised by the potato segment, cannabis, and apple segments, respectively. In the potato segment the Viewers were most surprised by the information presented on the potato's history

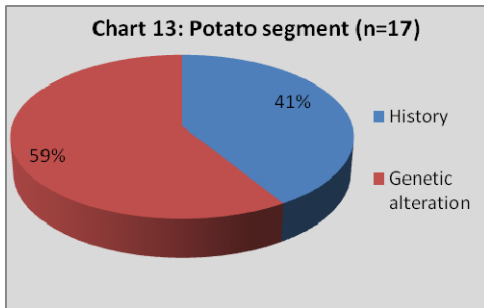
and genetic alterations, while in the apple segment the Viewers were most surprised by the history, properties, and market use of apples. Those pointing to the cannabis segment most often mentioned the politics, properties, and health/memory research of cannabis. Beyond the four segments, smaller groups of Viewers (8%) thought that *The Botany of Desire* had interesting perspectives and information about plants. A mere 5% of the Viewers were surprised by the information about genetic alteration, specifically how monocultures work, while 6% of the Viewers stated that nothing surprised them from the program.

### Subthemes within segments



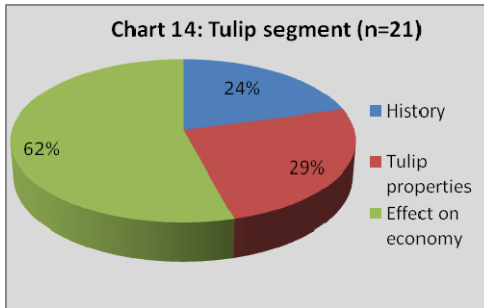
From the Viewers that were surprised by the information in the apple segment:

- 44% indicated that they were surprised by the history of apples
- 38% were surprised by the various properties of apples, specifically the differences in parent/offspring as well as the growth process of apples.
- 31% were surprised by the market use of apples, specifically that apples are used to make alcohol/cider.



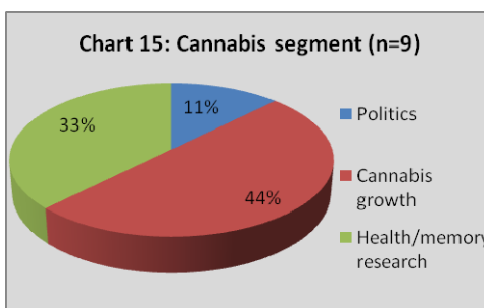
From the Viewers that were surprised by the information in the potato segment:

- 59% indicated that they were surprised by the genetic alteration that is done on potatoes, specifically the as it relates to McDonalds.
- 41% were surprised by the history of potatoes, specifically the Irish famine.



From the Viewers that were surprised by the information in the tulip segment:

- 62% indicated that they were surprised by the tulip's effect on the economy.
- 29% were surprised by the properties of tulips, specifically the smell and distribution of tulips.
- 24% were surprised the history of tulips, specifically about Tulipmania and the origin of tulips.



From the Viewers that were surprised by the information in the cannabis segment:

- 44% indicated that they were surprised by the growth of cannabis.
- 33% were surprised by the health/memory research connected to cannabis.
- 11% were surprised by the political issues that stem from cannabis.

Examples of Viewers' comments on each theme follows:

- **Apple segment (25%)**

History

- *The things that surprised me most were things I thought I knew the answer to, i.e. Johnny Appleseed, how to grow apples.*
- *It surprised me that apples came from Kazakhstan because I was under the impression that the only thing Kazakhstan produced was Borat. :)*
- *I found the story of the real Johnny Appleseed to be very surprising.*
- *The fact that apples had such a rich history.*

Apple properties

- *That apple seeds are a variety of apple characteristics and the subsequent trees may be very different from the original apple. I assumed that seeds either breed true or are sterile, not this huge variety of possibilities.*
- *That apple seeds planted will not create the same apple variety/taste/etc.*
- *I had no idea that the apple trees he was planting were not "ordinary" edible apples, but apples that were bitter and could only be used for hard cider. I still find it strange that he would not choose to use the method of "grafting" seedlings to grow trees and was instead spreading seeds, especially if he was doing it for incoming groups of people inhabiting the areas, even keeping in mind his religion.*

Market use

- *The information about the apples being used as hard cider was surprising. I had no idea that people could make alcohol from cider and I only figured they had other means of making alcohol.*
- *It surprised me that flowers bring in so much money. It surprised me that the cannabis plant is taken so seriously by growers. It surprised me that apples were used for alcohol at one time.*
- *That apples were used for hard cider. I never knew that. I knew about potatoes and grapes making alcohol, but not the apple.*

- **Potato segment (26%)**

History

- *I am surprised that we are walking a similar path to what led to the Irish potato famine. The nearly exclusive growing of a single variety of potato to supply the fast food trade is fraught with peril. Apparently we didn't learn our lesson the first time.*
- *I never knew that the potato famine came about because only one variety was grown there; I had never read about it, and I found that surprising.*
- *The historical use of different varieties of potatoes by the Incas, and how we somehow historically (especially in Ireland) didn't learn from that. In retrospect, it seems fairly obvious.*

Genetic alteration

- *I would have to say the most surprising thing is the McDonald's altering potatoes without really informing the public. It definitely shows that they should have since they aren't serving the product any more.*
- *That French fries drive the world market for potatoes -I thought it'd be more "traditional" use. That apples were primarily used in cider (I think I'd heard that before, but hadn't really thought about it)*
- *I was surprised that McDonald's listened to the protests and took the GMO off because the GMO's in corn are so widely used.*

- **Tulip segment (32%)**

History

- *I was also surprised by the origins of both potatoes and Tulips, since I thought they were both Dutch.*
- *I found the origin of the apple and tulip to be surprising, simply because I had previously thought they both had originated somewhere in Europe.*
- *How important tulips were in the 1600s, and how overvalued they were, how some farmers are moving away from monoculture.*

Tulip properties

- *Again, that tulips are prized for their scent, because I don't think I've ever found one that smells.*
- *That one out of three flowers on the little blue planet rolls thru a giant warehouse in Holland. It seems ridiculous to me that we send flowers all the way around the world. I think it speaks to an inherent flaw in the human condition.*
- *Tulips with color breaks are not exported or economically viable because of the bacterial infection that causes the color breaks weakens the plant.*

Effect on economy

- *I was surprised to learn about the tulip mania in Denmark. It would never have occurred to me that people would pay the equivalent of millions of dollars for a tulip bulb.*
- *It surprised me that flowers bring in so much money.*
- *I found it surprising that a flower with almost no other use than aesthetic value could drive such a financial boom and bust in a relatively sophisticated society.*
- *The Tulipmania in Holland surprised me. How people could get so worked up over something that simply provides an aesthetic need was really insane.*

- **Cannabis segment (14%)**

Politics

- *I was surprised by the laissez-faire attitude toward the growing of cannabis. I know that cannabis prohibition and legalization are controversial topics and I think the program elided the controversy.*

Cannabis' growth

- *The economy that cannabis growers invented to save growth time.*
- *How marijuana is more potent when grown in the lab.*
- *The growing of cannabis indoors and how it has developed stronger strains. I have heard this before, but I never really believed it.*

Health/memory research

- *Well again, the things that I learned were surprising. The role of cannabis in forgetting and its natural neurochemical analog was probably the most surprising to me.*
- *I'm going to have to revert to the forgetting concept in the cannabis segment as well as the apple purpose and history.*

- **History (26%)**

- *That apples and tulips seemed to evolve from the same region of the world and that there were just about the same amount of varieties.*
- *The vast quantity of varieties of all of the subjects. I didn't realize there were thousands of apples and tulips, considering only a few are commercially viable. I was surprised that the monoculture method of*

*farming effects how the plant responds to diseases. I didn't know this was a phenomenon in agriculture, nor had any other example to relate where it happens in other sciences or nature.*

- *I never knew that the potato famine came about because only one variety was grown there; I had never read about it, and I found that surprising.*
- *How Tulip varieties are grown, how when apples are grown from seed they often taste sour, how marijuana is more potent when grown in the lab, how important tulips were in the 1600s, and how overvalued they were and how some farmers are moving away from monoculture.*
- *The historical use of different varieties of potatoes by the Incas, and how we somehow historically (especially in Ireland) didn't learn from that. In retrospect, it seems fairly obvious.*
- **Program was interesting (8%)**
  - *It surprised me to think of plants in this way. That they could be manipulated us to get what they want. What an interesting perspective.*
  - *Mostly, I was surprised that it was so interesting. When I saw the word "Botany" in the title, I had anticipated something very boring.*
  - *Really all of it because I was not familiar with any of the info that was presented!*
- **Genetic alteration (5%)**
  - *I guess I kind of combined this question with the previous one. Although I guess I was surprised that they wouldn't continue to use a product like BT. I personally feel that doing something like that would be WAY better than spraying the plants with toxic pesticides time after time. I suppose a lot of people still get freaked out about the concept of genetically modified anything.*
  - *the vulnerability of each species to the whim and desires of mankind to allow them to prosper, not prosper, to be crippled, or to be dangerously modified*
  - *How monoculture works and evolves*



### 3.3 Did Viewers think or feel about plants in a new or different way after watching *The Botany of Desire*?

Most Viewers felt that the program did cause them to think or feel differently about plants as they now had a better understanding of: humans' symbiotic relationship with plants; the complexities of plant life; a renewed interest in gardening, planting and farming; GMO's; the importance of biodiversity; and potatoes and cannabis.

Those who felt that the program didn't cause them to think or feel differently most often indicated this was because they didn't connect with the program's content or because they already felt a strong connection with plant life prior to watching *The Botany of Desire*.

Viewers were asked whether their experience watching *The Botany of Desire* caused them to think or feel about plant life in a new or different way. Table 5 presents the percentage of Viewers saying *Yes* and *No* to this question, followed by their reasons in each case.

The majority of Viewers (80%) felt that the program did cause them to think or feel differently because after viewing they had a better understanding of: humans' symbiotic relationship with plant life (54%); how complex plants are (15%); renewed interest in gardening, planting and farming (14%); GMO's (6%); the importance of biodiversity (3%) and information about potatoes and cannabis (3%). A small percentage of Viewers had other reasons that caused them to think or feel differently (2%).

Just under a fifth of the Viewers (18%) indicated that the program didn't cause them to think or feel differently because: they could not connect with the program content (12%), or they already had a strong connection with plant life (5%). Examples of Viewers' comments on the above themes follow below:

Now have better understanding of...	80%
How plants may influence humans' actions	54%
The complexities of plant life	15%
Planting, farming, gardening	14%
GMO's	6%
Biodiversity	3%
The potato	3%
Cannabis	3%
Other	2%
Didn't cause to think/feel differently...	18%
Lack of connection to plant life	12%
Already had a strong connection to plant life	5%

- **Caused to think/feel differently**

*A better understanding of humans' symbiotic relationship with plant life*

- *Because nature can control us in many ways. So...be nice to plants!!*
- *How everything needs to work together to survive.*
- *I agree with Pollan that plants, in some way, have altered human behavior as much as we alter plants.*
- *I always thought that we could control plants. Now I realize that plants have more of a role in how they control us.*
- *As I mentioned above, I never had the perception of having a symbiotic relationship with plants. Now I will look at the plants we use for food and beauty completely differently. Seeing this made me truly believe that we have as much influence on plants as they have on us.*
- *I am reminded of both the awesome power of nature and of human's incredible power affect - for better and for worse - the evolution of plants.*
- *I did not think too much about plants apart from considering them as another form of living beings. But after this program I have started to see them from a human beings perspective of fulfilling desires.*
- *I enjoyed the idea that the plants do something to make us keep them around-that they are involved in evolution in direct interaction with us.*
- *I had never considered that plants might be propagating themselves by appealing to us.*
- *I hadn't really thought about humans being a tool of plants, that the plants that engage humans the most were the most successful. That being attractive to humans was a survival technique.*
- *I thought about humankinds relationship to the bigger picture*
- *I have always been extremely fond of plants and what they can do for humans, but never connected with what they might have taught us to do in their favor. Very interesting thought that they may be more calculating than I had considered. A manipulation that I don't mind a bit*
- *I learned to a greater extent how strong nature is, and how man cannot fully control nature, but must learn to live/adapt/work with it.*
- *I loved seeing our role in assisting the plants to grow and diversify and our unwitting role in supporting them vs. our traditional way of thinking that they support our lifestyles.*
- *I may be more aware of where my produce, or flowers, or other products come from and how they are marketed. Do consumers drive supply and demand for these products ... or do these products ultimately drive us? It's something I hadn't considered.*
- *I now have a deeper conception of how plants have adapted themselves to retain our dependence on them.*
- *I realized that we cooperate in subtle ways as we coexist with the plant world. They do not do our bidding, in fact, in some ways we do theirs (metaphorically speaking).*
- *I see a larger connection with these plants in daily life.*
- *I usually just think about plants being there and not so much about the connection with humans.*
- *Interesting paradigm presented on the intro, of plants influencing humans. We're not changing nature per se' -- we're accelerating the pace of natural selection (sometimes with unforeseen consequences), and that selection is influenced by the traits that plants themselves exhibit. Now I am on to what that tomato is trying to do to me in the grocery aisle. It looks all red and innocent, but I now have insight into its insidious designs on world domination. I will now have a steak instead. At least I know what's going on in the cow's head (nothing).*
- *It brought me to the realization that the symbiotic relationship between humans and plants is quite profound! It was very enlightening, and made me realize that the decisions we make everyday are very relevant today and in the future.*
- *It caused me to see plants as being smart, even though they can't process. They are using as for many things, and these things outnumber the things we use them for.*
- *It made me sad that I don't have a green thumb! And it was really interesting to me to see the connection between the plants and their "humans" (growers), like the people who grew the medical marijuana. I had heard people say to talk/sing to your plants, but always considered it kind of a hokey idea, LOL.*

- *It was presented from the point of view of the insect or plant.*
- *I've never thought about things from a plant's point of view because I don't think of them in that way. It was appealing.*
- *Taken in general, plants according to their genetics behave intelligently to their environment just as we do. They in fact can shape the way that humans develop their culture by adaptation and variation.*
- *That they truly have sustained the life of humans with regards to potatoes. Also the power over different cultures some plants have had. That a millions people died in Ireland because of the potato crops being infected with disease. What power over us humans.*
- *The ability to bend nature to man's will was clearly shown, nature's ability to protect itself.*
- *The program showed me how powerful nature truly is and how we all are woven together. Simply amazing!*
- *This program further confirmed my growing notion that every single thing on this planet is interconnected and that we as humans need to step back at times to get a different perspective on the relationships we have with the things and systems that exist in our natural world, and where we stand in such relationships.*
- *We are what we eat and desire. Plants affect us internally and externally, we may not exist without plants on earth.*
- *We need plants to sustain us. We desire things and we need them and we need to learn how to get these things.*
- *We play a vital role in the plants evolution and the plant holds an important part of our food supply.*
- *While I am accustomed to thinking of humans as dominating over nature, this program opened me up more to thinking of how plants are actually getting us to work for them...*
- *While I recognize that there is not the same level of consciousness apparent in plants, my thinking during the program was shifted into seeing the plant's actions being purposeful in the evolutionary sense. I found this to be both interesting and endearing.*

#### *A better understanding of the complexities of plants*

- *I am more aware of their beauty and complexity, and power.*
- *I am reminded of both the awesome power of nature and of humans' incredible power affect - for better and for worse - the evolution of plants.*
- *I feel differently about plants mostly because I had no idea that a simple plant could be so complex.*
- *I learned to a greater extent how strong nature is, and how man cannot fully control nature, but must learn to live/adapt/work with it.*
- *Made me appreciate the historic derivation of apples, cannabis, tulips, and potatoes!*
- *Now I am paying more attention to plant diversity and how it benefits humans and animals and our world.*
- *Our use of plants greatly affects our relationship with them, and imposes a continual evolution as a society and the farming of those plants. As a result of our interest and production of them, there are advancements, as well as consequences.*
- *The program showed me how powerful nature truly is and how we all are woven together. Simply amazing!*
- *While a plant, or even a gene, might not be useful now, it could become so in the future.*

#### *A renewed interest in gardening, planting and farming*

- *I have a fascination with plants and this film kindled my fascination. About my organic garden and what I am and am not doing to better it.*
- *I have always been extremely fond of plants and what they can do for humans, but never connected with what they might have taught us to do in their favor. Very interesting thought that they may be more calculating than I had considered. A manipulation that I don't mind a bit*
- *I have been moving toward a greener lifestyle and I love leaning about how the planet works, how our food is grown, and how we care for the environment.*
- *I may be more aware of where my produce, or flowers, or other products come from and how they are marketed. Do consumers drive supply and demand for these products ... or do these products ultimately drive us? It's something I hadn't considered.*
- *With regards to plants and food that we eat, I realize so much goes into the product of what we eat.*

- *It really made me want to grow things... I really like apples and this segment made me want to buy a house (I rent), plant apple trees, and start making cider. Even the potato segment made me want to grow things and cook them, rather than eating mostly prepackaged food like I do now. It renewed my interest in wanting to plant more fruit trees, and expand my garden.... Also, plant more tulips...*
- *The program reinforced my conviction that I have a lot to learn about plants and the physical sciences in general.*
- *Yes, I have a family farm in southwest Virginia. It gave me ideas on how we could use the land in a healthy natural way. We have a winery near the farm and gave me ideas regarding apple wine. Farming for healthier food sources. To garden with a more appreciation of nature.*

#### A better understanding of GMO's

- *Of the way plants are altered to improve our consumption of them.*
- *I'm going to be much more aware of GMOs now.*
- *I had always thought that GM plants were a good possible future for farming but I after seeing the program I would have to think a little more on my position.*
- *It made me think a little more about how our food is grown and made me appreciate organic a little more.*

#### A better understanding of the need for biodiversity

- *Now I am paying more attention to plant diversity and how it benefits humans and animals and our world.*
- *The program gives reason to the belief that biodiversity should be protected.*
- *Additionally, it makes a case for keeping as much biodiversity as possible. While a plant, or even a gene, might not be useful now, it could become so in the future.*

#### A better understanding of the potato

- *Again, the French fries, it bothered me that they were put in the food chain. But I thought about it and it was naturally appearing in another food and I was still on the fence. But I thought even if they were still making McDonald's fries out of those potatoes today, I would still eat them, knowing what I now know. It made me think a little more about how our food is grown and made me appreciate organic a little more.*
- *That they truly have sustained the life of humans with regards to potatoes. Also the power over different cultures some plants have had. That a millions people died in Ireland because of the potato crops being infected with disease. What power over us humans.*

#### A better understanding of cannabis

- *I was interested to hear the guy talk about the marijuana plants and how it was almost as though they sensed when the lady wasn't there. It made me think about energy and how as the narrator said, we think we're smarter than they are. Are we?*
- *As I previously mentioned, it made me think of cannabis in a whole new light. It's not like I'm going to start smoking pot now as a result of this program, but if I'm ever in Amsterdam (or California soon), who knows, I might give it a try.*

#### Other

- *It reinforced the basic notion that chemicals aren't the best way to deal with crop pests, nature has ways of taking care of it we should note and use.*

- **Didn't cause to think/feel differently**

Didn't connect with the information presented in the program

- *I just found it interesting, but not my connection*
- *I wasn't really watching because I wanted to. It was more akin to a school-based assignment--I felt like I was doing homework.*
- *I will continue to use plants the same way as before.*
- *It was a very interesting program, I learned a lot, but I don't think it made me feel any differently or change my mind about the plants in any way.*
- *It was interesting but I just didn't find most of it that interesting and put most of my thoughts above.*
- *I've known that plants depend of mammals (and wind) to spread their seeds, this show explored that in more detail.*
- *Most of the time during the video, I did not appreciate the use of the conscious plant metaphor. Honestly, I thought the view of plants affecting us humans didn't make sense at all. I would have preferred the information to be presented with the more straight-forward view of how us humans have affected the growth and spread of certain plants.*
- *This metaphoric theme was not explored enough for me; that said, if it had been a bigger preamble rather than the few sentences in the introduction, I could have been persuaded; yet the jarring thrust of that plants made us do these things is something I had to consciously put aside to enjoy and learn from the program (when I greater preamble may have sufficed me into the plant "controlling" us)*

Already had a strong connection with plant life

- *I already I knew how connected to plants I am.*
- *I don't think I think about plants differently now, because I have picked apples and visited gardens and arboretums in the past and present. I've always appreciated food/flowers. I think because I was also previously aware of the dangers of monoculture (which was the focus of the apple and potato segments) that I don't think there were any new "sparks" for me.*
- *I grew up planting a garden and every year, I have a garden. Two types of tomatoes, chilies, etc. I have a connection with plants.*

### 3.4 Did *The Botany of Desire* increase or decrease Viewers' interest in learning more about the connection between human nature and plants or how to affect biodiversity by making educated plant and food choices?

Viewers generally felt the program increased their interest in the connection between humans and plants as well their interest in learning how to affect biodiversity by making educated plant and food choices.

Viewers were asked to rate the extent to which seeing *The Botany of Desire* increased or decreased their interest in learning more about the connection between human nature and the plants where they live and about how to affect biodiversity by making educated plant and food choices. Table 6 shows the median ratings of decreased or increased interest on those topics on a scale of 1 (decreased strongly) to 7 (increased strongly), with 4 being neither decreased nor increased. Viewers generally felt that *The Botany of Desire* increased their interest in both topics (6 each).

Table 6: Median Viewer ratings of extent to which the program increased or decreased interest in learning about the program's main topics (n=65)							
	Decreased strongly			Neither decreased/ increased			Increased strongly
	1	2	3	4	5	6	7
The connection between you and the plants where you live?						6.0	
What you can do to affect biodiversity through your food and plant choices?						6.0	

A couple of subgroup differences were found in this section as Mann-Whitney tests indicated that female Viewers tended to rate their interest in learning about what they can do to affect biodiversity through their food and plant choices significantly higher than did male Viewers (6 each).<sup>16</sup> In addition older Viewers (40

<sup>16</sup> (  $U=375$ ,  $p=.037$ ,  $r=.26$  )

years and older) rated their interest in learning about this topic (6.5) significantly higher than did younger Viewers (6 each).<sup>17</sup>

When invited to explain their ratings, the majority of the Viewers mentioned that their interest was increased in both of the presented topics. Regarding the connection between human nature and the plant environment some Viewers mentioned that it did not increase their interest due to the fact that the plants presented are not grown in their area of residence. Regarding the actions that humans can do to affect biodiversity, some Viewers mentioned that it inspired them to learn more about biodiversity, while others mentioned that even though they learned how they can change they most likely won't.

Viewers' comments on their increased interest in these themes follow below.

- ***The connection between human nature/desires and the plants in the environment where you live***
  - *Again, "connection" is not the word that was sufficiently explored for me.*
  - *For the "connection" one, I guess it'll make me think and question why particular plants grow where they do, but that's mostly an academic question.*
  - *I think I'm pretty conscious of the plants in my area so the show has not influenced me there.*
  - *This program has increased my interest in learning more about the purpose of plants, human needs*
  - *As stated earlier I have got a different outlook of seeing plants from their perspective after watching this program.*
  - *I think that the ending of the program could be even more powerful if it related the viewer back to the impact that they can make on nature through their individual choices.*
  - *The program makes me want to plant a forest of apples, a variety of nasty tasting but interesting potatoes and I guess I should skip the marijuana experimentation until it reaches legal status everywhere. Tulips and apples actually don't like the Florida climate, so I might also have to move.*
  - *This program definitely has inspired me to investigate the plants we come into contact with every day, whether out in our yard, or the ones that are produced to feed us every day.*
  - *We are creatures of habit and convenience. Although compelled by the info it is unlikely that I will change my behavior by very much.*
  
- ***What you can do to affect biodiversity by making educated choices in the plants and foods you use***
  - *The "affect" one seems relevant - the apple segment in particular made me want to grow apples, buy an apple press on craigslist, and start making cider (hard and not).*
  - *With regard to choices, I would be much more inclined to purchase organic; however often times this is cost prohibitive for me. The show did reinforce my desire to do so, though.*
  - *Genetically engineered crops definitely make me think differently--the benefits being decreased pesticides, but the unknown negatives. Interesting.*
  - *I already feel positively about organic choices and local food movements. However I do make choices of convenience as well (i.e. McDonalds). I feel like I "knew" what to do already, but there are other influences besides what is right involved in the choices we make.*
  - *I am curious to learn more about biodiversity and my food/plant choices, but I can't change the potato McDonald's uses for French fries. I don't feel the program prepared me to take action or move forward on making any lifestyle changes (or offered any suggestions).*
  - *I have a garden, and I make a choice to shop daily for locally grown food.*
  - *I really don't know much now about how I can make different food choices to encourage biodiversity. While it seems apparent that buying more obscure and organic foods will help, I will need to do some research.*

---

<sup>17</sup> (  $U=381.046=.25$

- *I think I might be more likely to buy organic food. I already grow as much of my own as I can (but we have a short growing season here in MI!)*
  - *I will definitely be trying more varieties of plant to try and help farmers become more organic by planting more species.*
  - *I would like to know what I can do to encourage our country to stop supporting monocultures to the extent that we do.*
  - *I would like to learn more about genetic and biodiversity and I think this program definitely spurred that interest.*
  - *I'm a little more interested than before watching the video, but I do not think the video will affect any future actions I take such as shopping & buying food.*
  - *In today's society, I think it's just easier for me to not try to think about any of this stuff. I eat fast food, I go to Target and get the same apples every week and I get them because I really like the taste and texture. I'm not going to change that, that's why I live in America. ;)*
  - *It definitely strengthens my interest in shopping at organic markets locally to encourage the biodiversity of plants coming from these farms.*
  - *It made me think about the food I eat, how's it's grown, the work that goes into it, the resources that are used, but I honestly don't think it will make me change what I eat. I do have a greater appreciation for organic, but again I'm not going to run out and go organic.*
  - *The idea that corporations can use genetics to alter food for any reason is not a fun reminder, but the reality of the world.*
  - *The potato section of the program, where the potato was genetically engineered to kill the potato beetle, but how did it affect us? We didn't ever really find out. How dangerous that could have been.*
  - *We are in our first year of participating in a community shared agriculture program. We often receive a diverse variety of various types of products, including potatoes and tomatoes. My questions about this variety has to date have mostly revolved around the best use for the various types in the kitchen. I am now more interested in the other benefits the variety brings to our farm - pest control, disease resistance, etc.*
- **Opinions about the program overall**
    - *I feel it renewed interest in the topic and, as indicated earlier, I want to know more.*
    - *If I saw a magazine article about any of these topics in the next few weeks, I would read it whereas before I would have probably passed it over.*
    - *Overall, a great presentation.*
    - *The program did leave me wanting deeper information. I noticed a website flashed on the screen with further info on pbs.com. Sorry, should have checked, but are there linkages from the Botany program to online assets on the website?*
    - *This was a good film, one of the best documentaries I have seen. Michael's passion for what he is speaking about is evident, but he comes across so level headed and knowledgeable that it seems he could have gotten the film's messages through to anyone. Well done!*
  - **Other**
    - *Already explained*
    - *Rarely does a television program affect my actions.*



### 3.5 What was the impact of *The Botany of Desire* on Viewers' knowledge of history and characteristics of the apple, the tulip, the potato and cannabis?

Viewers significantly outperformed Control group participants on a content quiz designed to evaluate the impact of *The Botany of Desire* on Viewers' knowledge of specific topics relating to the history, biodiversity, and characteristics of the apple, tulip, potato, and cannabis. Out of a total possible score of 35, the Viewer group averaged 30 correct responses, while the Control group averaged 11 correct responses. The resulting effect size was considered a very large effect.

To evaluate the impact of *The Botany of Desire* on Viewers' knowledge of content covered in the program relating to the history, biodiversity, and characteristics of the four featured plants, respondents in both the Viewer and Control groups were asked to complete a 35 point assessment consisting of multiple choice, true/false, fill-in the blank, and open-ended questions. Participants in each group were also asked several short answer questions to qualitatively explore the nature and depth of the information participants took away from the program.

#### Summary of findings

The Viewer group significantly outperformed the Control group on the assessment. Out of a possible score of 35, the Viewer group averaged 30 correct responses, while the Control group averaged 11 correct responses.<sup>18</sup> The effect size in this case was 3.7, considered a very large effect.<sup>19</sup>

#### Detailed results

The quantitative and qualitative assessment consisted of 4 sets of questions covering the main content areas covered in the program, both relating to the specific characteristics and properties of the four featured plants as well as broader themes relating to biodiversity and human's relationships with plants. The findings from each assessment are presented under the following four headings:

*3.5a: History and characteristics of the apple*

*3.5b: History and characteristics of the tulip*

*3.5c: History and characteristics of the potato*

*3.5d: History and characteristics of cannabis*

---

<sup>18</sup>  $T(86)=20.391, p<.001, d=3.7$ ; 95% CI [17.3, 20.9]

<sup>19</sup> As noted under Method, the effect size helps interpret whether the difference observed is a difference of practical significance, in other words, a difference that matters. Following Cohen's (1992) interpretation, for T-tests .2 indicates a small effect, .5 a medium effect, and .8 a large effect. Effect sizes are important to report when presenting group differences, particularly when sample sizes are sufficiently large, as it is possible to produce statistically significant differences between groups when the size of the effect is in fact very small.



### 3.5a Questions on the history and characteristics of the apple

To assess whether the program influenced Viewers' knowledge of the history and characteristics of the apple, both Viewer and Control group participants were asked 5 true/false questions, 1 multiple choice question and 3 open ended questions. Table 7 below shows, for each group, the percentage of correct answers to the true/false questions and multiple choice question.

Table 7 Percentage of correct answers to true/false and multiple choice questions about apple characteristics and history		
Control (n=60)		Viewer (n=65)
<b>True/false questions</b>		
16%	Apples from trees planted and sold by the real life Johnny Appleseed were in high demand because of their sweet taste (F)	91%
20%	An apple's taste and appearance are rarely passes on through its seeds (T).	91%
35%	Sweetness in nature is a very rare quality, limited to honey and ripe fruit (T)	89%
73%	Grafting is a technique used to scrape the bark off fruit trees to reduce disease and pest problems (F)	95%
55%	Our attraction to sweet tasting foods is a biological desire that's inborn in all human beings (T)	99%
<b>Multiple choice question</b>		
18%	During the 1800's apples became known as the "evil fruit" in the United States because they were _____? <i>Used to make hard cider that led to rising rates of alcoholism</i>	97%

*Overall findings:* The Viewing group significantly outperformed the Control group on the question set relating to apples. Out of a possible score of 9, the Viewer group averaged 8.4 correct responses, while the Control group averaged 3.1<sup>20</sup>. The effect size in this case was 3.4, considered a very large effect.

*Item results:* For the five true/false statements presented in Table 7, significantly more Viewers than Control group participants correctly answered the questions:

- Apples from trees planted and sold by the real life Johnny Appleseed were in high demand because of their sweet taste (false: 91% vs. 16%);
- An apple’s taste and appearance are rarely passes on through its seeds (true: 91% vs. 20%);
- Sweetness in nature is a very rare quality, limited to honey and ripe fruit (true: 89% vs. 35%);
- Our attraction to sweet tasting foods is a biological desire that’s inborn in all human beings (true: 99% vs. 55%); and
- Grafting is a technique used to scrape the bark off fruit trees to reduce disease and pest problems *is* (false: 95% vs. 73%).

For the one multiple choice question that asked why apples became known as the “evil fruit” in the United States during the 1800s, 97% of Viewers and 18% of Control group participants correctly selected the response “Used to make hard cider that led to rising rates of alcoholism.”

**1st open-ended question on the apple: Value of the Kazakh apple forests**

Both Viewer and Control group participants were asked to complete the following sentence: *Apple researchers consider the Kazakh apple forests of Central Asia to be extremely valuable because:\_\_\_\_\_.* Participants that correctly completed this sentence indicated that: a) apples originated in Kazakh (origins), and/or b) Kazakh gave rise to or is the “seed bank” to all other apples around the world (biodiversity).<sup>21</sup>

As Table 8 shows 98% of Viewers compared to 28% of Control group participants correctly answered this question. Table 8 also shows that a comparable proportion of Viewers addressed the origins (60%) and biodiversity (65%) themes in their answers, while Control group participants were more likely to address origins (23%) than biodiversity (7%).

Table 8: Percentage of correct answers to the sentence: <i>Apple researchers consider the Kazakh apple forests of Central Asia to be extremely valuable because.</i>		
Control (n=60)		Viewer (n=65)
28%	Correct	98%
23%	<i>Addressed “origins”</i>	60%
7%	<i>Addressed “biodiversity”</i>	65%

**Examples of correct answers**

As indicated in Table 8, participants with correct answers in the Viewing group tended to address at least one, but often both of the origins and biodiversity themes while participants with correct answers in the Control group tended to offer short phrases or sentences and focused on just one themes, more often the theme of origins. For example:

<sup>20</sup>  $t(77)=18.49, p<.001, d=3.4, 95\% CI [4.7, 5.8]$

<sup>21</sup> An accurate answer mentioning either theme resulted in the participant getting 1 point.

Viewer Group:

- *This is where apples originated. Also, there are thousands of species of apples because they grow wild in the forests from seeds (many different apple characteristics) versus grafting (which is cloning).*
- *They are the original source of apples, and the seeds from these trees can be used to get back to a "clean" start, in case of biological decay of modern apple stores.*
- *That is the region of the planet where the apples originated and much of its genetic diversity is still found there.*

Control Group:

- *Kazakh could be considered the birthplace of apples.*
- *They are believed to be the original apple trees.*

Examples of incorrect answers

Participants with incorrect answers in each group tended to offer don't know responses or described the apples from Kazakh as being sweet, fragrant, and/or firm. For example:

Viewer Group:

- *Of their fragrance & taste.*

Control Group:

- *I don't know why Kazakh apples are extremely valuable but am interested.*
- *I have no idea, I did not even know there were apple forests in Central Asia.*
- *The apple they bear are sweet, firm and juicy.*

2<sup>nd</sup> open-ended question on the apple: apples' increasing vulnerability to pests

Both Viewer and Control group participants were asked to describe in their own words: *Why have apples become increasingly vulnerable to insects and disease in recent years?* Correct answers demonstrated an understanding that growing apples in monocultures has made apples more vulnerable to pests like insects and disease.<sup>22</sup> While use of the term *monoculture* was not required to qualify as a correct answer, as Table 9 shows, over two-fifths (42%) of the Viewers compared to 0% of the Control group participants applied the term.

Table 9: Percentage of correct answers when asked to describe in their own words: <i>Why have apples become increasingly vulnerable to insects and disease in recent years?</i>		
Control (n=60)		Viewer (n=65)
12%	Correct	94%
0%	<i>Mentioned "monoculture"</i>	42%

As Table 9 also shows, 94% of the Viewers compared to 12% of Control group participants answered this question correctly.

Examples of correct answers

Participants in both groups that correctly answered this question most often pointed to the increasing lack of apple varieties being grown. While 42% of Viewers actually used the term *monoculture* in their answers, other Viewers correctly described, through other phrasing, the idea that there has been reliance on a limited variety of apples, or they observed the related fact that growing multiple apple varieties helps defend plants against such pests. For example:

Viewer Group:

- *Only a few varieties have been cultivated, making them very susceptible to insects and disease.*

<sup>22</sup> A correct answer resulted in the participant receiving 1 point.

- *They are almost all the same unvarying variety - a monoculture.*
- *Their variety has been limited. Without cross pollination of multiple varieties, the insects and microorganism actually adapt to the vulnerabilities of the fruit.*
- *we started to grow only certain varieties that the public demanded, when you grown only a certain variety and an infestation occurs, it knocks out the entire orchard*

Control Group:

- *Most apples varieties are very similar genetically, so they have difficulty evolving to combat the insects and disease.*
- *Apple growers were cultivating only a handful of varieties so the plants didn't have the genetic diversity they need to survive so they became more susceptible to insects.*
- *Of diminishing variety of apple types and increasing sophistication on the part of insects and disease to adapt.*

Examples of incorrect answers

Participants with incorrect answers in each group tended to include don't know answers or focused on the growth of pesticide use or pests seeking out the sweet taste of apples. For example:

Viewer Group:

- *Migration. Apples were grown in amounts too great to be consumed in appropriate time. Apples ripened too quickly for consumption. Research was not yet done and preservatives have not been invented yet.*
- *Over production.*
- *Insects will naturally seek out sweetness.*

Control Group:

- *Of pesticide use, that has made for "stronger" pests immune to those chemicals*
- *I don't know*
- *introduction of non-native species*
- *Of their sweetness.*
- *Importing spread various insects and disease.*

3<sup>rd</sup> open-ended question on the apple: How scientists are using gene research

Both Viewer and Control group participants were asked to describe in their own words: *How are scientists using gene research to help apples become more resistant to such pests?*

Three types of responses were considered correct, those that referenced: (1) Studying/ collecting/making a library of resistant apples/apple seeds; (2) Grafting/transferring genes; and/or (3) Growing more varieties of apples.<sup>23</sup>

As Table 10 to the right shows, 86% of Viewers compared to 53% of Control group participants identified a way in which scientists are using gene research to help apples become more resistant to pests.

Table 10. Percentage of correct responses to: <i>How are scientists using gene research to help apples become more resistant to such pests?</i>		
Control (n=60)		Viewer (n=65)
53%	Correct	86%
25%	<i>Mentioned studying, collecting, or making library of resistant apples and its seeds</i>	32%
30%	<i>Mentioned grafting or transferring genes</i>	55%
3%	<i>Mentioned growing more varieties of apples</i>	25%

Examples of correct responses

In each group, those who provided correct responses most often mentioned grafting or transferring genes (55% Viewing vs. 25% Control), followed by studying, collecting, or making a library of resistant apples and its seeds (32% Viewing vs. 25% Control), and then growing more varieties of apples (Viewer 25% vs. 3% Control). For example:

Viewer Group:

- *The scientists remove genes that are resistant to the pests from one variety of apples and put it into the grafting of the sweet varieties.*
- *By cultivating a variety of species to grow in close proximity and reintroducing more of the Kazakh varieties, allowing the diversity to regain resistance*
- *By going back to the original seeds and genomes to find resistant apples and cross grafting with sweeter fruits.*

Control Group:

- *Studying gene patterns and making new varieties*
- *Continued use of grafting. Enables scientists to create new varieties of apples with increased resistance to invasive species and diseases.*
- *Scientists are using gene research to determine which apples have more resistance to certain pests. Scientists than use gene splicing from a resistant variety to a non-resistant variety. I have no more specific example to give.*

Examples of incorrect responses

Incorrect answers tended to include don't know answers in both cases, and in the case of the Viewing group, don't remember responses as well. For example:

Viewer Group:

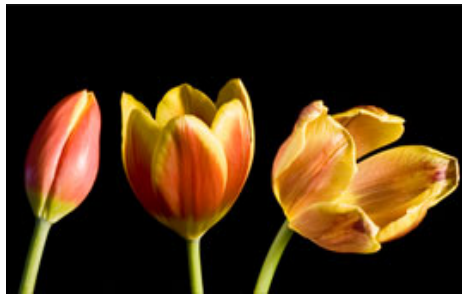
- *I don't remember*

Control Group:

- *No clue, no example*

---

<sup>23</sup> Mentioning one or more of these themes resulted in the participant receiving 1 point



### 3.5b Questions on the history and characteristics of the tulip

To assess whether the program influenced Viewers' knowledge of the history and characteristics of the tulip, both Viewer and Control group participants were asked 6 true/false questions, 1 fill-in question and 1 open ended question. Table 11 below shows, for each group, the percentage of correct answers to each true/false question.

Table 11: Percentage of correct answers to true/false and fill-in questions about tulip characteristics and history		
Control (n=60)		Viewer (n=65)
True/false questions		
20%	In addition to being enjoyed for their beauty, tulips have many practical uses as well (F)	88%
25%	Tulips have steadily increased in value since their introduction into the Netherlands in the 1600's (F)	82%
17%	Scientists believe that wild tulips originated in the same region and country where apples originated (T)	75%
37%	Planting a tulip bulb is the only way to make sure a tulip offspring will look the same as its parent (T)	86%
43%	An angiosperm is a type of fungal infection that affects tulips (F)	86%
55%	One out of every three flowers bought and sold in the world pass through a single flower auction located in Holland (T)	91%

*Overall findings:* Viewers significantly outperformed Control participants on the question set about tulips. Out of a possible score of 9.5, the Viewer group averaged 7.9 correct responses, while the Control group averaged 2.8.<sup>24</sup> The effect size in this case was 2.9, considered a very large effect.

*Item results:* Looking across the percentage of Viewer vs. Control group participants that correctly answered the questions presented in Table 11, the results show that for the six true/false questions significantly more Viewer than Control group participants correctly answered:

<sup>24</sup> ( $t(123)=16.383, p<.001, d=2.9$ ) 95% CI [4.4,5.8]

- In addition to being enjoyed for their beauty, tulips have many practical uses as well (false: 88% vs. 20%);
- Tulips have steadily increased in value since their introduction into the Netherlands in the 1600's (false: 82% vs. 25%);
- Scientists believe that wild tulips originated in the same region and country where apples originated (true: 75% vs. 17%);
- Planting a tulip bulb is the only way to make sure a tulip offspring will look the same as its parent (true: 86% vs. 37%);
- An angiosperm is a type of fungal infection that affects tulips (false: 86% vs. 43%); and
- One out of every three flowers bought and sold in the world pass through a single flower auction located in Holland (true: 91% vs. 55%).

### 1st open-ended question on the tulip: Definition and cause of broken tulip

Both Viewer and Control group participants were asked to complete the following sentence to define what a broken tulip was and what caused it:

*A broken tulip refers to a tulip that \_\_\_\_\_ and is caused by \_\_\_\_\_.*

Correct answers indicated that participants understood that: a) a broken tulip occurs when there is a break in the background color, and that b) that this is caused by a virus.<sup>25</sup> As Table 12 shows, 80% of the Viewers compared to 17% of the Control group participants correctly defined a broken tulip, while 68% of the Viewers compared to 35% of the Control group participants correctly identified what causes it.

Table 12: Percentage of correct answers when asked to complete the sentence: <i>A broken tulip refers to a tulip that _____ and is caused by _____.</i>		
Control (n=60)		Viewer (n=65)
17%	What a broken tulip is	80%
25%	What causes a broken tulip	68%

### Examples of correct responses

Participants that correctly answered part (a) of the statement most often mentioned variegated, streaks of color, stripes/breaks/different colors, multiple colors, and color pattern. Participants that correctly answered part (b) of the statement most often mentioned a virus, in particular, and/or infection, or disease more broadly. For example:

a. *A broken tulip refers to a tulip that \_\_\_\_\_*

b. *A broken tulip is caused by \_\_\_\_\_.*

#### Viewer Group:

- *has a variegated pattern*
- *has stripes or splashes of color*
- *a streak of flaming color against its solid background*

#### Viewer Group:

- *a virus*
- *a plant disease or virus*

#### Control Group:

- *has variegated petals*
- *is striped and/or blotched*
- *has varied colors patterns*

#### Control Group:

- *disease and infection.*
- *a virus*

<sup>25</sup> One point was assigned for correctly completing each blank, resulting in a 2 point question overall.



Examples of incorrect responses

Participants in both groups that incorrectly answered part (a) of the statement tended to refer to a broken tulip as damaged, inferior, limping, wilted, or broken. Participants that incorrectly answered part (b) of the statement tended to refer to reproductive abnormalities, harsh weather, insects, or to the tulip being physically damaged. For example:

a. A broken tulip refers to a tulip that \_\_\_\_\_

b. A broken tulip is caused by \_\_\_\_\_.

Viewer Group:

- Is not closed like an egg shape or dome
- has petals that are open (cracked)
- is wilted and limp
- I don't know

Viewer Group:

- is broken in half
- has a broken stem
- Does not open

Control group

- improper handling
- a genetic disease
- not sure
- accident

Control group

- don't know
- harsh weather conditions
- abnormality in reproduction
- an insect

2nd open-ended question on the tulip: events of Tulipmania

Both Viewer and Control group participants were asked to complete the following question: *Briefly list the main events that occurred during the period in Holland's history called "Tulipmania"?* Correct answers mentioned the following general events: (1) There was a preoccupation with tulips in Holland; (2) Tulip prices became exorbitant as tulips were overvalued; and (3) People risked and lost fortunes as tulip prices came crashing down.<sup>26</sup>

As Table 13 shows, 98% of the Viewer group compared to 35% of the Control group correctly identified one or more events.

Examples of correct responses

Viewers typically mentioned two or more events (86%). Control group participants that provided correct answers also tended to mention two or more events (23%).

Table 13: Viewer and Control groups' responses when asked to: <i>Briefly list the main events that occurred during the period in Holland's history called "Tulipmania"?</i>		
Control (n=60)		Viewer (n=65)
65%	No events correct	2%
12%	One event correct	12%
23%	Two or more events correct	86%

Viewer Group:

- *Tulips were discovered to be visually appealing. People chose to pay more for tulips than their intrinsic value, based on social convention. As prices went higher, speculation grew until there was a higher value in 'options' on what tulips would sell for than there was money in circulation. One flower went for the modern day equivalent of*

<sup>26</sup> Answers that included 2 or more events scored the question's full point value of 1.5 points; answers including only 1 event received .75 points.

*\$15 million. The day came when an auction did not bring an expected bid in, and prices plummeted from there. Tulips came to be known as a symbol of the folly of society.*

- *A red and white tulip's beauty caught the attention of society. As the bulbs were rare, their value skyrocketed. As people saw the scarcity, there was an increase in demand and in value. It turned into an economic bubble that could not sustain itself and eventually bust, leaving many people in financial ruin.*
- *The bulbs of the prized, mostly white with red tulips were sought after by the rich. At the height of Tulipmania, a single bulb was purchased for the price of a townhouse. At the fall of the market, the bulbs were not purchased at auction causing ruination for those who had invested in these tulips.*

*Control Group:*

- *Speculation about tulip values raised prices and the market crashed.*
- *Tulip bubble. Prices rose fast, everyone was investing and then prices collapsed, leaving many in poverty, much like our current housing bubble bust, but oddly instead of housing, flowers.*
- *Prices of tulips went up. Everyone who could was growing tulips and tulips were in demand - some prices were contracted for as much as 10 times its actual value. People all over Holland were speculating with tulip bulbs to make a profit.*

Examples of incorrect responses

Viewers and Control group participants incorrectly answering this question typically provided don't know responses, or in the case of the viewing group, don't remember.

*Viewer Group:*

- *can't remember*

*Control Group:*

- *I don't know. I suppose it was when the Dutch began making a lot of tulip varieties*
- *I have no idea as I have never heard of Tulipmania.*



### 3.5c Questions on the history and characteristics of the potato

To assess whether the program influenced Viewers' knowledge of the history and characteristics of the potato, both Viewer and Control group participants were asked 4 true/false questions, 1 multiple choice question and 3 open ended questions. Table 14 below shows, for each group, the percentage of correct answers to each true/false question and the multiple choice question.

Table 14: Percentage of correct answers to true/false and multiple choice questions about potato characteristics and history		
Control (n=60)		Viewer (n=65)
<b>True/false questions</b>		
20%	Over time Peruvian farmers generally became very successful at growing potatoes in the Andes	95%
42%	The Russet Burbank is the variety of potato used to make almost all the fast food French Fries throughout the world (T)	99%
13%	McDonalds has served products that use genetically modified potatoes for years with little public opposition (F)	72%
83%	Ireland faced widespread famine in the late 1840's primarily because the country was dependent on one type of potato (T)	98%
<b>Multiple choice question</b>		
43%	What innovation did the world's biggest biotechnology company (Monsanto) create in the 1990's to address one of the potatoes most deadly pests, the potato beetle? (Created the first genetically engineered potato which made a protein that killed the beetles)	94%

*Overall findings:* Viewers significantly outperformed Control participants on this question set about potatoes. Out of a possible score of 8, the Viewer group averaged 7.5 correct responses, while the Control group averaged 3.1.<sup>27</sup> The effect size in this case was 2.4, considered a very large effect.

<sup>27</sup> ( $t(75.14)=15.14, p<.001, d=2.9$ ) 95% CI [3.8,4.9]

*Item results:* Looking across the percentage of Viewer vs. Control participants that correctly answered the questions presented in Table 7, the results show that the differences between the two groups were substantial for all but one question. In the case of the question about Ireland’s 1840 famine (Ireland faced widespread famine in the late 1840’s primarily because the country was dependent on one type of potato) a high percentage of participants in both groups knew this statement to be true (98% vs. 83%), indicating this may not have been new information for Viewers, but rather “common knowledge.” For the remaining four questions, significantly more Viewer than Control group participants correctly answered that: The Russet Burbank is the variety of potato used to make almost all the fast food French Fries throughout the world (true: 99% vs. 42%); McDonalds has served products that use genetically modified potatoes for years with little public opposition (false: 72% vs. 13%); and Over time Peruvian farmers generally became very successful at growing potatoes in the Andes (true: 95% vs. 20%).

In response to the multiple choice question about the innovation that the world’s biggest biotechnology company (Monsanto) created in the 1990’s to address one of the potatoes most deadly pests, the potato beetle, 94% of Viewers compared to 43% of the Control group participants correctly chose the following response: the first genetically engineered potato which made a protein that killed the beetles.

**1st open-ended question on the potato: meaning of monoculture**

Both Viewer and Control group participants were asked to describe in their own words: *What does it mean to say you are growing a potato monoculture?*<sup>28</sup>

As Table 15 shows, 95% of Viewers compared to 20% of the Control group participants specified that growing a potato monoculture means growing one or a limited type of potatoes.

Table 15: Percentage of correct responses to question: <i>What does it mean to say you are growing a potato monoculture?</i>		
Control (n=60)		Viewer (n=65)
20%	Correct (grow one or a limited type of potato in a defined region)	95%

**Examples of correct responses**

Participants that correctly answered the question in each group specified growing one specific strain of potato, or a limited variety over a defined region. For example:

Viewer Group:

- *You are growing just one kind of potato in a large area.*
- *It means you are growing only one type of potato instead of many different diverse types.*
- *This means that there is (in this case, Russet) a single type of potato being grown, with identical genetic characteristics.*

Control Group:

- *I think it means you are growing only one type of potato by the same methods.*
- *Monoculture refers to growing a single type of plant over a huge amount of land.*
- *It means you are growing one type of potato.*

---

<sup>28</sup> Correct answers reflected an understanding that it meant to grow one or a limited type of potato only, and were scored 1 point.

### Examples of incorrect responses

Participants that incorrectly answered the question in the Viewer group tended to describe a monoculture as potatoes being grown in their natural form. In the Control group participants most often indicated don't know responses, that there were different varieties of potatoes, or that potatoes were transplanted in multiple areas.

#### Viewer Group:

➤ *It means it's the potato in its natural form and it's hasn't been mixed with any other varieties.*

#### Control Group:

- *I don't know*
- *I suppose they are potatoes that don't need male and female?*
- *different variety of potatoes*
- *maybe more than one place like it is original form the Asia but someone took it from Asia and put it in the U.S*

### 2nd open-ended question on the potato: Advantages and disadvantages of monocultures

Both Viewer and Control group participants were asked to: *List one advantage and disadvantage of growing a monoculture?* Correct answers were evaluated as follows:

- Correct advantages included any one of the following: mass production/large harvests, uniform/consistent quality such as taste or size (like for McDonalds fries); more demand for product/easier to sell, less expensive/can focus on one strain's needs (pesticides, water, fertilizer, etc.).
- Correct disadvantages included any of the following: lack of biodiversity, increased vulnerability to pests and disease, potential dependence on one type of crop that can lead to dire consequences such as famine, and can cause whole crops to be wiped out.<sup>29</sup>

As Table 16 shows, 97% of Viewers compared to 35% of Control group participants correctly identified at least one advantage. Similarly, 99% of Viewers compared to 42% of Control group participants correctly identified at least one disadvantage.

Table 16: Percentage of correct responses to question: <i>One advantage and disadvantage of growing a monoculture?</i>		
Control (n=60)		Viewer (n=65)
35%	Advantage: Correct	97%
42%	Disadvantage: Correct	99%

<sup>29</sup> Participants received 1 point for any correct advantage and 1 point for any disadvantage listed, resulting in a 2 point question overall.

### Examples of correct responses

Examples of correct responses in each group are provided below.

#### *Advantages*

##### Viewer Group

- *You can have large scale production and enjoy the cost advantages of volume...buying in volume one type of seed potatoes, one type of fertilizer, one type of pesticide.*
- *A steady crop with consistent and pre-designed attributes - color, size, taste, etc.*
- *The taste should pretty much be the same & the farmer can put all his effort in learning how to grow that variety so that it continues to survive.*
- *They are all farmed in the exact same way in a large, mechanized process and produce exactly the same product as the end result.*

##### Control Group

- *. You can treat every plant the same way.*
- *Predictable harvest pattern.*
- *You will always get the same kind of potato.*
- *You always know what you are getting and you can create a controlled atmosphere to grow the potato*
- *All resources are geared towards growing that one specific type.*

#### *Disadvantages*

##### Viewer Group

- *If that variety dies, there is no other potato variety to replace it.*
- *Infection of a virus is exponential and potentially infects all potatoes in proximity.*
- *No biodiversity means it is more susceptible to pest and disease.*
- *Vulnerability to plant diseases and pests. A single successful pest can wipe out a farmer's entire crop, business and livelihood if he/she is growing a potato monoculture*

##### Control Group

- *If one of the common disease or insect problems somehow changes and the potato strain can no longer combat it, the entire field will be wiped out.*
- *If there is an infestation, it will wipe out the entire potato crop.*
- *You would not have variety.*
- *If a potato is susceptible to a virus, all potatoes grown have the same weakness.*
- *they are vulnerable for the same type of disease and also they lack in variety*

### Examples of incorrect responses

Participants that provided incorrect responses most often said don't know or offered responses that didn't fit under a specific theme.

#### *Advantages*

##### Viewer Group:

- *organic products*

##### Control Group:

- *I don't know*
- *None*
- *Limits the amount of bugs that could kill the crop.*

#### *Disadvantages*

##### Viewer Group

NA

##### Control Group:

- *Some of the potatoes may have disease*
- *I don't know*



### 3.5d Questions on the history and characteristics of cannabis

To assess whether the program influenced Viewers' knowledge of the history and characteristics of cannabis, both Viewer and Control group participants were asked 4 true/false questions and 3 open ended questions. Table 17 below shows, for each group, the percentage of correct answers to each true/false question.

Table 17: Percentage of correct answers to true/false questions about cannabis characteristics and history		
Control (n=60)		Viewer (n=65)
True/false questions		
18%	Scientists believe that the "high" cannabis users experience is because the brain does not have any natural chemical similar to the main chemical found in the drug (F)	81%
30%	Cannabis was first discovered in Mexico (F)	65%
18%	The life cycle of cannabis grown indoors is about 90 days (T)	81%
35%	Cannabis was a popular treatment for asthma in America during the 1800's (T)	55%

*Overall findings:* Viewers significantly outperformed Control participants on this question set about cannabis. Out of a possible score of 7.5, the Viewer group averaged 6.6 correct responses, while the Control group averaged 2.1.<sup>30</sup> The effect size in this case was 2.4, considered a very large effect.

*Item results:* Looking across the percentage of Viewer vs. Control participants that correctly answered the questions presented in Table 7, the results show that the differences between the two groups were consistently substantial for all but one question. For the question relating to whether the life cycle of cannabis grown indoors is about 90 days, 55% of the Viewer group compared to 35% of the Control group

<sup>30</sup>  $t(123)=13.47, p<.001, d=2.4$  95% CI [3.8,5.1]

correctly answered that this statement *is true*. While the difference between the two groups was still 20 percentage points, a much higher percentage of Viewers to Control group participants correctly answered the other three questions: Scientists believe that the “high” cannabis users experience is because the brain does not have any natural chemical similar to the main chemical found in the drug (false: 81% vs. 18%); Cannabis was first discovered in Mexico (false: 65% vs. 30%); and Cannabis was a popular treatment for asthma in America during the 1800’s (true: 81% vs. 18%).

**1<sup>st</sup> open-ended question on cannabis: role in mental functioning**

Both Viewer and Control group participants were asked to explain in their own words: *What role do scientists think that cannabis plays in mental functioning with respect to memory?* Correct answers indicated reference to one of the following types of descriptions: people forgetting, memory loss, or blocking of memories.<sup>31</sup>

As Table 18 shows 95% of the Viewer group compared to 50% of the Control group correctly identified the role of cannabis in memory.

Table 18. Percentage of correct responses to question: <i>What role do scientists think that cannabis plays in mental functioning with respect to memory?</i>		
Control (n=60)		Viewer (n=65)
50%	Correct	95%

**Examples of correct responses**

Participants’ correct answers in both groups most often included descriptions that referenced phrases such as: blocks memories, helps to forget, and impairs memory.

Viewer Group:

- *It is believed to suppress memory, a drug for forgetting.*
- *The chemical compound in cannabis reacts with receptors in the brain to help people forget.*
- *Scientists believe that cannabis helps block or eliminate bad memory experiences.*

Control Group:

- *It worsens your memory capacity.*
- *I think it makes it hard for you to remember things.*

**Examples of incorrect responses**

Participants’ incorrect answers in both group most often referenced memory being enhanced or were don’t know answers.

Viewers’ Group:

- *Cannot recall.*
- *It triggers the memory part of the brain and enhances that Consciousness.*

Control Group:

- *That cannabis can help improve memory in small doses*
- *Unknown.*
- *I didn't know it had anything to do with memory.*
- *Sorry I don't know because I am not expert in that filed but I would love to learn.*

<sup>31</sup> The participants received 1 point for any correct answer.



## 2nd open-ended question on cannabis: studies to understand the role in memory

Both Viewer and Control group participants were asked to: *Briefly describe a study scientists have carried out to better understand the role that cannabis plays in memory?* Correct answers mentioned any one of the following 4 types of studies:<sup>32</sup>

- (1) Biochemical analysis of cannabis components (e.g., lab analysis to break down chemical components of cannabis to see what might be causing effects on memory)
- (2) Behavioral analysis of cannabis' effects on humans: (e.g., test cannabis components (THC) in humans To learn what the effects are)
- (3) Brain activity analysis to determine chemical action in the brain: (e.g., investigate the effects of cannabis on the brain/if receptors in the brain bind to the chemical components of cannabis)
- (4) Experimentation with mice exposed and not exposed to cannabis: (e.g., train mice to find underwater platform and then take away and compare mice on cannabis to mice not on cannabis to see the effects on their looking for the platform).

As Table 19 shows, 80% of the Viewing group compared to 10% of the Control group correctly described at least one experiment.

Table 19: Percentage of correct responses to the question: <i>Briefly describe a study scientists have carried out to better understand the role that cannabis plays in memory</i>		
Control (n=60)		Viewer (n=65)
10%	Correct	80%
2%	<i>Mentioned experimentation with mice exposed to cannabis</i>	66%
8%	<i>Mentioned behavioral analysis of cannabis effects in humans</i>	8%
0%	<i>Mentioned biochemical analysis of cannabis components</i>	5%
0%	<i>Mentioned brain activity analysis to determine chemical actions in brain</i>	3%

Sample answers from each group follow below.

### Examples of correct responses

Viewers that answered the question correctly most often referenced the program's section on the experimentation with mice exposed and not exposed to cannabis (66%). Far less frequently Viewers referenced research involving: the behavioral analysis of cannabis effects in humans (8%), the biochemical

---

<sup>32</sup> Inclusion of any one of these studies scored the full point question value of 2.5 points.

analysis of cannabis components (5%) or brain activity analysis to determine chemical actions in the brain (3%). Those in the Control group who did cite correct responses most often referenced research involving the behavioral analysis of cannabis components in humans (8%).

Viewer Group:

- *Scientists would put mice in a pool of cloudy water to see if the mouse would find its way to a submerged platform. Mice who did not have cannabis would try to find the platform that they had found previously. Mice who did have cannabis would not try to find the platform that they had found previously (before cannabis).*
- *They took the rats and they put them in a pool of water with the intention of letting the rat find a white pad; his was only done after the rat had been trained. The next step would be to take the pad out of the water to see if the rat remembered. After being introduced to the drug, they saw that the rat forgot that the pad was taken out.*
- *The scientists have used mice swimming in a tank with a platform hidden just under the surface of the water. The mice swim in the tank with and without the platform and they remember where it is. After they are given the THC, the mice forget about the platform.*
- *Scientist have had people watch event will under the influence of cannabis and then had them try and recall the events.*
- *They found receptors in the brain that lock in to a chemical found in cannabis that is similar to a chemical found and produced in the brain.*
- *They broke down the plant and found out that there was THC in the plant that activates chemical receptors. After they found this out they knew why people felt high and enjoyed the plant so much.*
- *Scientists gave cannabis to people to see if it would help them forget traumatic events that caused PTSD.*
- *The fellow who discovered THC, isolated the molecule and used it to experiment on its impact on human memory. He used his friends as experiment subjects.*

Control Group:

- *Do studies on those who suffer from post dramatic disorder. Testing memory.*
- *They let some people smoke a joint. They showed several items to the people. They let the people see if they remembered the items.*
- *I saw in a movie a man who took a memory test while high on cannabis. He was given a phrase at the beginning of the test, asked to perform a variety of mental tasks and then asked to recall the phrase given at the beginning.*
- *Mice who are given pot cannot use mazes.*

Examples of incorrect responses

Participants that provided incorrect responses in each group typically indicated they didn't know or couldn't remember any specific research or studies.

Viewer Group:

- *Don't remember.*
- *Not sure*

Control Group:

- *I have not heard of cannabis/memory experiments. It does seem to be a useful drug.*
- *I don't know.*
- *No idea*
- *cannot think of any*

3rd open-ended question on cannabis: Why male plants are kept out of growing rooms

Both Viewer and Control group participants were asked to describe in their own words: *Why do indoor cannabis growers keep the male cannabis plants out of the growing room?* Correct answers demonstrated a basic understanding of the film's treatment of this subject, such that keeping the male plants out of the room will trick female plants into producing more resin (as addressed in the film, separating the males

prevents fertilization and increases the “sexual frustration” of the females so they produce more of the substance).<sup>33</sup>

As Table 20 shows, 82% of the Viewers compared to 18% of the Control group participants correctly described why male cannabis plants are kept out of the growing room.

Table 20: Percentage of correct responses to question: <i>Why do indoor cannabis growers keep the male cannabis plants out of the growing room?</i>		
Control (n=60)		Viewer (n=65)
18%	Correct	82%

Examples of correct responses

Viewing group participants that correctly answered the question

tended to describe that keeping the male plants out of the growing room makes females produce more of a “sticky substance,” or “chemical that’s valued,” or as “a substance that has psychoactive value.” Control group participants that correctly answered the question tended to describe the process in terms of growers attempting to prevent fertilization and did not focus on the properties of the resin.

Viewer Group:

- *So the female plants will produce more resin in attempts to attract the nonexistent male plants. The more resin, the more powerful the cannabis.*
- *The female cannabis plant has a type of pollen that's sticky. They do this to sexually frustrate the females to make that sticky substance more, thus making the plant thicker and more potent.*
- *The female plants, without fertilization, become "frustrated" and produce more of the sap which contains more THC.*
- *The female plants secrete a resin to trap the pollen from the male plants. When the female plants don't get pollinated they start secreting more and more of the resin to try harder to catch pollen. This is desirable because the TCP is present in the secretions.*

Control Group:

- *To help the female produce more resin - if the male plants remain with the females, then the females will be pollinated and will produce seeds instead of resin*

Examples of incorrect responses

Participants in both groups that incorrectly answered the question most typically included don’t know answers or indicated: male plants hurt/damage/infect the female plants, male plants have a limited lifespan, and/or that male plants don’t grow well indoors.

Viewer Group:

- *I'm not sure.*
- *A chemical emitted from male plants can inhibit the growth and potency of the female plants.*
- *I'm not sure. Maybe to keep the size down? There's a concern with indoor plants growing too tall.*
- *can't remember*

Control Group:

- *It can infect the female plant. ????*
- *I do not know why.*
- *Not sure. To keep from contaminating the female plants.*
- *Because male cannabis plants will not grow very well indoors on 12 hours, and would have to be started off with more light.*

---

<sup>33</sup> A correct answer scored 1 point.

## Part 4: What were the extended influences of *The Botany of Desire*?

The evaluation team conducted follow-up telephone interviews with a random sample of Viewers approximately 2 weeks after participants watched the program and completed the post-viewing questionnaire. The interviews explored the longer term impact of the film and whether and how Viewers or their families used the project's outreach components.

### Recruitment and procedure

A total of 24 randomly selected participants were sent an email request to participate in a 10-minute interview two weeks after completing a post-viewing questionnaire. A total of 20 participants were reached within the evaluation period and agreed to participate, resulting in an 83% response rate (20/24). The group was gender balanced, including 10 men and 10 women respectively.

The interviews addressed seven issues, which are reviewed below:

*Issue 1: Did interviewees discuss The Botany of Desire with others?*

*Issue 2: Did interviewees encounter anything in various media that brought the show to mind?*

*Issue 3: Did interviewees do anything new or different as a result of seeing The Botany of Desire?*

*Issue 4: Did interviewees think about anything new or different as a result of seeing The Botany of Desire?*

*Issue 5: Did interviewees visit The Botany of Desire website?*

*Issue 6: Did interviewees have additional comments they wanted to share with the producers?*

## Issue 1: Did interviewees discuss *The Botany of Desire* with others?

All but 2 interviewees said they had discussed the program subsequent to their viewing with significant others, family members, friends, children, or colleagues. The majority had conversations regarding the apple segments, the history of Johnny Appleseed and the nature of grafting apple trees. Many interviewees discussed the cannabis segment, most often focusing on its growth and the ramifications of legalization, while others described conversations about the importance of biodiversity and the possible negative impact of monocultures. A few described conversations about their overall impression of the program. One interviewee recommended the program to his boss, a Michael Pollan fan.

A more detailed breakdown of the interviewees' responses follow:

- Almost half (n=9) of the interviewees said they discussed the apple segment of the program to one or more people, including significant others, family members, friends, children, or colleagues. Their conversations typically focused on the history and planting techniques. For example:
  - *My co-workers, my kids, my husband. I spoke with my kids about apples and they had talked about grafting in school, so we spoke about why.*
  - *I also discussed cider and the Johnny Appleseed anecdotes with a couple other friends while we were drinking.*
  - *I spoke to my wife about the processes of growing apples (to make them sweet).*
  - *I had a conversation with my family about the show. We discussed the history of Johnny Apple Seed, and the effects of valued commodities (like the tulip flower) that can have a huge impact on the economy in a positive, and possibly eventually, in a negative way...*
  - *I've also referenced some of the fun facts that have stuck with me about apples in casual conversation, for example the propensity to be bitter if the trees are grown from seeds instead of grafted using a sweet parent plant and the subsequent use for hard cider.*
- Over one-third (n=7) described discussions on the cannabis segment. Discussions typically focused on legalization and planting techniques. For example:
  - *We talked about the modern marijuana growth techniques (separating male and female plants).*
  - *I talked to my husband about the way pot grows and the way the different foods grow...*
  - *I've actually done so. Because of proposition 19, some friends and I discussed some issues affecting people due to marijuana. I stated many facts from the video that showed that it might be better to legalize it. I also spoke to some other friends about some of the other information I learned from watching the video.*
  - *I told a friend whose child has Sensory Processing Disorder that the chemical in pot makes people forget things ... and that our brain produces something similar that does this. Her child cannot tune out details, so this intrigued her.*
- Another third (n=7) described discussions on the importance of biodiversity and the possible negative impact of our society's reliance of monocultures. For example:
  - *I discussed the biodiversity in my village as it relates to a very high percentage of Oak trees that could be susceptible to disease, just as the potato famine was exposed to mold due to the lack of multiple subspecies. I also had a short conversation with someone who visited Peru about the variety of potatoes grown there.*
  - *I spoke with my daughters (ages 9 and 12) and my wife. I spoke to my daughters about the potential problems with limited species of plants made available for large scale consumption.*

- *I talked about it with my kids about how they got monocultures. It said in the show that the U.S. only sells 3 different kinds of apples, my kids disagreed and the next time we went grocery shopping, we went to several different stores and there were really only 3 kinds. The film said that only the most popular varieties are grown base on how they sell.*
  - *I spoke with all 3, my kids, husband and co-workers about the balance between living in the Northeast, buying local, encouraging biodiversity, and the attractive draw of convenience and consistency of product. Particularly at work we have an ongoing discussion over the years of buying local. This show added another layer for me to the conversation; if not buying local, buying diverse products.*
  - *We discussed biodiversity and genetic engineering (McDonalds fries) and the impact it has on nature and us.*
  - *The first person was someone at church, we were talking about food and pesticides and I brought it up about how monocultures are probably the reason why we have to have pesticides. I also talked to my son who had to do a report about pesticides on our food.*
  - *Following the program I asked our local organic farmer (from whom we get our produce every week Jun-Dec) about his pest control techniques and diversification on the farm.*
- **A couple of interviewees (n=2) had conversations about their impression of the program. One participant (n=2) recommended the program to his boss, a Michael Pollan fan. For example:**
    - *I discussed it with some friends...we talked about who liked it, who didn't, what specific parts/chapters we liked best*
    - *I discussed it with my boss, who is a huge Michael Pollan fan. He talks about In Defense of Food all the time (it was our university's "Big Read" book for last year). He hadn't read The Botany of Desire yet, but was super excited about it, so I suggested he watch the apple section at least.*

## Issue 2: Were interviewees reminded of the program when encountering other print, visual, or audio media?

Interviewees were asked if they had read anything, seen anything on television or in the movies, or heard anything on the radio that reminded them of *The Botany of Desire*. The majority interviewees described at least one media experience that led them to think about the film. Most often they recalled connections that occurred through print media, television or film experiences, or radio, as follows:

- **Half (n=10) of the interviewees said they read something that reminded them of *The Botany of Desire*.** Three were reminded of the program from publications discussing the legalization of cannabis in California prior to the elections while one participant read about a large cannabis seizure in Mexico. Two were reminded of the program while reading about “bubbles” that they compared to “Tulipmania” while one participant was reminded of tulips through an article on roses. The remaining Viewers were reminded of *The Botany of Desire* while reading about cooking with apples, organic farming, genetically engineered food, or Michael Pollan. Two Viewers were reminded of the program in general. For example:

### Cannabis:

- *I also thought of the advances in Marijuana growing as it was discussed as a proposition in California.*
- *There has been significant news coverage of the marijuana law revision proposal in California. The video did not persuade me to support the legalization of marijuana, though I do support its*

*decriminalization. I agree with Mitchell Rosenthal of Phoenix House who wrote an op ed that I read recently.*

- *Prop 19 was the only thing that I noticed.*
- *Recently, the newspaper had an article about a large scale drug enforcement bust in Mexico, that yielded a large quantity (tons) of marijuana. I also remember from the show that the quality of marijuana in Mexico has been surpassed by the new techniques applied in the United States.*

Tulips:

- *I read an online article about an "online movie streaming" bubble that reminded me of Tulipmania.*
- *Something I read reminded me of the tulip craze, the bubble bust. That was mentioned a couple times in the article I read about the housing bust and that analogy reminded me of the show.*
- *I read something about roses and it made me think about the whole tulip thing and how flowers are pretty much useless and are only around because we like them and they're pretty.*

Apples, organic farming, genetic engineering or Michael Pollan:

- *I read an article on cooking with apples in the newspaper; it made me think of the many varieties of apples that exist but are not widely available to the public.*
- *I recently received a newsletter at my front door from a local organic farm which delivers organic fruits vegetables to the home on a weekly or bimonthly basis. The article included information on buying and eating organic.*
- *Politically speaking, all the market ads that have been around about genetically engineered food.*
- *I saw a book while in the bookstore that was written by Michael Pollan (not Omnivore's Dilemma) and remembered he was in the film*

In general:

- *I looked up the book in Amazon after hearing a brief mention of it somewhere, but I haven't seen any other media discussion of it.*
- *I have read things recently and in the past that certainly cover these topics, but not since I watched the show. Particularly I am thinking of Barbara Kingsolver's Animal, Vegetable Miracle.*

- One-fifth (n=4) of the interviewees reported watching something that reminded them of the program. A few interviewees watched scenes or news segments that involved cannabis. One interviewee was reminded of the show from a movie scene involving apples, while another cited seeing a Netflix advertisement for *The Botany of Desire*. For example:

- *Anytime there is a scene about smoking marijuana has reminded me of the show.*
- *A segment on medical marijuana in connection with the recent vote on Prop 19 in California*
- *I watched a movie that had something to do with apples, and I immediately thought of The Botany of Desire.*
- *I saw an advertisement on Netflix for The Botany of Desire*

- A couple (n=2) of interviewees said they were reminded of *The Botany of Desire* while listening to the radio with several others (n=5) qualifying that they rarely or never listen to radio. Responses follow:

- *A radio show discussed GMO foods.*
- *Our local farmers market has been advertising on the radio.*

### Issue 3: Did interviewees do anything new or different as a result of seeing *The Botany of Desire*?

Interviewees were asked whether seeing *The Botany of Desire* had affected anything that they had done in the weeks since they saw the program. Over one-third reported (n=8) that they had done something new or differently, including changing their shopping and eating habits or seeking out additional information about topics in the program. In particular:

- Over one-fourth (n=6) changed their shopping and eating habits: For example:
  - *I deliberately bought a diverse package of potatoes.*
  - *I was going to buy my girlfriend tulips but she doesn't like them....I do now though! I didn't realize that this little flower was so interesting.*
  - *I buy organic foods as often as possible.*
  - *I've been looking for different varieties of potatoes. I noticed in the store a variety I had never seen before.*
  - *I am very conscious of the food I buy for my family. I signed up for the winter CSA, even though it requires a lot of cooking, because I feel it's the right thing to do for TN farmers and for my family.*
  - *Although my husband and I both really like European hard cider, I was motivated to ask our local wine shop about the possibility of carrying a better selection of French and Spanish cider.*
- Two interviewees (n=2) sought out additional information about topics in the film: For example:
  - *I looked on craigslist for a cider press and checked if any local apple orchards are still open*
  - *I have put the Apples book author's book on hold at the library and have begun researching potato varieties to grow at home.*

### Issue 4: Did interviewees think about anything new or different as a result of seeing *The Botany of Desire*?

Interviewees were asked whether seeing *The Botany of Desire* had affected anything that they had thought about in the weeks since they saw the program. Three-quarters (n=15) reported that the program affected something they thought about since watching the show. Most often interviewees focused on: the importance of biodiversity and genetic engineering's role in the food chain, interest in apples and growing apples, the push to legalize cannabis in California during this years' election, interest in potato diversity, and/or the importance of shopping organic. In particular:

- One-fourth (n=5) reported thinking more about the importance of biodiversity and the role genetic engineering plays in the food chain. Several interviewees indicated concern with the direction our country is heading regarding monocultures and genetic engineering. One interviewee thought about how biodiversity came about while another thought about how she could incorporate biodiversity into her produce shopping. For example:
  - *I think about the real issue facing consumers worldwide with respect to diversifying consumable plant life. If some sort of large scale contamination takes place, we as consumers are in big trouble. I wonder how much thought is being done at the government level to address this risk?*



- *Issues I've thought about since seeing the show include: genetic engineering to address hunger and food production problems in developing countries, domestic agricultural policies and individual consumption habits that drive the profitability of monoculture farms in the U.S. and the fine line between human greed and the resulting potential damage and the incredible potential good from scientific innovation and its wise application.*
  - *Initially, I thought the presentation was trying to defend genetic engineering, but as I thought about what I had seen, I thought, the message was more us needing to be more cautious about genetic engineering.*
  - *As in the first question, I've been thinking about adding to my desire to buy local to buy diverse. Sometimes these go hand in hand, sometimes not. At the farmers market I am more drawn to the "boutique" types of stands that sell many varieties, but I hadn't really thought about the implications of the benefits of diversity. I've added another level to what I look for in produce, local, organic and now diversity.*
  - *I watched a documentary on the planets and it was talking about how some scientists believe that particles from mars traveled to earth thus starting the chain of succession. I immediately thought of the movie because I learned that people migrated a lot of different organisms to different locations around the globe, and some of them still thrived.*
- **One fifth (n=4) thought about apples and growing apples.** Two interviewees thought about the process of grafting apples trees and another two thought about eating them. For example:
    - *I thought about the grafting part of the apple segment. I was wondering if you graft green apples to a red apple tree, will it grow green apples?*
    - *I thought very much about the apples piece, mostly because I've been growing an apple tree from seed and have wondered if it will be a bitter variety and if I could graft a good tasting variety onto it*
    - *The apples (in particular, how the seeds don't determine the taste/variety of the apple) I think of it every time I eat one.*
    - *I've been more interested in apples and making and drinking cider*
  - **A few (n=3) interviewees had thoughts of the legalization of cannabis in California or cannabis in general.** A couple thought about the implications of the legalization of cannabis in relation to the programs' view of cannabis. For example:
    - *Totally, because it was before the time of Prop 19 getting passed and the whole marijuana segment could have entirely new implications depending on how the vote goes.*
    - *I watched the show before the election, and a measure was introduced to legalize Cannabis under California law, but not under federal law. After watching The Botany of Desire, and realizing the positive impact that Cannabis can have on helping people who are suffering, and that a similar chemical can be found in our own brain, it made me think twice about whether or not it should be legalized for people who in the present economy may be suffering and cannot obtain the drug for its health benefit.*
  - **A few (n=3) had thoughts of expanding the potato variety in their diet.** Two interviewees thought to consciously change their potato purchases to include more varieties while another reflected on the genetically engineered potatoes they may be consuming. For example:
    - *The biodiversity of potatoes came up in conversations.*
    - *When I am shopping and come across a potato, I think of the show. I deliberately bought a package of potatoes that were of different varieties (Publix) because I watched the show. The same thing is true of apples. I rarely see tulips here; we get our fresh flowers from Colombia.*
    - *I just simply think about if the potatoes have been altered in any way when I eat McDonalds fries.*

- Finally, a couple (n=2) of participants thought about incorporating organic produce into their diet. For example:
  - *Now I go to the farmers markets and talking to them about the impact of organic farming. How are they being organic? Are they growing a different variety of things, using natural pesticides? Thinking about the choices I make when purchasing food.*
  - *The food I eat and how it is grown. Also, the tulips remind me of the price of gold and silver climbing.*

## Issue 5: Did interviewees visit *The Botany of Desire* website?

Interviewees were asked if they visited the *Botany of Desire* website and if so, to describe what they did, what they enjoyed most, if there was anything they disliked and what they learned that interested them the most. The majority of interviewees did not, and were unaware of the site, but some did access the site, as follows:

- A few (n=3) reported visiting *The Botany of Desire* website. Two interviewees browsed the website while one looked of the programs air date.
  - *Just took a look at the content out of curiosity*
  - *Browsed the chapter overviews and viewed the map and timeline*
  - *I looked for date when the show would air and skimmed around a bit*
- Two (n=2) interviewees enjoyed the ease of navigation around the website and the visuals and graphics the most. For example:
  - *I really liked the interactive map and in general, the structure of the site that allowed you to "filter" by plant. The site is very user friendly and informative, especially for biology novices like me*
  - *The graphics/visuals; it's a very appealing website to the eyes*
- Two (n=2) found topics of interest on the website. For example:
  - *The economy of desire section was interesting, especially given that economic conditions drive the evolution of plants in the hands of human desire. It turns out the state we currently call "home" is the second largest grower of marijuana, after California*
  - *George Washington & Thomas Jefferson used to grow hemp!*
- One disliked the difficulty of finding local air times for the program. For example:
  - *It was difficult to find air date. I had to select through a bunch of different stations to find my local one.*
- Among the remaining 17 interviewees who did not visit the website, 14 stated that they did not know there was a website. For example:
  - *No, the end of the program only told how you could buy the program, but not that there was a website you could go to!*
- A few (n=3) stated that while they did know about the website, they either didn't have time, don't spend time online, or still planned to look at it. For example:
  - *I've been meaning to. I saw at the end of the program to go to the website for more detailed information. I jotted it down but never got around to it*
  - *I don't spend much leisure time online, but if I did, I probably would visit it.*
  - *I'm just really too busy. I would like to, but I have a book I'm trying to read.*

## Issue 6: Did interviewees have additional comments they wanted to share with the producers?

At the conclusion of the interview, participants were offered the opportunity to add any other thoughts or comments that they would like to share with the producers of *The Botany of Desire*. Over half (n=11) of the interviewees responded with additional comments. Most often interviewees praised something about the program or offered suggestions on how to improve the program. A few acknowledged the parts of the program that interested them the most. In particular:

- About one-half (n=9) of the interviewees took the opportunity to add additional praise for the overall program, entertainment value, and educational value. For example:
  - *It was a fun show!*
  - *I loved the way they set it up. It was easy to follow.*
  - *I hope the producers have more programs in the works!*
  - *This was a wonderful documentary that I plan on sharing with friends and family. Very informative!*
  - *I really liked it and was interested in it*
  - *It was a beautifully done documentary, and I enjoyed watching it! I learned a lot from it, as well.*
  - *It gave me a renewed appreciation for science/nature programs*
  - *I am a professor, so some of my interest in the subject was a natural interest in science. I did make my kids leave for the segment on marijuana, silly maybe, but they are young. But they liked it and asked to watch it, so I thought it was a good show for multiple ages.*
  - *What really got me were the historical references for each of the segments. I really liked the potato one, for example, when they talked about the societal revolution of Northern Europe was influenced by the potato. That was kinda cool, I didn't know that.*
  
- A few (n=3) of the interviewees ended by praising the film but also pointing out something they wish had been handled differently in how the film was produced. For example:
  - *The scientific information didn't have the "wow" factor for me. It was interesting but it wasn't anything I didn't already know or have read about... The title of the show kinda threw me off. When I first received the DVD I thought it was some kind of romance show!*
  - *Try for more contemporary AV presentation.*
  - *I feel like there was an ulterior motive to the program, but I'm not sure what it was. What was the message of the program supposed to be? I feel like there was something personal there. I haven't read the book. Maybe it's in there. I did enjoy the program and it was very thought provoking. I liked that initially, I thought one thing, and then after thinking about it, thought something else at the conclusion. I also thought the photography was very nice.*

# Conclusions

This section reviews the findings from *The Botany of Desire* evaluation as supported by the responses of the adult audience that viewed and gave feedback on the PBS version of the program when viewed at home. The evaluation examined the appeal, clarity, and educational impact of the program, focusing on the goals identified in the project's grant proposal to the Informal Science Education (ISE) division of the National Science Foundation (NSF), which provided funding for both *The Botany of Desire* project and the independent evaluation. These goals focused on educating Viewers about:

- Biodiversity and genetic diversity in domesticated plant species, and in particular about: a) the importance of biodiversity and genetic diversity in both domesticated and wild plant species, and b) the risks to – and consequences of the loss of – biodiversity and genetic diversity in domesticated plant species.
- The connected nature of plants and people, and in particular that human desires continue to be intertwined with the evolution of diverse plants, and by extension affect global economic and ecological systems.
- The human impacts on the evolution and biodiversity of domesticated plants, as well as global economic and ecological systems.
- The global agricultural/economic implications of preserving biodiversity.
- Individuals' participation in the reciprocal relationship between people and plants through their choices of plants and foods.
- How individual gardeners and consumers can affect biodiversity by making educated choices in the plants and foods they use.
- The value of pursuing conversations with family members, friends, or co-workers about food, plant, and land use choices and/or by taking positive actions regarding such choices.

The evaluation design comprised a two-group posttest only randomized study of recruited Viewers experience viewing *The Botany of Desire* in an at-home setting, as compared to a group of Control participants who didn't view the program but who completed the same set of demographic/background questions and a "quiz" on the program related to the history and characteristics of the apple, tulip, cannabis, and potatoes. Viewers were also asked a series of qualitative questions to explore their learning from the program and what they found to be most interesting, salient, surprising, and personally impactful. In addition Viewers rated and provided feedback on the program's appeal, clarity, production values, storytelling, and density of information and science. Finally, the evaluation further explored the longer-term impact of the program within a few weeks of viewing, in this case focusing on the extent to which Viewers made personal connections with the program and discussed, thought about, or engaged in any program-related activities.

## Sample information

A total of 125 participants, including 65 Viewer and 60 Control group participants completed questionnaires that formed the basis for the evaluation findings. The Viewer portion of the sample included:

- A balance of females (52% to males (48%).
- A wide range of ages, spanning 20-70 years, with a mean age of 40.
- A racial/ethnic distribution comprising 79% Whites, 5% Asian, 3% African-Americans, and 12% mixed-race Viewers. Eight percent (8%) were of Hispanic origin
- Residents from 19 different states, including: AZ, CA , FL, GA, IL, KY, MA, MI, NC, NY, OH, OR, PA, TN, TX, UT, VA, WA, and WI.
- A combination of high school through graduate level educated respondents, including: 2% with a high school education or less, 49% with some college education or a college degree, and 49% with some graduate school education or a graduate degree.
- A majority of participants who watch science/nature programs weekly (52%) or monthly (17%).
- A majority of participants who watch PBS programs daily (17%) or weekly (40%).
- A majority of participants who look for science information online regularly (54%) or occasionally (45%).

The evaluation gathered demographic and background information to determine whether the two independent samples (Viewers vs. Control) should be evaluated as having come from the same population. T-test and Chi-square analyses indicated that the two groups did not differ significantly with respect to the measured variables, which included: gender, race/ethnicity, age group, education, and occupation.

## Viewing circumstances

Most Viewers (69%) indicated they watched the program alone. Those who watched with someone else most often (15%) said they watched the program with a spouse/partner. Smaller percentages reported watching with children (9%) or some combination of spouse/partner or children (7%). None reported watching with a friend.

While two-thirds (66%) of the Viewers said they watched the program without disruption, the remaining Viewers experienced some disruption that briefly interrupted their viewing experience, as they: tended to children (12%), answered phone or door (8%), or briefly dozed off/zoned out (5%). Other disruptions mentioned by individual Viewers (9%) related to their: making a snack, tending to a family member, getting distracted by a barking dog, or having to use the restroom.

## Findings

The evaluation findings are summarized in 4 parts:

- *Part 1: How appealing and engaging Viewers found The Botany of Desire*
- *Part 2: How successful The Botany of Desire was for Viewers in terms of clarity, density of information and science, and communicating information about the history and characteristics of the apple, tulip, cannabis, and potatoes*
- *Part 3: What Viewers learned from watching The Botany of Desire*
- *Part 4: What the longer-term impact was of The Botany of Desire on Viewers' thoughts, personal connections, and actions two weeks after viewing.*

## Part 1: How appealing and engaging did Viewers find *The Botany of Desire*?

- Viewers gave *The Botany of Desire* high marks in terms of overall appeal, content interest, visual engagement, storytelling, clarity, and their likelihood of recommending the program. Using a scale of 1 (lowest rating) to 7 (highest rating) the median ratings indicated Viewers liked the program (6) and generally agreed that the program was visually engaging (6), had engaging storytelling (6), and covered interesting content (6). Viewers were even more enthusiastic about their likelihood of recommending the program to others (7).

When Viewers were invited to explain their ratings, most mentioned that they would recommend *The Botany of Desire* to others, particularly for the *experts* featured in the program and for the *history* presented about apples and tulips. A few Viewers, however, indicated that they would not recommend the program since the content wasn't particularly interesting to them or they felt the program's audience would be limited primarily to gardening enthusiasts. Viewers elaborating on the program's storytelling especially liked the format the producers chose, although some wished that the storytelling featured more dramatization or felt the pace was slow in places. Those who commented on the show's visual engagement praised the visuals as *beautiful, emotionally moving, and/or engaging*.

- When asked to describe what they liked about *The Botany of Desire*, Viewers most often pointed to information they learned from one or more of the program's four segments on apples, tulips, cannabis, and potatoes. Nearly half (45%) the Viewers pointed to a specific segment of the program, most often the apple segment (33%), followed by the tulip segment (27%), and then the potato and cannabis segments (20% each).
- Viewers were also drawn to *The Botany of Desire's* broader theme of human's relationship with nature as well as the interesting and unfamiliar facts and storytelling. While nearly half of the Viewers pointed to a specific segment of the program as noted above, about one-third (29%) said they enjoyed learning and thinking about humans' relationship with nature, especially from the point of view of plants and the theory that humans are actually the plants "*puppets*". About one-third (28%) of the Viewers also liked the program's emphasis on *interesting and unfamiliar* facts, particularly involving the history and properties of the featured plants and our relationship with nature. Many Viewers were drawn to the program's style of presentation and storytelling (22%). Others enjoyed: hearing about the historical perspectives provided about the featured plants (18%), the visual effects (17%), or the use of clear and interesting scientific explanations (17%). Several Viewers also enjoyed learning more about the importance of biodiversity and the problems that come with monocultures (12%) and/or the narrator with his obvious enthusiasm for the subject matter (9%).
- When asked to describe what they liked least about the program, no one major theme stood out among Viewers' responses, although some suggested the program was too long or described a dislike about a specific segment. Just over one-third of the Viewers (35%) felt that the program was too long and could be broken into shorter episodes. Over one-fifth (22%) pointed to specific program segments, specifically the tulip segment, followed by the cannabis and then potato segments, with none finding anything to dislike about the apple segment.

- A minority of Viewers raised dislikes relating to *The Botany of Desire's* plant-based perspective or to the program's message, narration, subject matter appropriateness for youth, pace, and tone. In addition to those who took issue with the program length or a specific segment, another one-tenth (11%) felt that the program's personification of plants was unrealistic. Smaller groups of Viewers indicated they liked everything about the program (8%) or that the program's "take-home" message was unclear (8%). A few additional Viewers cited issues with the narration (6%) or felt the program: needed to clarify or provide more information in certain places (6%), featured inappropriate subject matter for youth audiences (6%), had a tone that was too preachy and/or biased (6%), or was too slow paced (5%).

## Part 2: How successful did Viewers find *The Botany of Desire* in terms of: density of information, science, and scientific explanations and communicating about the nature of plants?

- Viewers felt that the amount in information presented in the program was about right. On a scale of 1 (too little) to 7 (too much), with 4 being "just right," Viewers generally felt the program struck the right balance in terms of amount of information (4.0), science (4.0), and scientific principles (4.0). When Viewers were invited to explain their ratings, the majority said that the amount of information and science in the program was just right and well balanced, while some Viewers would have welcomed more information on: generic bioengineering as well as scientific explanations on some of the concepts presented. Some others felt that there was too much information presented in a short amount of time.
- Viewers generally felt the program was successful in accomplishing the communication goals the producers set out to address relating to biodiversity and our relationship to plants. Using a scale of 1 (not at all successful) to 7 (extremely successful), Viewers felt that the program was successful in communicating all of the intended themes, including: the connected nature of plants and people, particularly how human desires are intertwined with the evolution of diverse plants (6), how the connected nature of plants and people affect global economic and ecological systems (6), and especially the importance of biodiversity and genetic diversity in domesticated plant species (7).

When invited to explain their ratings, several Viewers' touched on each theme. Regarding the human connection to the evolution of plants, some suggested that the program could have spent more time illustrating how human actions within the plant world affect global issues. Regarding the connection between plants and people and how it affects the global economy and ecological systems, several indicated surprised by and interest in the dynamics involved in humans' effects on nature. On the importance of biodiversity, several viewed this to be the main theme, with some looking for further information on the role of genetic modification.

## Part 3: What did Viewers learn from *The Botany of Desire*?

The program's learning value was evaluated with a combination of self-report, open-ended, and forced-choice objective content-based assessments. To assess knowledge gains relating to the information presented about the history and characteristics of the apple, tulip, cannabis, and potatoes, both Viewer and

Control group participants completed a 35 point “quiz” type assessment that included a combination of multiple choice, true-false, fill-in-the-blank, and open ended questions. Additionally, Viewers were asked to rate the program for how much they estimated they learned from viewing and to describe the most interesting things they felt they learned. Viewers also described what they found most surprising, and whether they felt or thought any differently about plants after viewing. The main evaluation findings are summarized below.

- When asked to describe the most interesting things they learned from watching *The Botany of Desire*, all of the Viewers identified one or more new things of interest, with a large group directing their comments at one of the four program segments. About half (52%) of the Viewers said they enjoyed learning information presented about the apple in the opening segment on apples, particularly relating to the apple’s history and properties. A little more than a third of Viewers were each interested in the potato (37%), cannabis (38%) and tulip (37%) segments. Here again, in each case information on the history and properties of each plant most intrigued Viewers, with those pointing to the segment on cannabis also interested in the health/memory research and those pointing to the tulip segment interested in the effects on the economy. Just under one-third of the Viewers (29% and 32%) were interested in 1 or 2 segments, respectively. Just under one-fifth (17%) indicated that they were not interested in any specific segment while 15% of the Viewers were fascinated by three different segments, while 6% had the most complete responses encompassing all four segments.
- Viewers were also attracted to the historical perspectives woven throughout *The Botany of Desire* as well as the program’s broader themes of genetic engineering, humans’ relationship with plants, and biodiversity. In addition to the segment learning described above, nearly a third of the Viewers (29%) said they were interested in the historical perspectives provided throughout the program, specifically relating to the origin of the featured plants. A few smaller group were particularly intrigued with the information presented about genetic engineering of crops, specifically as it relates to genetically modified foods (22%), human’s relation with nature (18%), and the biodiversity within plants (15%). A small percentage of Viewers (11%) provided other responses, which included comments about enjoying the clear presentation, scientific perspectives, and a general interest in the nature content.
- When asked to describe what were the most surprising things they learned from *The Botany of Desire*, most of the Viewers indicated they were surprised by one or more new facts, and here again they tended to focus their comments around a specific segment. About a third of the Viewers (32%) were surprised by the information presented in the tulip segment, in particular relating to the tulip’s history, properties, and effect on economy. About a quarter of the Viewers were surprised by the potato (26%), cannabis (26%), and apple segments (25%), respectively. In the potato segment Viewers were most surprised by the information presented on the potato’s history and genetic alterations, while in the apple segment the Viewers were most surprised by the history, properties, and market use of apples. Those pointing to the cannabis segment most often mentioned the politics, properties, and health/memory research of cannabis. Beyond the four segments, smaller groups of Viewers (8%) thought that *The Botany of Desire* had interesting perspectives and information about plants. Finally, a few (5%) Viewers were surprised by the information about genetic alteration, specifically how monocultures work, while 6% of the Viewers stated that nothing surprised them from the program.



- When Viewers were asked whether their experience watching *The Botany of Desire* caused them to think or feel differently about plants, most (80%) confirmed that the program did cause them to think or feel differently. Many of these Viewers felt they had a better understanding of humans' symbiotic relationship with plant life (54%) or how complex plants are (15%). Some expressed a renewed interest in gardening, planting and farming (14%). Others felt they had a better understanding or appreciation for GMO's (6%), biodiversity (3%), and/or potatoes and cannabis (3%). Just under a fifth of the Viewers (18%) indicated that the program didn't cause them to think or feel differently because they could not connect with the programs content (12%), or they already had a strong connection with plant life (5%).
- When asked to rate the extent to which their experience watching *The Botany of Desire* increased or decreased their interest in learning more about the connection between human nature and plants in their area of residence and how they can affect biodiversity through educated food and plant choices, Viewers consistently indicated a high level of increased interest in these topics: Using a scale of 1 (decreased strongly) to 7 (increased strongly) the median ratings for both topics were 6.0.
- Viewers significantly outperformed Control group participants on a 35 point assessment relating to the history and characteristics of the apple, the tulip, the potato and cannabis. To evaluate the impact of *The Botany of Desire* on Viewers' knowledge of content covered in the program, respondents in both the Viewer and Control groups were asked to complete a 35 point assessment consisting of multiple choice, true/false, fill-in the blank, and open-ended questions. Participants in each group were also asked several short answer questions to qualitatively explore the nature of the information participants took away from the program. Out of a possible score of 35, the Viewer group averaged 30 correct responses, while the Control group averaged 11 correct responses. The effect size in this case was 3.7, considered a very large effect.

#### Questions on the history and characteristics of the apple

The Viewing group significantly outperformed the Control group on the question set relating to apples. Out of a possible score of 9, the Viewer group averaged 8.4 correct responses, while the Control group averaged 3.1. The effect size in this case was 3.4, considered a very large effect.

- True/false and multiple choice questions on the history and characteristics of apples: Significantly more Viewers than Control group participants correctly answered that: Apples from trees planted and sold by the real life Johnny Appleseed were in high demand because of their sweet taste *is false* (91% vs. 16%); An apple's taste and appearance are rarely passed on through its seeds *is true* (91% vs. 20%); Sweetness in nature is a very rare quality, limited to honey and ripe fruit *is true* (89% vs. 35%); Our attraction to sweet tasting foods is a biological desire that's inborn in all human beings *is true* (99% vs. 55%); and Grafting is a technique used to scrape the bark off fruit trees to reduce disease and pest problems *is false* (95% vs. 73%). For the multiple choice question that asked why apples became known as the "evil fruit" in the United States during the 1800s, 97% of Viewers and 18% of Control group participants correctly selected the response "Used to make hard cider that led to rising rates of alcoholism."
- Open-ended question on the value of the Kazakh apple forests: Both Viewer and Control group participants were asked to complete the following sentence: *Apple researchers consider the Kazakh apple forests of Central Asia to be extremely valuable because:\_\_\_\_\_*. Participants that correctly completed this sentence indicated that: a) that apples originated in Kazakh (origins), and/or b) that

Kazakh gave rise to/is the seed bank of all other apples around the world (biodiversity). Almost all (98%) of the Viewers compared to 28% of the Control group participants correctly answered this question. A comparable number of Viewers addressed the origins (60%) and biodiversity (65%) themes in their answers, while Control group participants were more likely to address origins (23%) than biodiversity (7%).

- Open-ended question on the apple's increasing vulnerability to pests: Both Viewer and Control group participants were asked to describe in their own words: *Why have apples become increasingly vulnerable to insects and disease in recent years?* Correct answers demonstrated an understanding that growing apples in monocultures has made apples more vulnerable to pests like insects and disease. Ninety-four (94%) of the Viewers compared to 12% of Control group participants answered this question correctly. While use of the term *monoculture* was not required to qualify as a correct answer, over two-fifths (42%) of the Viewers compared to 0% of the Control group participants applied the term.
- Open-ended question on how scientists are using gene research: Both Viewer and Control group participants were asked to describe in their own words: *How are scientists using gene research to help apples become more resistant to such pests?* Three types of responses were considered correct, those that referenced: (1) Studying/ collecting/making a library of resistant apples/apple seeds; (2) Grafting/transferring genes; and/or (3) Growing more varieties of apples. More than four-fifths (86%) of Viewers compared to 53% of Control group participants identified a way in which scientists are using gene research to help apples become more resistant to pests.

#### Questions on the history and characteristics of the tulip

Viewers significantly outperformed Control participants on the question set about tulips. Out of a possible score of 9.5, the Viewer group averaged 7.9 correct responses, while the Control group averaged 2.8. The effect size in this case was 2.9, considered a very large effect.

- True/false and multiple choice questions on tulip history and characteristics: Looking across the percentage of Viewer vs. Control group participants that correctly answered the questions, the results show that for the six true/false questions, significantly more Viewer than Control group participants correctly answered that: In addition to being enjoyed for their beauty, tulips have many practical uses as well *is false* (88% vs. 20%); Tulips have steadily increased in value since their introduction into the Netherlands in the 1600's *is false* (82% vs. 25%); Scientists believe that wild tulips originated in the same region and country where apples originated *is true* (75% vs. 17%); Planting a tulip bulb is the only way to make sure a tulip offspring will look the same as its parent *is true* (86% vs. 37%); An angiosperm is a type of fungal infection that affects tulips *is false* (86% vs. 43%); and One out of every three flowers bought and sold in the world pass through a single flower auction located in Holland *is true* (91% vs. 55%).
- Open-ended question on the tulip: Definition and cause of broken tulip: Both Viewer and Control group participants were asked to complete the following sentence to define what a broken tulip is and what causes it: *A broken tulip refers to a tulip that \_\_\_\_\_ and is caused by \_\_\_\_\_.* Correct answers indicated that participants understood that: a) a broken tulip occurs when there is a break in the background color, and that b) that this is caused by a virus. Four-fifths (80%) of the Viewers compared to 17% of the Control group participants correctly defined a broken tulip, while 68% of the Viewers compared to 35% of the Control group correctly identified what causes it.
- Open-ended question on the tulip: events of Tulipmania: Both Viewer and Control group participants were asked to complete the following question: *Briefly list the main events that occurred during the period in Holland's history called "Tulipmania"?* Correct answers mentioned the following general

events: (1) There was a preoccupation with tulips in Holland, (2) Tulip prices became exorbitant as tulips were overvalued, and (3) People risked and lost fortunes as tulip prices came crashing down. Nearly all (98%) of the Viewer group compared to 35% of the Control group correctly identified one or more events.

### Questions on the history and characteristics of the potato

Viewers significantly outperformed Control participants on this question set about potatoes. Out of a possible score of 8, the Viewer group averaged 7.5 correct responses, while the Control group averaged 3.1. The effect size in this case was 2.4, considered a very large effect.

- True/false and multiple choice questions on the history and characteristics of the potato: Looking across the percentage of Viewer vs. Control participants that correctly answered the five questions, the results show that the differences between the two groups were substantial or all but one question. In the case of the question about Ireland's 1840 famine (Ireland faced widespread famine in the late 1840's primarily because the country was dependent on one type of potato) a high percentage of participants in both groups knew this *is true* (98% vs. 83%), indicating this may not have been new information for Viewers, but rather "common knowledge" to an extent. For the remaining four questions, significantly more Viewer than Control group participants correctly answered that: The Russet Burbank is the variety of potato used to make almost all the fast food French Fries throughout the world *is true* (99% vs. 42%); McDonalds has served products that use genetically modified potatoes for years with little public opposition *is false* (72% vs. 13%); and Over time Peruvian farmers generally became very successful at growing potatoes in the Andes *is true* (95% vs. 20%). In response to the multiple choice question about the innovation that the world's biggest biotechnology company (Monsanto) created in the 1990's to address one of the potatoes most deadly pests, the potato beetle, 94% of the Viewer group compared to 43% of the Control group correctly chose the following response: the first genetically engineered potato which made a protein that killed the beetles.
- Open-ended question on the meaning of monoculture: Both Viewer and Control group participants were asked to describe in their own words: *What does it mean to say you are growing a potato monoculture?* Nearly all (95%) of the Viewer group compared to 20% of the Control participants specified that growing a potato monoculture means growing one or a limited type of potatoes.
- Open-ended question on the advantages and disadvantages of monocultures: Both Viewer and Control group participants were asked to: *List one advantage and disadvantage of growing a monoculture?* Correct advantages included any one of the following: mass production/large harvests, uniform/consistent quality such as taste or size (like for McDonalds fries); more demand for product/easier to sell, less expensive/can focus on one strain's needs (pesticides, water, fertilizer, etc.). Correct disadvantages included any of the following: lack of biodiversity, increased vulnerability to pests and disease, can cause dependence on one type of crop that can lead to dire consequences such as famine, and can cause whole crops to be wiped out. Nearly all (97%) of Viewers compared to 35% of Control group participants correctly identified at least one advantage. Similarly, 99% of Viewers and 42% of Control group participants correctly identified at least one disadvantage.

### Questions on the history and characteristics of cannabis

Viewers significantly outperformed Control participants on this question set about cannabis. Out of a possible score of 7.5, the Viewer group averaged 6.6 correct responses, while the Control group averaged 2.1. The effect size in this case was 2.4, considered a very large effect.

- True/false and multiple choice questions on the history and characteristics of cannabis: Looking across the percentage of Viewer vs. Control participants that correctly answered the questions, the results show that the differences between the two groups were consistently high for all but one question. For a question relating to whether the life cycle of cannabis grown indoors is about 90 days, 55% of the Viewer group compared to 35% of the Control group correctly answered that this statement *is true*. For the other three questions, a much higher percentage of Viewer to Control group participants correctly answered that: Scientists believe that the “high” cannabis users experience is because the brain does not have any natural chemical similar to the main chemical found in the drug *is false* (81% vs. 18%); Cannabis was first discovered in Mexico *is false* (65% vs. 30%); and Cannabis was a popular treatment for asthma in America during the 1800’s *is true* (81% vs. 18%).
- Open-ended question on the role of cannabis in mental functioning: Both Viewer and Control group participants were asked to explain in their own words: *What role do scientists think that cannabis plays in mental functioning with respect to memory?* Correct answers mentioned people forgetting or blocking memories. Nearly all (95%) of the Viewer group compared to 50% of the Control group correctly identified the role of cannabis in memory.
- Open-ended question on studies to understand the role in memory: Both Viewer and Control group participants were asked to: *Briefly describe a study scientists have carried out to better understand the role that cannabis plays in memory?* Four-fifths 80% of the Viewing group compared to 10% of the Control group correctly described at least one experiment.
- Open-ended question on why male plants are kept out of growing rooms: Both Viewer and Control group participants were asked to describe in their own words: *Why do indoor cannabis growers keep the male cannabis plants out of the growing room?* Correct answers demonstrated a basic understanding of the film’s treatment of this subject, such that keeping the male plants out of the room will trick female plants into producing more resin. Four-fifths (82%) of the Viewing group compared to 18% of the Control group correctly answered this question.

#### **Part 4: The impact of *The Botany of Desire* on Viewers’ thoughts, personal connections, and actions two weeks after viewing**

Follow-up telephone interviews were conducted with a subset of adult Viewers to explore the longer term impact of the program and whether and how Viewers thought about or took any actions related to their viewing of the program. The interviews were conducted approximately 2-3 weeks after participants watched the program and completed the post-viewing questionnaire. The interview requests were sent to a group of randomly selected participants via electronic mail. Those interested, available, and willing to be contacted responded via email. Among the 24 confirmations received, 20 included contact information and belonged to individuals who could be reached within the 2-3 week evaluation period. Among this group, all were able to participate in the interviews during the evaluation window, resulting in a 83% response rate. The group was gender balanced, including 10 men and 10 women respectively.

The main evaluation findings are summarized below.

➤ All but 2 interviewees (n=18) said they had discussed the program subsequent to their viewing. They had discussed the program subsequent to their viewing with significant others, family members, friends, children, or colleagues. The majority had conversations regarding the apple segments, the history of Johnny Appleseed and the nature of grafting apple trees. Many interviewees discussed the cannabis segment, most often focusing on its growth and the ramifications of legalization, while others described conversations about the importance of biodiversity and the possible negative impact of monocultures. A few described conversations about their overall impression of the program. One interviewee recommended the program to his boss, a Michael Pollan fan.

➤ All but four interviewees (n=16) recalled at least one connection that occurred for them to the program through television or program experiences, print media, or radio. Half (n=10) of the interviewees said that they had read something that reminded them of *The Botany of Desire*. Three were reminded of the program from publications discussing the legalization of cannabis in California prior to the elections while one participant read about a large cannabis seizure in Mexico. Two were reminded of the program while reading about “bubbles” that they compared to “Tulipmania” while one participant was reminded of tulips through an article on roses. The remaining Viewers were reminded of *The Botany of Desire* while reading about cooking with apples, organic farming, genetically engineered food, or Michael Pollan. Two Viewers were reminded of the program in general.

One-fifth (n=4) of the interviewees reported watching something that reminded them of the film. A few interviewees watched scenes or news segments that involved cannabis. One interviewee was reminded of the show from a movie scene involving apples, while another cited seeing a Netflix advertisement for *The Botany of Desire*. A couple (n=2) of interviewees said they were reminded of *The Botany of Desire* while listening to the radio with several others (n=5) qualifying that they rarely or never listen to radio.

➤ Over one-third reported (n=8) that they had done something new or differently. Over one-fourth (n=6) changed their shopping and eating habits. Two interviewees (n=2) sought out additional information about topics in the film.

➤ Three-quarters (n=15) of the interviewees indicated that *Botany of Desire* had affected something they had thought about in the weeks since they saw the program. One-fourth (n=5) reported thinking more about the importance of biodiversity and the role genetic engineering plays in the food chain, with several indicating concern with the direction our country is heading regarding monocultures and genetic engineering. One fifth (n=4) thought about eating, growing, or grating apples. A few (n=3) interviewees had thoughts of the legalization of cannabis in California or cannabis in general. A couple (n=2) of participants thought about incorporating organic produce into their diet.

➤ The majority of interviewees did not visit the *Botany of Desire* website. Most were unaware of the site. A few (n=3) reported visiting *The Botany of Desire* website. Two respondents browsed the website while one looked of the programs air date. Two (n=2) interviewees enjoyed the ease of navigation around the website and the visuals and graphics the most. Two (n=2) found topics of interest on the website. One disliked the difficulty of finding local air times for the program. Among the remaining 17 interviewees who did not visit the website, 14 stated that they did not know there was a website. A few (n=3) stated that while they did know about the website, they either didn't have time, don't spend time online, or still planned to look at it

- Over half (n=11) of the interviewees ended the interviews with additional comments. Most often interviewees praised something about the program or offered suggestions on how to improve the program. A few acknowledged the parts of the program that interested them the most. About one-half (n=9) of the interviewees took the opportunity to add additional praise for the overall program, entertainment value, and educational value. A few (n=3) of the interviewees ended by praising the film but also pointing out something they wish had been handled differently in how the film was produced

## Final Remarks

The above findings show that *Botany of Desire* appealed to the Viewers recruited for the evaluation and had a significant impact on their knowledge of the history and characteristics of the apple, tulip, cannabis and potatoes. Overall, Viewers liked the program, thought the story was interesting, felt the program was visually exciting and clear, judged that the program struck the right balance in terms of the amount of information and science provided, and they expected to recommend it to others. While Viewers were somewhat divided about their use or even awareness of the program website, the follow-up telephone interviews revealed that all those interviewed ultimately made some connection to the program, thought about it further, or pursued a follow-up activity within a few weeks of viewing.

It is notable that relatively few subgroup differences were found across the evaluation findings. The few that were found involve female Viewers and older Viewers (40 years and older) tending to rate aspects of the film higher than male and younger Viewers. Relating to the film's appeal, female and older Viewers tended to rate their liking of the film, interest in the program's content, and likelihood of recommending the film higher than did male and younger Viewers. Both females and older Viewers tended to rate the film's clarity higher than did male and younger Viewers. Females further found the program's visual engagement and learning value to be higher than did male Viewers, and they also tended to give higher ratings to program's success at communicating information about how human desires are intertwined with our own. There were no age-related differences for these three aspects of the program, although there was one additional aspect of the film that resulted in gender and age group differences, as females and older Viewers again tended to rate their interest in learning about what they can do to affect biodiversity through their food and plant choices significantly higher than did male and younger Viewers.

In each of these cases though, it is important to bear in mind that the ratings were very high to begin with, as the median ratings spanned 6-7 on a scale of 1 (lowest rating) to 7 (highest rating). Therefore, taken together with the program's overall lack of other major subgroup differences, the findings indicate that *The Botany of Desire* was well received by and successful with both males and females and with individuals of varying ages, levels of education, and occupation.

Finally, the evaluation results indicate that *The Botany of Desire* was a successful informal science learning initiative with the general viewing audience recruited for the summative evaluation. As always, caution should be taken in drawing broad implications from any one study. In this case, *The Botany of Desire* is a multi-faceted media project, which presented many alternative ways to evaluate the project's success in meeting its informal science learning goals. This study focused on the experience of recruited Viewers watching and providing immediate and follow-up feedback on the broadcast program on PBS. Below, we

briefly summarize aspects of the program that stood out for Viewers in this study, looking *across* the findings and at themes that emerged in numerous places, not just in response to specific questions.

Reflecting on the themes that stood out from this vantage point, we highlight 13 themes, each of which we briefly introduce below with a sample Viewer comment that captures the spirit of the theme:

- *That never occurred to me:* Viewers repeatedly said that the program featured *interesting and unfamiliar* facts, some of which might have run counter to what they previously thought to be true. That this was a selling point of the film was also evidenced by Viewers' in-depth discussion of the interesting and unexpected facts they learned, their propensity to point to specific segments of the program and facts when discussing what they liked and learned from the program, and their high scores on the quiz. These findings collectively indicated that the film's learning value was high, and that the learning process was engaging, perhaps in part due to this focus on the unfamiliar and/or on information that ran counter to what Viewers have previously thought to be the case, as one Viewer indicated: *I did enjoy the program and it was very thought provoking. I liked that initially, I thought one thing, and then after thinking about it, thought something else at the conclusion.*
- *I never thought of putting myself in the shoes of a tulip:* While a minority of Viewers felt that the program's personification of plants was *unrealistic*, many Viewers were fascinated by the opportunity to take-on another perspective, and think about humans' relationship with nature from the point of view of plants, particularly the idea that humans are actually the plants' "puppets." Viewers by and large seemed to welcome the "jab" to their usual way of thinking about nature or "the order of things," and they enjoyed the chance, as one Viewer reflected, to consider the plants' "point of view": *This one grabbed me with the premise that "Maybe plants are the ones using humans, and not the other way around?" I never thought of the world from that POV, so it got my attention -- probably would have too, had I been surfing through channels or if that were in the description field on my DVR program schedule.*
- *What really got me were the historical references:* Many Viewers enjoyed the historical facts that were woven through the film, as captured by one Viewer's comment: *What really got me were the historical references for each of the segments. I really liked the potato one, for example, when they talked about the societal revolution of Northern Europe was influenced by the potato. That was kinda cool, I didn't know that.* In part, these comments further indicate that Viewers were attracted to the new and unfamiliar information as noted above, but in addition, they repeatedly highlighted their enjoyment of the historical context and references presented within the film's science content.
- *I could get and relate to the science:* Viewers' ratings of the film's density of information and science, their quiz results, and their comments indicated that the science provided in *The Botany of Desire* was understandable to those without a science background, and also generally relatable to their own experiences, as captured by the following Viewer: *The other appreciable aspect was due to my low education levels, this type of documentary brings a simplistic approach that I find much easier to relate to, than more scientific research. Could be why I'm not remembering the specifics of marijuana experimentation, where it did get a little more scientific, but the rest of the program was easy enough for an average person to grasp and connect the associated botany to desire. Makes me want to read the book and hope for more depth on some of the segments. Could also have something to do with being of Dutch immigrant parents :) Growing up on an apple orchard, tulips, and the flower auction and of course Potatoes, made it seem very uniquely designed for my personal pleasure. Even the Cannabis segment has long been a fascinating study and I want a sequel to follow as to why this weed affects some brains in ways that it does not affect others.*

- *The science was also about me:* In addition to featuring material people could relate to in their daily lives, Viewers were attracted to the connections the program drew between humans and the scientific themes of biodiversity, and humans' relationships with plants. As one Viewer reflected: *I liked the way the one person was fitted in between the three pieces to add a sort of subjective, theoretical holistic perspective to the idea that plants are really using 'us' humans to continue their 'world domination' through the power of the senses such as beauty and sweetness, things that correspond to the human sense of desire. I think it made a very important point that we are at a great telling point in our history and our cultivation of food and plant sources for medicine. It's a very good background and foundation for opening the discussions and debate regarding biogenetics in plant diversity, and similar issues such as why all should return to organic gardening.*
- *I didn't flip the channel:* A number of Viewers made the point that the program captured their attention up front, and didn't evoke in them the perennial urge to "flip" the channel, as one Viewer reflected: *Found myself drawn in from the onset -- with nature/history/documentary programs, the first 3 minutes are so critical to me. Is the premise and hypothesis interesting? Do I flip the channel? This program or WWE Smackdown?*
- *It was like reading a book:* Storytelling was a recurring theme in Viewers' responses to various questions. While storytelling factors frequently arise in documentary evaluations, what stood out in this case were comments relating to the film being based on a book, and being presented in a way that allowed the book to "come to life" in a more personal and visual way, as the following Viewer observed: *The story telling aspect was the most awesome part and the way the program was structure. It was like reading a book and imagining things at the same time.*
- *He could have gotten the film's messages through to anyone:* Although the evaluation did not specifically ask about the narrator, comments about Michael Pollan surfaced throughout many Viewers' responses. While a few Viewers indicated prior familiarity with Michael Pollan as an author, most did not, yet they were still impressed enough to comment on him, variously describing him as *likeable, curious, thoughtful, knowledgeable, enthusiastic, and/or unassuming*. As one Viewer summed up: *Michael's passion for what he is speaking about is evident, but he comes across so level headed and knowledgeable that it seems he could have gotten the film's messages through to anyone. Well done!*
- *But I don't like plants:* A minority of Viewers indicated hesitation that the program didn't personally impact them, or that they didn't feel differently about plants after viewing the program, or that they wouldn't recommend the program because the content wasn't particularly interesting to them or they felt the program's audience would be limited primarily to "gardening enthusiasts."
- *Maybe it could be broken into shorter episodes:* Viewers watched the program as a two-hour presentation in one sitting. While the majority of Viewers did not complain about the program's length or pace, some suggested breaking the program into two separate episodes, or otherwise felt the program was a *little long or dragged in places*.
- *I guess I'm still unclear as to the take-home message:* While Viewers took away many specific facts from the program and generally felt the film was successful in communicating about the larger themes of biodiversity and humans' relationship with plants, some Viewers wondered about the point of the film. As the film was divided into "chapters," this might have had the effect of some Viewers perceiving the material as disjointed as one Viewer observed: *It didn't seem cohesive. Seemed like several separate stories--it was hard to see the thread that connected them. For others it could be about clarity around audience, as in: I'm still at a loss as to who the target audience is for this. As an adult that enjoys specials on PBS, I*



*enjoyed it, but I guess I'm still unclear as to what the take-home message is for me - what does this program want me to remember, want me to do, want me to share?*

And for others, perhaps it was the film's focus on two major themes, which in a sense divided their attention as to what to focus on, as one Viewer elaborated: *There seemed to be two strong themes competing for attention. One is the premise that Plants are Manipulating Humans for its Survival. That theme is strongest in the Tulip and Mary J segments. These were clear in that the characteristics that both tulips and cannabis evolved, encouraged humans to propagate those species. The second is the pros and cons of Monoculture--this theme is strongest in the potato and apple segments. The apple segment covered the first and second theme equally. With the potato though, the monoculture warning seemed to overshadow everything else, even the fascinating exploration of the societal impact of the potato on N. European development. I may need to view the film over again, but it seems that the premise and the wrap were not 100% congruent. Both are compelling themes, and having these together in one show is not unnatural. However, because the monoculture message was so strong near the end, I forgot the original premise of Plants Exercising Influence on Humans theme that was laid out for me in the beginning.*

And yet for others, it could be that a stronger ending that wrapped up the show's factual and conceptual threads would have resolved this issue, as in: *The ending message was not clear and the integration of the four features (tulips, potato, cannabis and apples) could have been more in-depth pertaining to the takeaway from the human beings perspective.*

- *Should I show this to my kids?* While only a minority, some Viewers raised the question of the content appropriateness of the film for youth, most notably the section on cannabis. As one educator debated: *I'm still at a loss as to who the target audience is for this. I'm an educator, and although there are parts I would love to show my students in the classroom, I certainly can't show the segment on marijuana, and the hard cider part would not be appropriate.* On the other hand there were some parent Viewers who had their children watch the show with them and didn't raise this concern, and others who reported in the follow-up interviews that they talked with their children about various aspects of the show.

While the evaluation was not designed to evaluate youths' experience with the show, these findings may be worth exploring further as the program is used in educational settings. The cannabis segment is one that the follow-up interviews found adults speaking at length with others about, including such issues as: the ongoing debate relating to Proposition 19 in California, the potential applications of the drug for a friend's daughter who had a Sensory Processing Disorder, and the possible advantages of showing the segment to high school students.

- *I deliberately bought a diverse package of potatoes:* Although *The Botany of Desire* wasn't heavily oriented toward promoting Viewer "action" beyond seeking out additional information and inspiring conversations around the film's topics, many Viewers in the follow-up interviews indicated they were inspired to take some course of action, with some inclined to move towards a *greener lifestyle* or renewed interest in gardening, planting and farming. As one Viewer reflected: *It really made me want to grow things... I really like apples and this segment made me want to buy a house (I rent), plant apple trees, and start making cider. Even the potato segment made me want to grow things and cook them, rather than eating mostly prepackaged food like I do now. It renewed my interest in wanting to plant more fruit trees, and expand my garden.*

Meanwhile, a few Viewers felt the film did not motivate them to do anything different, perhaps as a result of not accepting or understanding the plant metaphor, as one Viewer suggested: *Most of the time*

*during the video, I did not appreciate the use of the conscious plant metaphor. Honestly, I thought the view of plants affecting us humans didn't make sense at all. I would have preferred the information to be presented with the more straight-forward view of how us humans have affected the growth and spread of certain plants. For others, perhaps the metaphor wasn't explored quite enough to sink in, as one Viewer suggested: This metaphoric theme was not explored enough for me; that said, if it had been a bigger preamble rather than the few sentences in the introduction, I could have been persuaded.*

Again, though, for a film that wasn't designed to necessarily promote changes in consumer behavior or lifestyle changes, the fact that it got people deliberating about the issue is noteworthy.

Finally, the above list of 13 themes are ones that we found to be most pertinent to the goals of the current evaluation, and with possible implications for future work produced by Kikim Media and other groups focused on producing television documentaries funded by NSF's Informal Science Education Division. Future evaluations could benefit from further exploring both the unique and synergistic contributions of these, and other themes that emerged from the findings, to Viewers' engagement with and learning from films like *The Botany of Desire*.