

INVENTING TOMORROW

GRADES 5 - 12
CLASSROOM GUIDE

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TEACHING THE FILM:

Inventing Tomorrow is an inspiring documentary that follows the stories of young scientists from around the globe who participate in Intel's ISEF science fair. A class screening of the film may complement an environmental science, math, or world affairs curriculum, and will encourage students to reflect on the importance of the critical thought and scientific participation worldwide. Discussion questions and supplemental materials facilitate further research into related topics such as health and the environment, community organizing, and technology development, reminding us all that kids can make a difference!

All SFFILM Education materials are developed in alignment with California educational standards for media literacy. SFFILM Education welcomes feedback and questions on all printed study materials.

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education



USING THIS GUIDE

This study guide is intended to flexibly support educators in preparing for and following up on a class screening of *Inventing Tomorrow*.

Support materials are intended to facilitate group discussion, individual and collaborative creative exercises, subject-based learning and access to resources for further investigation of material. Educators are encouraged to adapt and abridge the content as necessary to meet their unique learning objectives and circumstances.

ABOUT THE FILM

Intel's ISEF Fair is the science fair that kids all over the world want to qualify for. This inspirational and wildly entertaining documentary profiles the young scientists behind four projects and their hopes to win the top prize in their field. From the shy Muslim girls who invent an air filter for ships mining tin in Indonesia to the trio of endearing boys from Monterrey, Mexico, who develop paint that can absorb pollution, these future-focused wunderkinds inspire the science geek in us all.

In English, Spanish, and Indonesian, with English subtitles.



Directed by Laura Nix
(USA, 2018) runtime 105 min



Recommended Subject Areas:

- Environmental Science
- Journalism
- Math
- Science
- World/Current Affairs

DISCUSSION QUESTIONS

PRE-VIEWING TOPICS AND DISCUSSION:

1. How can thinking about an environmental problem in your community lead to collaborating with other students to collect data or research ideas you may have?
2. What kind of data could you collect to solve a problem in your community?
3. Do you have any ideas about how Americans can learn about environmental problems they're not aware of or not exposed to?
4. Do you have a place in your community to enjoy nature? Can you think of ways that the natural environment can be protected and made more accessible to others?
5. Do you think it is more important to clean up pollution that has already occurred or help prevent it in the future? What are your ideas to make this happen?
6. How can science inform environmental activism?
7. Can you think of ways for youth to come together, share ideas, and collaborate to solve environmental problems?
8. Is there an environmental issue that a grandparent, older relative, or friend has inspired you to think about or to pursue?
9. What technology would you like to see invented that would help solve an environmental problem in your community?

HOW CAN SCIENCE INFORM ENVIRONMENTAL ACTIVISM?

POST VIEWING DISCUSSION:

1. Did you notice any similarities amongst the four students' science fair projects? How were they different?
2. How are the student scientists working/helping to improve the health of their local environment? How will this help to affect broader communities and the rest of the world?
3. What are some ideas you have to expose kids in the US to environmental problems that they don't know exist?
4. Should there be a uniform language for science? Did you see any signs that language differences created barriers?
5. Were any relations built despite language differences or language barriers?
6. Did you notice any gender biases? Were there differences in the way that a boy and a girl scientist were treated?
7. Did the judging seem fair to you?
8. Did you notice the amount of work the students put into their projects?
9. Did you notice any themes around what inspired the student scientists to start their science research projects in the first place?
10. Did you notice any similarities in who the student scientists looked to for support? Do you have ideas about how to get resources and advice on projects?



11. Did you notice what relationship the student scientists had to nature and their natural surroundings? What effect does their natural surroundings have towards inspiring the student scientists?

12. What effect can one person have on making changes that make a difference to one's natural surroundings? Can one person's idea make a difference?

13. How does collaboration impact science and environmental improvements?

14. Can you think of any ways that technology could be used to help your community?

15. Did you notice a relationship between science and religion? Did religion have any impact on the science?

16. Are you motivated to do something after watching "Inventing Tomorrow"? What environmental problem do YOU want to solve using science?

SHORT ESSAY QUOTE DISCUSSION:

Respond to these quotes from the student scientists: Explain their meaning.

1. **Sahithi Pingali:** In Bangalore, India (which used to be "City of 1000 Lakes"), 16-year-old Sahithi takes samples of the areas lakes, which are so contaminated that they're covered in mountains of noxious foam, which often blows into the streets and onto unsuspecting pedestrians.

- "Water and the earth. We all share them."
- "It's inevitably our job—the next generation—to fix this."
- "Nature is precious, and we want to restore it."

- "Sometimes, I get that sense of being so small and that cleaning the lake would be such a huge task. But it's a place that I really love."
- "When you look at kids in developing countries, they get more connected to the environmental issues."
- "Data talks. It really makes a difference, and it makes people listen to you."

2. **Jesús Alfonso Martínez Aranda, José Manuel Elizalde Esparza, and Fernando Miguel Sánchez Villalobos:**

In Monterrey, Mexico, teenagers Jesús, José, and Fernando are concerned with the air pollution plaguing their hometown.

- To science fair attendees: "It's about cultural change, but it starts with us young people—you guys, too. Hopefully science interests you because it can make a big difference."
- "This is my home. I have to be a part of the solution."

3. **Shofi Latifah Nuha Anfaresi:**

For Nuha, the most urgent issue confronted by the island of Bangka, Indonesia, is the waste produced by the region's tin mining operations which are poisoning the ocean. She is trying to find a way to reduce the lead waste from tin mining.

- "The challenges that we face as an island of tin mining, you can see here that the miners are discharging a byproduct of the tin ore recessing to the sea water. Makes all the locals afraid of (the water)."
- Nuha's dad: "The P.T. Timah (mining company) should be proud that there is a (local) young student that is interested in the environment."

4. **Jared Goodwin:** In Hilo, Hawaii, Jared is fixated on investigating arsenic levels in his community's soil, exacerbated by two 20th-century tsunamis.

- "I was always taught to respect the land we live on."

WHAT ENVIRONMENTAL PROBLEM DO YOU WANT TO SOLVE USING SCIENCE?



POST-VIEWING ACTIVITIES

Helping the Environment

Have students list ways that people affect their environment every day, for example, driving cars, using water, disposing of garbage, or smoking cigarettes. Have students make a second list of ways that people affect their environment through seasonal activities, for example, watering lawns, burning leaves, fishing, or hunting. Use a Venn Diagram to compare and contrast the two lists. Have students discuss which activities are more harmful or helpful to their environment. Ask students to suggest ways that people can change their behavior and improve their environment. From <https://www.nationalgeographic.org/idea/geography-rich-classroom/?page=3>

Pick a side! Write a persuasive essay on the following topic: Do photocatalytic paints reduce air pollution? Use the two resources below to support your perspective and find your own sources!

Pro: <https://www.smithsonianmag.com/innovation/smog-eating-buildings-battle-air-pollution-180954781/>

Con: <https://www.chemistryworld.com/news/smog-eating-paint-does-more-harm-than-good/3007932.article>

Travel! Are there any places you would like to travel after seeing this film? If so, where and why? Create a travelogue of a virtual visit to one of the locations in the film. Use the sites provided below or find some of your own!

START A SCIENCE FAIR AT YOUR SCHOOL!

Organizing a school science fair can be a daunting task, but it's rewarding when you see the students' projects and observe what they have learned. Plus, when students develop science projects, they are utilizing science curriculum objectives from the state. The following steps will hopefully ease the work of organizing a science fair in your own school.

1. In September, have a meeting with all the science teachers at school to discuss your objectives. Set a one week block of time in January or February for your fair. It should be at least one month or more before the next level fair you'd like your students to enter, such as the California Science and Engineering Fair, which is in March. Plan where in the school you will hold the fair.
2. Be sure to read the rules and regulations for the California Science and Engineering Fair (at http://cssf.usc.edu/Info_Gen/Info_Stud.html) in order to match their categories and criteria in your school's fair.
3. Check for fairs at the city and county levels. Review rules and regulations for any county or regional fairs that your students might want to try for. See County/Regional Fairs at <http://cssf.usc.edu/Fairs/County.to.Fair.html>
4. It is important to have your principal's support. Meet with your principal, custodian, librarian and physical education teacher to set the date on the school calendar so it won't interfere with any other school function. Talk with your custodian concerning the number of tables, chairs, electrical cords, etc. that you will need.
5. Prepare a letter to be sent to the parents and returned with their signature and date on it. At this time, explain to the students that a science project is a requirement and is part of their grade.
6. Next you can pass out Internet resource websites so students can get started on their own. At this time, it is a good idea to explain to the students about plagiarism.
7. If you have time it would be a good idea to make your category signs for the fair. This saves time later in the year. The sturdier the signs the longer they last and can be used over again.
8. In October, work on prizes for the winners. You may want to ask your principal if they can contribute something along with donated prizes from businesses whatever you can get, but NO MONEY.
9. Enlist a team of judges for the fair. The number of judges should correspond to the number of students participating. Each project will be judged by three different judges. Create the judging criteria and a point scale to be used that will later be turned into a grade for their project. Here are useful sites for creating the judging criteria: Louisiana Science and Engineering Fair Judging Criteria and Guidelines (<http://www.lasciencefair.org/judging.htm>), Judging Criteria for Intel ISEF (<https://student.societyforscience.org/judging-criteria-intel-isef>)
10. In November, work on getting assistants to help you at the fair, volunteer parents, students, teachers. By this month, the students should be well into working on their projects.
11. In December, meet with the judges. Tell them the time they can arrive to the fair. Explain the criteria and procedures. Calculate how many projects each judge will have to assess. Explain that when the judges are finished scoring, they can put their results for each student next to their display, which will help to tally up the three scores and the winner in that section at the end.
12. January/February On the day before the fair, be sure chairs, tables, signs, etc. are set up. Be sure to have some refreshments on-hand for the judges.
13. On the morning of the fair, classes can also visit the projects to observe and critique them as an assignment while you tally up scores and organize the winners. Awards can be ribbons. A white ribbon is for the participants that did not win a higher prize. Other ribbons—blue, red, green and yellow—are for first, second, third and fourth places in each division and grade.
14. The next day is takedown. You can decide to distribute the ribbons in the individual classes or at an assembly. If awards cannot be distributed on the day of the fair, this should be done very soon after.
15. Thank everyone who participated and helped you. Next, help winners fill out the applications for the California Science and Engineering Fair and start working on improving the students' projects!

The original list that this is based on was created by Joellen O'Neill, a science teacher and science fair organizer associated with the Northeastern Ohio Science and Engineering Fair.

California Media Literacy Standards Addressed In This Lesson

- Grade 7: Standard 1.8 Analyze the effect on the viewer of images, text, and sound in electronic journalism; identify the techniques used to achieve the effects in each instance studied.
- Grade 8: Standard 1.9 Interpret and evaluate the various ways in which visual image makers (e.g., graphic artists, illustrators, news photographers) communicate information and affect impressions and opinions.
- Grades 9 & 10: Standard 1.14 Identify the aesthetic effects of a media presentation and evaluate the techniques used to create them (e.g., compare Shakespeare's Henry V with Kenneth Branagh's 1990 film version).
- Grades 9 & 10: Standard 1.2 Compare and contrast the ways in which media genres (e.g., televised news, news magazines, documentaries, online information) cover the same event.
- Grades 11 & 12: Standard 1.1 Recognize strategies used by the media to inform, persuade, entertain, and transmit culture (e.g., advertisements; perpetuation of stereotypes; use of visual representations, special effects, language); Standard 1.3 Interpret and evaluate the various ways in which events are presented and information is communicated by visual image makers (e.g., graphic artists, documentary filmmakers, illustrators, news photographers).

For more information about media literacy standards in your state, visit:

- MediaLiteracy.com: resources for advancing media education, United States Standards for media literacy education. <http://www.medialiteracy.com/standards.htm>
- Frank W Baker's guide to State Standards Which Include Elements of Media Literacy. http://frankwbaker.com/state_lit.htm

California Core Standards Addressed In This Lesson

This lesson addresses the English and Language Arts standards for Reading Informational Texts grades 9-12. Additional specific standard applications are listed below:

CCSS.ELA-Literacy.RL.11-12.2 Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

CCSS.ELA-Literacy.RL.11-12.3 Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).

CCSS.ELA-Literacy.RI.11-12.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.

CCSS.ELA-LITERACY.RH.11-12.7

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RH.11-12.8

Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.



MEDIA LITERACY RESOURCES

SCREENING WITH MEANING

We live in a world where technology mediates a large portion of human interaction and the exchange of information. Every projected image, every word published on a page or a website, and every sound from a speaker reaches its audience through the medium, through the language of the device. The ability to parse the vast array of media messages is an essential skill for young people, particularly in a mainstream commercial culture that targets youth as a vulnerable, impressionable segment of the American marketplace. Most students already have a keen understanding of the languages different media use and the techniques they employ to inspire particular emotions or reactions, but they often lack the skill or awareness to fully deconstruct the messages they continuously receive.

Analysis of a media message—or any piece of mass media content—can best be accomplished by first identifying its principal characteristics:

- (1) Medium: the physical means by which it is contained and/or delivered
- (2) Author: the person(s) responsible for its creation and dissemination
- (3) Content: the information, emotions, values or ideas it conveys
- (4) Audience: the target audience to whom it is delivered
- (5) Purpose: the objectives of its authors and the effects of its dissemination.

Students who can readily identify these five core characteristics will be equipped to understand the incentives at work behind media messages, as well as their potential consequences. Media literacy education empowers students to become responsible consumers, active citizens and critical thinkers.

CORE CONCEPTS OF MEDIA ANALYSIS

MEDIUM	<p>All Media Is Constructed. How is the message delivered and in what format? What technologies are used to present the message? What visual and auditory elements are used? What expectations do you bring to the content, given its medium and format?</p>
AUTHOR	<p>All Media Is Constructed by Someone. Who is delivering the message? Who originally constructed the message? What expectations do you have of the content, given its author(s)?</p>
CONTENT	<p>Media Is A Language For Information. What is the subject of the media message? What information, values, emotions or ideas are conveyed by the media content? What tools does the author employ to engage the viewer and evoke a response? To what extent did the content meet your expectations, given the format/author?</p>
AUDIENCE	<p>All Media Messages Reach an Audience. Who receives the message? For whom is the message intended? What is the public reaction to the media content and/or its message? What is your reaction to the media content and/or its message? How might others perceive this message differently? Why?</p>
PURPOSE	<p>All Media Messages Are Constructed for a Reason. Why was the message constructed? Who benefits from dissemination of the message? How? To what extent does the message achieve its purpose? What effect does the message have on the audience it reaches, if any?</p>



THE NON-FICTION FILM WHAT IS A DOCUMENTARY?

A documentary is a film whose goal is to capture truth, fact or reality as seen through the lens of the camera. But there are many kinds of documentaries, and not everyone's idea of truth is the same. The Scottish filmmaker John Grierson coined the term "documentary" in 1926 to describe American filmmaker Robert Flaherty's romanticized culture studies, but nonfiction filmmaking dates back to the earliest motion picture reels.

The definition of documentary expanded as filmmakers experimented with technology and the goals of nonfiction. Avant-garde documentarians, like Dziga Vertov in the 1920s, believed that the mechanical eye of the camera gave a truer image of reality than the human eye and pointed his lens at newly industrialized cities. Leni Reifenstahl's propaganda films from Nazi Germany used the nonfiction form to convey a political message, a slanted truth. The international cinema vérité or observational movements of the 1960s attempted to remove authorship from the documentary. The observational filmmaker hovered like a "fly on the wall" watching the world without commentary. Modern documentaries often seek to raise awareness about a social, environmental or political issue, guiding their audiences toward civic participation and activism.

While watching a documentary, it is important to remember the core concepts of media analysis: who made the film, for what audience and why? The nonfiction format can be deceptively subjective, as all filmmaking involves an inherent selection process: in the images that are shot, the music and narration that accompanies them and, most significantly, the way in which they are all edited together. Media literacy means always analyzing a documentary for its message and authorial intent.

A BRIEF TIMELINE OF THE DOCUMENTARY

- 1895** The Lumiere brothers developed the first motion picture film reels, capturing brief, unedited clips of life around them called "actualities" (e.g., *Train Arriving at the Station*)
- 1900-1920** Travelogue or "Scenic" films became popular, showcasing exoticised images from around the globe.
- 1926** John Grierson coined the term "documentary" to describe Robert Flaherty's romantic nonfiction film, *Moana*.
- 1929** Dziga Vertov, with the Soviet Kino-Pravda movement, released the experimental nonfiction film, *Man With a Movie Camera*.
- 1935** Leni Reifenstahl released *Triumph of the Will*, the infamous propaganda film that chronicled the 1934 Nazi Party Congress.
- 1939** John Grierson collaborated with the Canadian government to form the National Film Board of Canada, with the initial goal of creating Allied propaganda in support of the war.
- 1960s** The cinema vérité movement began in Europe, shortly followed by "direct cinema" in the U.S. Portable cameras and sync sound allowed filmmakers to capture intimate footage with minimal intervention.
- 1968** The Argentine film, *La Hora de los Hornos (The Hour of the Furnaces)* opened the door to the activist cinema of the 1970s, which used film as a tool to counter capitalist and neo-colonial politics in Latin America.
- 1988** The US Congress mandated that the US government support the creation of independent non-commercial media, and the Independent Television Service (ITVS) was founded.
- 2000s** The widespread use of digital cameras and editing software made the documentary medium vastly more affordable to independent and amateur filmmakers. Video sharing sites such as YouTube and Vimeo allowed amateur filmmakers to broadcast their work.
- PRESENT DAY** The term "documentary" has come to encompass a wide range of nonfiction cinema. Contemporary filmmakers continue to push the boundaries of truth in film and to explore new avenues and applications for the medium.



THE MAKING OF A DOCUMENTARY

Idea, Issue, Story.

Even though they are nonfiction films, most modern documentaries structure their content around a traditional story arc, with a beginning, middle and end, as well as characters, and a conclusion, theme or thesis to impart to the audience. Documentary filmmakers begin their projects with an idea or an issue that they wish to explore more deeply. Through research and planning, they develop a comprehensive plan before they begin shooting.

The Production Process.

To capture candid moments on film, modern documentary makers often leave the camera running, collecting far more footage than the final film requires. They may do this during interviews or in observational-style encounters with their subjects. To get increased access and an observational aesthetic, documentary makers often use handheld cameras and natural light, rather than staging a more formal filming environment.

Post-Production and the Documentary.

Because a documentary film relies upon candid footage, a large part of the film's construction occurs in the editing room, where you work with what you've captured. A documentary editor will sift through long interviews just to find a few phrases that will summarize

the film's message. To emphasize important points and build the story, some documentaries use a voiceover, an interview or a scripted narrative that brings candid footage together into a coherent statement. An original score can work alongside the voiceover to unify the footage and shape the mood of the film. Audiences often underestimate the power of sound to generate an emotional response. Many documentaries also use charts, graphs and historical footage to add context and emphasize key points.

Distribution.

Once a film is completed, the filmmaker needs to help it find its audience. Many documentaries are made independently on small budgets, but what's the point of all your work if no one hears your message? Some documentaries will be released in theaters around the country or get programmed on public or cable TV channels, but most documentary filmmakers will start by submitting their work to film festivals, in hopes of attracting distributors for the theater and television markets. Filmmakers may also make their films available online and use social media to reach their target audience.

SUPPLEMENTAL RESOURCES

Online resources to start and run a successful science fair:

5 Basic Steps in Conducting a Successful Science Fair in School

(from International Society of Biomechanics (ISB) Glasgow, Scotland)

<https://www.isbglasgow.com/15-basic-steps-in-conducting-a-successful-science-fair-in-school/>

A Guide to Planning a Science Fair (from Science Buddies) (Downloadable pdf)

http://stemed.unm.edu/sites/all/docs/SB-SciFairTeacher_GUIDE.pdf

How to Put on a Great Science Fair!: http://www.educationworld.com/a_curr/curr220.shtml

You Can Run a Science Fair – Online Tools and Resources (from Learners Online)

<http://www.learnersonline.com/lo/learners-online/you-can-run-a-science-fair-online-tools-and-resources/>

Two tip sheets for science fair participants (from Northeastern Ohio Science and Engineering Fair):

For Students: <http://www.stemwizard.com/wpcontent/uploads/2015/07/GuideStudents.pdf>

For Teachers: <http://www.stemwizard.com/wpcontent/uploads/2015/07/GuideTeachers.pdf>

Science Connections from the Film

GreenFacts publishes clear summaries of existing scientific reports on health, the environment and sustainable development for non-specialists.

Arsenic: <https://www.greenfacts.org/en/arsenic/index.htm>

Phosphate resources management: <https://www.greenfacts.org/en/phosphate-resources/index.htm>

Pacific Tsunami Museum: Through education and awareness, we believe that no one should die due to a tsunami.

The goals of the Museum are to promote public tsunami education and to preserve history. The Museum serves as

a living memorial to those who lost their lives in past tsunami events: <http://www.tsunami.org/index/index.html>

Information about Tin Mining: http://www.australianminesatlas.gov.au/education/fact_sheets/tin.html

Information about Photocatalysis: <http://www.greenearthnanoscience.com/what-is-photocatalyst.php>

Science Fairs

Intel: <https://student.societyforscience.org/intel-isef>

The California Science & Engineering Fair (students grades 6 – 12): <http://cssf.usc.edu/>

Bay Area Science Festival: <http://www.bayareascience.org/festival/>



ARTICLES AND REVIEWS

Variety

January 20, 2018 by Nick Schager

Jeffrey Blitz's 2002 spelling-bee documentary "Spellbound" continues to cast a long shadow over contemporary nonfiction cinema, with Laura Nix's "Inventing Tomorrow" the latest doc to hew to that formal template. Nix's film follows a collection of young kids as they prepare for, and then compete at, the Intel International Science and Engineering Fair (ISEF), dubbed by one speaker as "The science fair of science fairs." "Inventing Tomorrow" won't win points for originality, but this snapshot of adolescent ingenuity and innovation, premiering at the Sundance Film Festival, nonetheless proves equally entertaining and inspiring.

The documentary is structured in two parts, the first focusing on the backstories and creative undertakings of its subjects as they face polluted home environments. In Bangalore, India, 16-year-old Sahithi takes samples of the area's lakes, which are so contaminated that they're covered in mountains of noxious foam, which often blows into the streets and onto unsuspecting pedestrians. Teenagers Jesus, Jose and Fernando, meanwhile, are concerned with the air pollution plaguing their hometown of Monterrey, Mexico. The most urgent issue confronted by Bangka, Indonesia, student Nuha is the waste produced by the region's tin mining operations, which are poisoning the ocean. And in Hilo, Hawaii, Jared is fixated on investigating arsenic levels in his community's soil, exacerbated by two 20th-century tsunamis.

The kids' solutions to these problems are clever, be it a photocatalytic paint devised by Jesus, Jose and Fernando that can turn smog into nontoxic elements, or the homemade app designed by

Sahithi to analyze pollutants. Nix's portraits of these intrepid youngsters are concise and compelling, if skimpy; aside from a few brief interactions with peers and parents that relay their economic backgrounds and particular dilemmas, there's no larger sense of who they are and where they come from. Given the director's storytelling format, this shortcoming is predictable, but one still clamors for more background on how these kids became enamored with their fields of study, realized that they'd struck upon a topic of interest, and first figured out how to tackle it.

Once "Inventing Tomorrow" makes its way to Los Angeles and the enormous, multicultural ISEF, it manages to compensate for its early tenuousness by depicting the vital, and heartening, dialogue engendered by the event — an intercultural exchange of ideas and experiences that broadens teens' horizons, allows them to share ideas with those who are different from themselves and to develop and spread social and scientific consciousness. United by their fondness for intellectual challenges, they exemplify the limitless possibilities created when people use their imagination for altruistic problem-solving and collaborate with others for the greater good.

As such, though "Inventing Tomorrow" builds toward judgment day — when the kids battle nerves and language-barriers to give presentations to evaluators — the question of who will win and who will lose becomes something of an afterthought. There's no heartbreak in Nix's film, only mild disappointment that's quickly overshadowed by the belief that academic ambition is something that benefits not just individuals but the world around them. No matter the formulaic way that message is communicated, it can't help but leave the viewer feeling hopeful about the future.